Proceedings

19th International Symposium
and
11th Conference
Lameness in Ruminants

MOBILITY, HEALTH and ANIMAL WELFARE

7th to 9th September 2017
Munich, Germany


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Proceedings of the

19th International Symposium

and

11th Conference Lameness in Ruminants

7th to 9th September

MOBILITY, HEALTH and ANIMAL WELFARE

Katholische Akademie München

Edited by Andrea Fiedler and Katharina Schindhelm

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GREETING

The Organizing Committee of the 19th Symposium and 11th Conference on Lameness in Ruminants is delighted to welcome you to Munich, the capital of Bavaria. The venue is located within an important area for Germany’s dairy production. The city of Munich has a lot of attractions to offer for all ages and tastes, whether you are interested in history, architecture, art or just in the Bavarian way of life.

This International Symposium on Lameness in Ruminants is being held for the 19th time, 41 years after the first meeting. Many of you have travelled a long distance and will attend this Conference for the first time. We hope you enjoy your stay in our beautiful city and can find some time to visit its surroundings.

At the Symposium, a good number of our profession's most respected experts will present the newest information available in all aspects on lameness in ruminants. We are offering a four-day programme with a wide variety of subjects including a Farm Day at the University’s Field Station.

The workshops on the Farm Day cover important subjects such as claw trimming in dairy cattle as well as pigs, hygiene and digital dermatitis. From Thursday, September 7th onwards, all posters and talks will be presented in different sessions at the Catholic Academy in the city centre. The scientific program will be presented in two lecture halls. Lectures in the Main Hall will be translated from English to German. There are three keynote lectures and 80 oral presentations, supplemented with more than 80 poster presentations. Additionally, we have scheduled three Question and Answer panel discussions. These promise to be concentrated and efficient means of distributing new and interesting information.

This year’s program includes topics on new research in the fields of digital dermatitis and laminitis as well as topics on genetics, detection and recording. Sessions on small ruminants and beef cattle and a session about the impact of hoof disorders in pigs are also included.

Core thoughts about inflammation and lameness will be the topic of our first keynote lecture. Diagnostic imaging will be represented by a keynote lecture as well as by oral and poster presentations. New ideas in the field of claw kinematics will conclude the cycle of keynote lectures.

The Symposium not only promises to be full of new experiences and inspiring ideas from all over the world concerning the problems of lameness, but participants will have ample opportunity to meet old colleagues and to make new contacts. We thank all our colleagues for their contribution towards making this Symposium a great event and for sharing their knowledge with us.

We are very pleased that you have made the journey and hope that you will also be able to take the time to explore this very scenic country. The surrounding countryside is of outstanding natural beauty much of which can be explored in day trips from the central city.

We are very grateful to our sponsors and exhibitors without whose generous support it would be impossible to run this conference. Their patronage has enabled us to have the conference in this wonderful venue and to arrange a memorable social program for our delegates and guests.

Therefore, we hope that our efforts will make your visit to Munich a satisfying experience.

With our very best wishes

Andrea Fiedler

Johann Maierl

Representative for the Organizing Team

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EXHIBITORS:

CONTENT

THURSDAY

07th Sept. 2017

Time	Main Hall		Title	2nd Hall		Title
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09:00	***Keynote***	***Inflammation; Could it Preclude Lameness***				
		A. Gomez				
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		3	**Klawitter:** To bandage or not bandage: The curative effect of bandaging digital dermatitis lesions		**17**	**Kretschmar:** Tibial nerve paresis in post partum German Holstein cows - Etiology and treatment under farm conditions
		4	**Kröger:** New ways to preserve claw health - comparative study on the efficacy of antibiotics and antibiotic-free treatments for digital dermatitis		**18**	**Ranjbar:** Magnitude of wear in wooden hoof blocks is associated with the density of the wood
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	Döpfer, Gomez, Kröger, Ariza					
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07th Sept. 2017

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		6	**Newsome:** A prospective cohort study of digital cushion thickness, body condition and claw horn lesions in Holstein dairy cattle		20	**Silva de Oliviera:** Are biosecurity measures associated with the odds of digital dermatitis in dairy herds?
		7	**Munzel:** Evaluation of a modified claw trimming method on different floors		21	**Müller:** An approach to filtering and recycling copper sulfate foot bath solutions to decrease cost and environmental impact
		8	**Reilly:** Do Dorsal Wall Lengths of 7.5cm Result in Inadequate Sole Thickness?		22	**Blowey:** PCR detection of digital dermatitis treponemes within cattle footprints and on equipment surfaces
		9	**Cramer / Stoddard:** Evaluating the Effect of Two Hoof trimming Techniques on Lesion Incidence		23	**van Ranst:** MmmooOgle Accutrim: A new technology in claw health monitoring and prevention.
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	Müller, Kofler, Nuss, Steiner					
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		11	**Wendtland:** Effects of Low Stress Cattle Handling in Hoof Trimming on Animal Welfare, Human Safety, and Farm Efficiency		25	**Kulow:** Evaluation of clinical stages of digital dermatitis in beef cattle through histological examination and determination of risk factors for spirochetal skin invasion
		12	**Mandl:** Lameness and claw lesion prevalence in cows from compost bedded dairy barns in Austria		26	**Relun:** Outbreaks of digital dermatitis in beef fattening units: clinical findings and control
		13	**Alsaood:** Effect of floor type on characteristics of locomotion comfort		27	**Orsel:** Occurrence and economic impact of beef cattle lameness in Canadian feedlots
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FRIDAY

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			J. Kofler			
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		30	**Proost:** Comparison of computed tomography versus radiography for the evaluation of the distal phalanx in cows diagnosed with complicated toe necrosis		**47**	**Reisinger:** Ex vivo and in vitro models to evaluate potential trigger factors for laminitis in horses and ruminants
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08th Sept. 2017

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		37	**Eichhorn:** Investigation of Bovine Claws Infected with Toe Tip Necrosis Syndrome Using Biomechanical Testing		**54**	**Maselyne:** First validation of three different sensor technologies for possible lameness monitoring in sows
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		43	**Zillner:** Environmental and animal physiological influences on pedometric activity in dairy cows		**60**	**Pijl:** Incidence rates for claw disorders in relation to status of female ancestors based on assessments at routine hoof trimming in German Holstein dairy cattle
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19:00	**Gala Dinner / Gala Party**					

SATURDAY

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		of lesion development and prevention"				
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		64	**Weiß:** Evaluation of non-invasive reconstruction using biplane high-sped fluoroscopic kinematography for 3D research of bovine distal limb kinematics		**73**	**Molinero:** Assessment of prevalence and economic impact of three claw disorders within Spanish herds with and without preventive hoof trimming
		65	**Grund.** In vivo distal limb joint kinematics measured with biplane high speed fluoroscopic kinematography in two Holstein Friesian heifers		**74**	**Remnant:** Nationwide improvement in prevalence of lameness in dairy cattle in Great Britain
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		68	**Bell:** Repeatability of visual scoring of digital dermatitis lesions from photographs of standing animals		**77**	**Orsel:** Impacts of changing freestall area on prevalence of lameness, lying time and leg injuries on dairy farms in Alberta
		69	**Dopfer:** Seven Groups of Chronic Consequences for Bovine Digital Dermatitis.		**78**	**Burgstaller:** The impact of lameness and claw lesions on fertility in Austrian dairy cows
		70	**Kopke:** Genetic parameters for improved phenotypes of susceptibility for digital dermatitis in Holstein dairy cattle		**79**	**Randall:** Lameness in Dairy Heifers Long-term impacts of Hoof Lesions
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12:00	**General Assembly, Decision on Venue 2021**					
13:30	**END**					
15:30	**"Munich Residence" - guided tour**					

KEYNOTE LECTURES

Lameness: could it be driven by inflammation?

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Introduction

During the last decades, increased understanding of the main lameness risk factors has provided the possibility of establishing successful prevention and control programs. Despite the efforts, the reality is that the lameness prevalence often found in commercial farms is higher than desirable from a farm profitability perspective[1], and certainly unacceptable considering the animals' welfare[2]*. Is there any underlying biological process, still not fully understood, limiting our success?*

This abstract aims at indicating some of the reasons why inflammation might determine lameness events, either before or after lameness symptoms can be recognized. I will list some of the implications that inflammation management can have in practice. More detailed information will be presented during the oral presentation.

Inflammation

What do we think about inflammation when we hear about it? Is it good or bad? We are very used to recognize the traditional signs of inflammation when we observe, specifically in relation to hoof health problems, areas that are red, swollen, hot and painful, or that lost some of the normal function. In the field, is also not uncommon to hear about (wrongly called) "laminitis", implying some sort of inflammatory process, when we refer to lameness events that present mild or non-specific symptoms. We even use therapeutics to reduce inflammation under certain conditions. In all, we tend to attache negative attributes to inflammation.
Inflammation is defined as a localized protective response elicited by injury or destruction of tissues that aims at destroying and diluting the causing agent and certainly restoring back the original healthy state. When in balance, inflammation is therefore "good", with this responsibility taken by the immune system. Both extremes, not enough response and too much inflammatory response, is what truly deserves the "bad" qualification.

Why should be looking at inflammation (imbalance) as a determinant of lameness?

- Most of the cutting-edge advances in the understanding of some of the animal and human metabolic[3,4], musculoskeletal[5] , infectious[6] or even neurological diseases[7] has occurred in the area of inflammation.
- Some of the recent research in cattle lameness indicates inflammation as an outcome that needs to be considered to understand the consequences of lameness but also to establish appropriate control measures[8].
- Chronic states have been recognized as key factors to increase prevalence of hoof diseases such as digital dermatitis[9].
- We continuously need to better define the current lameness management programs and eventually explore alternative strategies that lead us into a more successful prevention.

Is there any evidence that an impaired or exaggerated inflammatory response can play a crucial role on INITIATING or PERPETUATING lameness?

As widely recognized, lameness is multifactorial and, therefore investigating the relationship between lameness and inflammation should consider different perspectives. However, the literature review is limited in regards to the amount of research published, likely given the constraints on budgets dedicated to study basic lameness biology. There are some inherent characteristics of lameness (ethics, timing of diagnosis, standardization of lesion definitions, measurement of specific metabolites,…) that also limit the amount of research developed in the area. The good news is the quickly evolving field and growing use of molecular biology techniques is providing excellent tools and becoming more affordable to approach the analysis of these complex relationships.
Let's look at some of the relationship between inflammation and lameness from a tissue/anatomy, functional, behavior/management and nutritional perspectives:

Tissue/Anatomy

The classical approach to non-infectious lesion problems has been to describe the immediate tissue damage produced by the excessive trauma generated in the interaction between hard structures (external surfaces and internal bone structures) with the soft tissues of the hoof. In this regard, the group at Nottingham University has extensively researched and laid out the likely mechanisms underlying the occurrence of events[10]. Specifically for inflammation, they have shown how lameness events can lead to bone destruction and bone growth and promote inflammation. In the same direction, in a different publication it has been demonstrated how the use of anti-inflammatory drugs can additionally help in hoof lesion recovery after treatment[8]. It is obvious that inflammation can be playing a role in perpetuating hoof lesions (chronic stages).
To discuss if inflammation can also preclude hoof tissue damage and lameness we need to observe some of the research published in humans and their new trends for musculoskeletal problems therapy. Briefly, inflammation of any origin is now being considered a plausible cause of joint, ligament and tendon problems. This can be evidenced by the link between spondyloarthritis and inflammatory bowel disease[11]. Similarly, in regards to therapy, given that inflammation is part of the interaction between mechanical overload, aging, neovessel formation and pain management, anti-inflammatory strategies has been promoted[5] to improve no so optimistic historical results. This trend has caused the surge of newly created study areas such as "Resoliomics" (study of endogenous compounds with curing propreties) including new molecules of the lipoxins or resolvins families[12].

Functional

Much attention has been given to the hoof fat pad, thanks to its functional role in modulating the interaction between the bone (hard) surfaces and the soft tissues. In example, the relationship between the total volume of the fat pad has been correlated with the occurrence of clinical lameness[13]. Even body condition score changes throughout the lactation in dairy cattle have been associated with locomotion score problems[14]. It exists then certain evidence that loss of functionality of the fat pad might be a lameness causing factor. However, research is ambiguous, with some of the new research showing differing opinions about the final responsibility of the fat pad[15].
But can inflammatory processes in the first place modify the fat pad characteristics, subsequently leading to lack of function? To my knowledge, no specific research has been developed to answer this question in cattle. However, it is well known that several sources of inflammation, stimulating different pro-inflammatory pathways (Lipopolysaccharide stimulation of toll-like receptors, activation of tumor necrosis factor alpha, modification of insulin cellular intake,…) can promote changes in fat pad globules, with the consequent increase in local inflammation, leucocyte activation and cellular damage, therefore compromising the normal characteristics of the fat tissue[16].

Behavior/Management

The dairy cattle industry, primarily in confinement systems, has adopted regular functional and therapeutical trimming as a lameness prevention and control intervention. Depending on various management characteristics, different protocols can be found. Thus, some farms trim their animals according the stage of lactation, by lactation number or use calendar time to schedule their trimmings. The outcomes of this programs have demonstrated to be inconsistent[17].
In addition, many studies have investigated the impact of the transition period on the immune system and specifically, some highlighted the importance of the transition period in regards to lameness[18]. It is clear, that differences in trimming (i.e. timing and quality) can lead to differences in lesion healing times and when inadequate, to the chronic development of these lesions. Chronic inflammation plays then a role in the accumulation of lame cows. Similarly, lame cows, especially during the transition period, can promote the appearance of other metabolic and infectious problems leading to severe states of inflammation[19].
In the opposite direction, many changes in behavior and deficient management practices can impair the immune system (impaired inflammation). It has been documented that limitations in dry matter intake during the pre-partum[20] period correlates with an increased occurrence of infectious diseases (i.e. metritis), and also is associated with increased loss of body weight during the early lactation. Both situations can obviously increase the occurrence of lameness[8].

Nutritional

One route that has shown in horses a connection with increased lameness incidence is the generation of pro-inflammatory substances, from deficient digestion of nutrients, altering the circulation in the hoof and negatively affecting the hoof[21]. In cattle, due to the different anatomy characteristics of their feet, digestive problems, namely (sub-acute) ruminal acidosis, have not shown such a clear causal effect on increased lameness incidence, at least as a sufficient cause alone. However, recent research have revealed digestive upsets, primarily with origin in the small intestine of cattle and other farm animals, can lead to increased amount of pro-inflammatory components in blood, likely responsible for damaging internal hoof tissues and decreasing functionality[22].
Research has also shown an interesting distribution of fatty acids (PUFA and MUFA) in the hoof also well known as precursors of pro-inflammatory components[23]. Specifically, the fat characteristics in the hoof is distributed according to the different natural zones of traction and stress. This suggests that fat accumulation, instead of being just shock absorbing, could play a functional role by offering inflammatory precursors is areas subject to higher demands. This opens up the possibility for nutritional strategies aimed at changing the fatty acid profile of the hoof structures.
Successful use of aminoacid-metal complexes have shown to be beneficial for the prevention of infectious[24] and non-infectious hoof lesions[25]. These effects have been primarily justified by the implications of the different trace minerals in the formation of keratin and ligaments. Most recently, cutting-edge research has identified differences in local expression of inflammatory genetic markers and other functional molecules in cows hooves through the transition period[26]. Similarly, cows receiving a specific formulation with aminoacid-metal complexes[27], have shown a different expression in structural genes (i.e. biotinidases or keratin transcription factors), but also on the expression of pro-inflammatory genes (i.e. TNFalpha, Interleukin-6) and lipid and immune modulators (i.e. PPARs). This work is paramount to unveil the functional role of trace elements, in addition to their known structural responsibilities in hoof health, opening new avenues for intervention.

"Anti-inflammatory Lameness Management Strategies": What are the implications in practice?

The in-deph knowledge of the role of inflammation in lameness occurrence will define some of the strategies for prevention and control. Here are some examples of the implications in practice ome questions for reflection.

- *Behavior and stress can promote inflammatory states, affecting hoof health and increasing lameness*. *Does breaking hierarchies between cows affect lameness? If a farm has limitations in resting or eating space, Can that lead to increased competition, stress and lameness? Are first lactation animals in disadvantage? Should we seriously adopt low-stress handling cattle?*
- We have traditionally built facilities for the average cow and troubleshoot big the bigger “mistakes”. *Is high frequency – low intensity trauma affecting the level of lameness by means of subclinical inflammation? Should we build smooth walking surfaces with just the right traction?*
- To my knowledge, only the use of aminoacid-metal complexes has proven to help on the reduction of infectious and non-infectious hoof diseases. *Should we add aminoacid-metal complexes to the standard diets to help manage inflammation? What are other nutritional changes we can adopt to optimize immune function?*
- The transition period is by far the stage of lactation where cows can have the greatest impairment of their immune system. *Should we make the transition period a special focus for lameness prevention? Can we establish different lameness level goals based on stage of lactation?*
- Some research has evidenced variable results in trimming. *Should we adapt the trimming technique to reduce trauma and inflammation? .What is the expected duration until lesion resolution? Can we avoid chronic lesions?*
- In lameness research, limited attention has been given to inflammation. *Should we include inflammation markers in lameness research?*

Advances in the study of the relationship between inflammation and lameness suggest novel approaches to lameness prevention and control and new current and future technologies can provide effective solutions. Cattle wellbeing and farm profitability is at stake, but we have an opportunity to increase our success. Let’s go!

References

1. Liang et al., 2017. Estimating US dairy clinical disease costs with a stochastic simulation model. J. Dairy Sci. 100: 1472
2. Grand et al., 2017. A review of the relationship between hoof trimming and dairy cattle welfare. Vet. Clin. North Am. 33: 365
3. Permana et al, 2006. Macrophage-secreted factors induce adipocyte inflammation and insulin resistance. Biochem. Bioph. Res. Comm. 314: 507
4. Farney et al., 2013. Anti-inflammatory salicylate treatment alters the metabolic adaptations to
   lactation in dairy cattle. Am. .J Physiol. Regul. Integr. Comp. Physiol. 305
5. Rees et al., 2013. Tendons- time to revisit inflammation. B J. Sports. Med.0
6. Serhan, C. 2017. Treating inflammation and infection in the 21st century: new hints from decoding resolution mediators and mechanisms. The FASEB journal. 31:1273
7. McGeer et al., 2016. Inflammation, Antiinflammatory Agents, and Alzheimer’s Disease: The Last 22 Years. Journal of Alzheimer’s disease. 54
8. Thomas et al., 2016. Evaluation of treatments for claw horn lesions in dairy cows in a randomized controlled trial. J. Dairy Sci. 98: 1477

9. Döpfer et al., 1997. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. *Vet. Rec.* 140:620
10. Newsome et al., 2016. Linking bone development on the caudal aspectof the distal phalanx with lameness during life. J. Dairy Sci. 99: 4512
11. Shaw et al., 2016. Mediators of inflammation and bone remodeling in rheumatic disease.Sem. Cell Dev. Boil. 49
12. Serhan et al., 2004. Novel endogenous small molecules as the checkpoint controllers in inflammation and resolution: entrée for resoliomics. Rheum. Dis. Clin. North Am. 30
13. Bicalho et al., 2009. Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. J. Dairy Sci. 92: 3175
14. Randall et al., 2015. Low body condition predisposes cattle to lameness: An 8-year study of one dairy herd. J. Dairy Sci. 98:3766
15. Newsome et al., 2017. A prospective cohort study of digital cushion and corium thickness. Part 2: Does thinning of the digital cushion and corium lead to lameness and claw horn disruption lesions? J. Dairy Sci. 100:4759
16. McNellis and Olefsky. 2014. Macrophages, immunity and metabolic disease. Immunity, 41
17. Gomez et al., 2015. Should we trim heifers precalving? 2013. Proc. Am. Assoc. Bov. Pract., Milwaukee, WI
18. Calderon and Cook. 2011. The effect of lameness on the resting behavior and metabolic status of dairy cattle during the transition period in a freestall-housed dairy herd. J. Dairy Sci. 94:2883
19. Esposito et al., 2014. Interactions between negative energy balance, metabolic diseases, uterine health and immune response in transition dairy cows. Cattle reproduction 144
20. Huzzey et al., 2007. Prepartum behavior and dry matter intake identify dairy cows at risk for metritis. J. Dairy Sci. 90:3220
21. Hood D., 1999. Laminitis in the horse. Vet. Clin. North Am. 15
22. Mani V. 2012. Understanding intestinal lipopolysaccharidepermeability and associated inflammation. Thesis dissertation lib.dr.iastate.edu/cgi/viewcontent.cgi?article=3795&context=etdby
23. Iqbal et al., 2016. Digital Cushion Fatty Acid Composition and Lipid Metabolism Gene Network Expression in Holstein Dairy Cows Fed a High-Energy Diet. Plos One. DOI:10.1371/journal.pone.0159536
24. Gomez et al., 2014. A randomized trial to evaluate the effect of a trace mineral premix on the incidence of active digital dermatitis lesions in cattle. J. Dairy. Sci. 97:6211
25. Nocek et al., 2000. Digital Characteristics in Commercial Dairy Herds Fed Metal-Specific Amino Acid Complexes. J. Dairy Sci. 83.
26. Osorio et al., 2012. Corium tissue expression of genes associated with inflammation, oxidative stress, and keratin formation in relation to lameness in dairy cows. J. Dairy Sci. 95:6388
27. Osorio et al., 2016 Corium molecular biomarkers reveal a beneficial effect on hoof transcriptomics in peripartal dairy cows supplemented with zinc, manganese, and copper from amino acid complexes and cobalt from cobalt glucoheptonate. J. Dairy. Sci. 99:9974

Diagnostic Imaging in Bovine Orthopedics

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Introduction

Diagnostic imaging techniques such as ultrasonography, radiography, computed tomography (CT), magnetic resonance imaging (MRI) and infrared thermography (Table 1) have become widely used in bovine orthopedics in the past decades, particularly in veterinary teaching hospitals *(52, 54).* In particular, CT and MRI are still limited to well-equipped institutions because of their high costs and the necessity to use general anesthesia *(68).* Furthermore, a radiographic unit is not standard equipment for the bovine practitioner *(54).* The same condition applies for infrared thermography, which is up to day used increasingly for scientific applications *(1-3, 93, 103-105).* On the contrary, non-invasive ultrasonography evolved into a high valuable diagnostic imaging technique in bovine musculoskeletal disorders within the last 20 years *(48, 52, 54).* This is most probably due to the development of technically improved, cost effective portable units allowing its use at any given location and any time *(28).*

One objective of this article is to encourage veterinarians to use in particular ultrasonography, however even radiology, for the evaluation of bovine orthopedic disorders. Furthermore, more sophisticated diagnostic imaging techniques of CT and MRI should be kept in mind for possible application in valuable bovine patients. However, in particular, it is the main intention of this article to point out the wide range of indications of diagnostic ultrasound in bovine musculoskeletal disorders. Furthermore, bovine practitioners should be encouraged to apply their already available ultrasonographic units equipped with 5 – 8 MHz rectal probes, commonly used exclusively for the investigation of the bovine female reproductive tract, in the diagnosis of bovine musculoskeletal disorders. Not only do these diagnostic imaging techniques improve the likelihood of a definitive diagnosis in every bovine patient, but also in particular owners of highly valuable cattle demand increasingly more diagnostic and surgical interventions that require top-level specialized techniques *(91)*.

A careful physical and orthopedic examination of the patient is always the first step in making a clinical diagnosis before imaging techniques are applied to achieve a definite diagnosis *(50, 54, 81)*. This thorough orthopedic examination reveals the “region of interest” for the subsequently applied diagnostic imaging technique *(34, 49, 54).*

Diagnostic ultrasound in bovine orthopedics

Nowadays, ultrasound is an integral part of diagnostics in orthopedics and all other organ systems in many veterinary teaching hospitals all over the world *(28, 52, 54).* The person undertaking the physical examination usually also performs the ultrasonographic investigation. The advantage of this union is that the operator is well informed about the anatomical sites in question and is therefore able to relate these to the previously determined clinical findings *(79, 52).* Making an accurate clinical diagnosis in distal and, in particular, in proximal bovine limb disorders with diffuse soft tissue swelling is often challenging. It is frequently impossible to identify with certainty by clinical examination the incriminated anatomical structures when two or more adjacent synovial cavities (joints, tendon sheaths, bursae) or adjoining muscles are involved *(30, 38, 43, 48, 64, 86, 88).* Anyway, ultrasonography is superior to radiography for the diagnosis of conditions affecting the soft tissues and for early stages of arthritis *(28, 34, 43).* It is ideal for evaluation of arthritis, tenosynovitis, bursitis, tendon and muscle lesions, because they are frequently associated with extensive soft tissue swelling and inflammatory exudation *(4, 40, 41, 43, 44, 48, 63, 67, 69, 88)*. Sonographic units with 7.5 MHz (5–8 MHz multifrequency) linear probes became widespread in ambulatory practice for the examination of the bovine reproductive tract, and these probes fit just as well for the evaluation of all orthopedic disorders in calves and in adult cattle with some limitations (Table 1) for disorders of proximal limb regions *(48, 49, 52).*

Preparation of the patient

Ultrasonography of bovine limbs, except the digits, is best achieved with the patient standing. For evaluation of the digital joints and the digital flexor tendon sheath, the animal should be confined in a chute with the affected limb raised and secured or placed in lateral recumbency on a hoof trimming table *(48, 49, 54).* If sedation is required, xylazine (0.05-0.1 mg/kg i.v.) or detomidine (10 μg/kg i.v.) may be administered *(24).* Calves can be examined standing or restrained in lateral recumbency. The region of interest is clipped, washed and cleaned with alcohol, and coupling gel is applied *(48, 49, 52, 54)*.

Ultrasonographic examination technique

A 7.5 MHz (5 to 8 MHz multifrequency) linear probe is recommended for examination of superficial structures that are less than approximately 6 centimeters from the skin surface. This frequency can also be used to examine all the joint regions in calves *(43-49, 52)*. For evaluation of thick muscle bellies of the trunk, hip, thigh and shoulder region in adult cattle and severe swelling anywhere on the limb, the use of a 5.0 or 3.5 MHz convex probes is advised (Table 1) *(5, 23, 43, 44, 48, 49, 67, 69, 80, 87, 88, 94).*

The operator starts by obtaining a general overview of the “region of interest” for orientation purposes by locating and imaging anatomical landmarks *(34, 48, 54).* Once these landmarks have been identified, the search for pathological changes begins *(28, 48, 54).* The “region of interest” must be examined always systematically in longitudinal, transverse and sometimes in oblique planes, from proximal to distal, from cranial to caudal, and from medial to lateral. The entire length of ligaments, tendons and tendon sheaths should be examined, and all joint pouches (dorsal/cranial, palmar/plantar/caudal, lateral, medial) are inspected. The following criteria have to be evaluated: 1) exact anatomical location of the structure/lesion, 2) echogenicity, echo pattern, size of the structure/lesion, 3) type of border of the lesion/cavity, 4) presence or absence of flow phenomena, 5) and the presence of artifacts such as acoustic enhancement or acoustic shadowing *(28, 48, 54).*

Flow phenomena can be elicited by balloting or compressing a fluid-filled cavity with the probe or manually, and by passive flexion or extension of the joint *(34, 48, 52, 54).* The presence of flow phenomena indicates liquid content (serous, serofibrinous, purulent or hemorrhagic). Absence of flow phenomena indicates a semi-solid to solid effusion, such as fibrinous clotted exudate or clotted blood *(30, 38, 43-45, 48, 49, 52, 54).*

The size of distended synovial cavities, abscesses, hematomas and other fluid accumulations as well as the distance between the skin surface and the lesion can be accurately measured using the electronic cursors. Comparison with the contralateral normal limb is recommended in cases of doubt *(48, 54).* Joints should be examined in the normal as well as flexed position to allow inspection of as much articular surface as possible and to detect possible subchondral lesions *(43, 44, 48, 52, 54).*

Many large vessels (medial and lateral saphenous artery and vein, median artery and vein) as well as smaller distal limb vessels can be inspected by ultrasound *(31, 36, 37, 42).* Each vessel is evaluated along its course, noting pulsation of arteries, compressibility of veins and the presence of intraluminal thrombi, which are associated with loss of compressibility and increased intraluminal echogenicity *(31, 36, 37, 42).* For the evaluation of blood flow, a color Doppler can be applied *(28).*

Ultrasonographic standard examination planes

Ultrasonographic examinations should adhere to a standardized protocol *(34, 52).* With whose assistance, the operator examines the "region of interest" in a certain sequence ensuring that all anatomical structures in the "region of interest" are carefully inspected, in order to not overlook lesions or conditions *(28, 34, 52, 54).* For practical purposes, there are certain ultrasonographic planes that facilitate orientation, making identification and evaluation of the "region of interest" easier for the operator *(4, 12, 19, 23, 33, 46-48, 52, 54).*

For all the bovine joint regions including associated structures such as joint capsule, joint forming bone surfaces, joint pouches and collateral ligaments of the bovine limbs, the standard examination plane of choice is the longitudinal for the dorsal (cranial), lateral, palmar/plantar (caudal) and medial aspect depending on their particular anatomy *(4, 5, 19, 33, 46-48, 54, 77).* Cartilaginous growth plates at the distal and/or proximal ends of the long bones in calves are imagined longitudinally as well *(12, 22, 48, 49, 52, 54).*

Transverse planes are the standard examination planes of choice for the digital flexor tendons, the suspensory ligament, the carpal and tarsal flexor and extensor tendons, their tendon sheaths and for muscles because they allow a better overview *(22, 30, 33, 38, 48, 49, 52, 54, 65, 96).*

The oblique longitudinal plane along the femoral neck axis is suited best for the inspection of the coxofemoral joint. The transducer is placed on the trochanter major and moved craniomedially toward the cranial end of the sacrum *(23, 48, 49, 54).* This procedure enables imaging the surface of trochanter major, femoral neck and head, the joint space, the joint capsule and the acetabulum. In adult cattle, a 2.5 or 3.5 MHz convex transducer is required to image the coxofemoral joint, which usually lies 12 to 18 centimeters distant from the skin surface *(23, 87, 94).* Transrectal ultrasonography (5 – 8 MHz linear rectal probe) allows the evaluation of the entire bony pelvic girdle, the ventral contour of the caudal lumbar vertebrae and sacrum, the iliosacral joints and the abdominal aorta and its branches *(23).*

Ultrasonographic appearance of musculoskeletal disorders

The normal ultrasonographic appearance of the anatomical structures of the musculoskeletal system is listed in Table 2. Normal synovial cavities in cattle are difficult or impossible to visualize by ultrasound due to the very small physiological amount of synovial fluid *(4, 33, 46-49, 54, 96).* Inflammatory (septic) processes and traumatic soft tissue injuries are in particular suitable to be diagnosed by ultrasound due to fluid accumulation in the affected tissues *(5, 9, 30, 38, 40, 43-45, 64, 66, 69).*

Arthritis, tenosynovitis and bursitis

Septic disorders of synovial cavities occur frequently in cattle *(5, 14, 24, 30, 38, 43, 44, 64, 67, 69, 80, 86, 88).* Traumatic arthritis is often associated with tearing of the joint capsule, tearing or rupture of collateral (cruciate) ligaments, and luxation or subluxation *(48, 60, 87, 94).* Synovial effusion can be detected reliably using ultrasonography even in very early stages *(5, 24, 38, 43, 44, 64, 67).* The diseased synovial cavity (joint pouch, tendon sheath, bursa) appears mildly to severely distended, and the thin echoic capsule is distinctly displaced from the articular surface. The echogenicity of the effusion ranges from anechoic to echoic depending on its nature (serous, serofibrinous, fibrinous, purulent) *(48).* Liquid content can be identified based on flow-phenomena, which are characterized by small and large hypoechoic to echoic particles or clots that are seen floating in anechoic fluid *(34).* In long-standing cases of sepsis, the precipitated gelatinous masses of fibrin impair or prevent aspiration of fluid, and these semi-solid masses appear hypoechoic to echoic and show no flow-phenomena *(5, 24, 38, 41, 43-45, 67).* Definitive information about the nature of effusion is provided by puncture of the synovial cavity *(50, 76, 81).*

An accurate diagnosis of traumatic arthritis can be made when lesions of the joint capsule, articular bone, the collateral and cruciate ligaments or the menisci can be identified ultrasonographically *(48, 54),* and arthrocentesis might reveal a hemorrhagic sample *(76).* In cattle with swollen joint regions, the differential diagnosis includes concurrent tenosynovitis, periarticular abscess, hematoma, seroma, subcutaneous edema and fracture near the joint. In cases of periarticular disorders without any involvement of the joint, the joint pouch appears normal and the fluid accumulation is located completely extra-articular *(48).*
The most commonly affected tendon sheath in cattle is the digital flexor tendon sheath of rear limbs *(6, 7, 9, 40, 44, 62, 96).* Septic disorders of other tendon sheaths are uncommon but occur occasionally in the sheaths of the tendons of the extensor carpi radialis muscle, the common and lateral digital extensor muscles, the carpal flexor muscles and the tendons of the flexor hallucis longus and tibialis caudalis muscles in the tarsus *(30, 38, 66).* Aseptic tenosynovitis of the tendon of the extensor carpi radialis muscle has also been described *(29, 38).*
The most commonly incriminated bursae are the bursa subcutanea and subtendinea calcanei, the bursa tarsalis lateralis, and the precarpal bursa (carpal hygroma) *(30, 38, 60, 80).* The bursa intertubercularis and the bursa of the tendon of the infraspinatus and the biceps femoris muscle *(5, 67, 69)* are rather rarely affected.

Bone lesions

There is no doubt that radiography is the method of choice for the evaluation of bone lesions, such as fractures, luxation, osteomyelitis and bone sequestra *(8, 54, 90).* However, bone lesions located on the bone surface, can easily be detected by ultrasound although its full extent can be imaged *(52, 61, 82).* Ultrasound waves are reflected by the bone contour and are completely absorbed so that in the healthy bone, only its surface can be evaluated *(28).* Due to anatomical reasons some bones are difficult to assess by radiography such as the scapula, ribs and the pelvis. However, in general, almost all bone surfaces in cattle can be examined by ultrasound, if a radiographic unit is not available which is common in bovine practice *(48, 52, 54).* The pelvis may be examined transcutaneously and transrectally *(23, 54).* The normal bone contour appears as a smooth hyperechoic reflective band *(24, 43, 46, 47, 54, 61).* Fractures are characterized by an abnormal interruption or a step in the smooth contour of the bone. Careful manipulation of the affected limb may exacerbate this gap at the sonogram. Furthermore, a bone structure might be found in an abnormal area or position like in case of coxofemoral luxation where the femoral head is displaced into the gluteal muscles *(87, 94).* Small bone fragments in the soft tissues produce hyperechoic reflections with distal acoustic shadowing *(60, 75, 82).* A concurrent fracture-associated hematoma appears as an anechoic to hypoechoic area of varying size around the fracture site *(82).* Early ultrasonographic signs of osteitis and osteomyelitis, before these disorders can be detected radiographically, include thickening and displacement of the echoic periosteum from the bone surface by anechoic exudate and swelling of the surrounding soft tissue *(26, 45).* Bone lysis and periosteal reaction appear later as irregular roughening and interruption of the normal smooth contour of the bone surface *(45, 48, 54).*

Tendinitis and desmitis

Main indications for ultrasonography are swellings along the course of tendons or ligaments with a history of trauma, of wounds with possible damage to tendons and/or ligaments, and cases of suspected tenosynovitis *(48, 54, 65, 67, 69, 92).* The diagnosis of aseptic tendinitis or desmitis with partial fiber rupture and/or avulsion fracture of their insertion site has been documented in cattle *(6, 7, 11, 65, 92).* Thickening of the incriminated tendon or ligament, alterations in the texture, loss of the parallel fiber alignment, and a marked hypoechoic appearance (of normally echoic tendons and ligaments) are characteristic findings *(11, 65).* In a recently published article the clinical, ultrasonographic and radiographic findings in eleven dairy heifers with rupture of the suspensory ligament (interosseous medius muscle) were reported in detail *(65).* The sonographic appearance of injured flexor tendons is well described in cattle *(33, 40, 44, 96)* including infection of the digital flexor tendon sheath with a concurrent purulent infection of a flexor tendon. Purulent tendinitis lesions may occur even due to a penetrating foreign body *(48, 54, 62)* and are characterized by a circumscribed, diffuse decrease or a delineated loss of echogenicity (anechoic “core” lesion), and loss of the parallel fiber arrangement extending over a considerable length *(40, 44, 48, 54).*

Muscle lesions

The main indications for ultrasonography are muscle swelling, deep decubital ulcers of the skin over muscle bellies, and septic tendinitis and tenosynovitis at the transition site from muscle to the tendon of origin *(48, 54).* Depending on the causative event (acute trauma, chronic ischaemia and hypoxia due to continuous pressure, iatrogenic origin etc.) muscle trauma may result in formation of hematomas, muscle tears, compartment syndrome, muscle necrosis and/or abscess *(59).* Various sonographic patterns have been described, including anechoic fluid accumulations of various sizes in fresh muscle hematomas, irregularly-shaped lesions with scattered low-level echoes (muscle tears), ill-defined echoic areas with loss of normal muscle striations and overall increase in muscle echogenicity (muscle compartment syndrome, muscle necrosis), and highly reflective zones with acoustic shadowing and loss of normal muscle architecture *(59, 84).*

Abscess and hematoma

Due to their morphology, abscesses generally have a heterogeneous appearance *(30, 32, 38, 48, 54, 59).* They are characterized by a predominantly anechoic content which is well demarcated from the surrounding tissue and may contain unevenly distributed, small, floating hypoechoic or echoic reflections. Furthermore, many minute echoic to hyperechoic reflections (gas bubbles) or large dorsal gas pockets can be seen and flow phenomena can be elicited as well *(32, 48, 54).* Therefore, abscesses may appear ultrasonographically similar to a purulent arthritis *(54).*
Fresh hematomas show an anechoic appearance, flow phenomena and acoustic enhancement. With progressive coagulation, heterogeneous areas are noticed with alternating anechoic (fluid), hypoechoic and echoic (organized) areas *(32, 48, 54).* Ultrasonography facilitates differentiation of abscesses, hematomas and seromas from infections of synovial cavities, in particular when they are located on joint regions. Subsequent targeted needle aspiration confirm the diagnosis *(28, 48).*

Ultrasound-assisted needle aspiration or biopsy

If the unit is available, ultrasonographic inspection of the structure of interest should always be carried out before puncture *(48, 52, 54).* The position and size of the distended cavity and the location of liquid effusion within as well as its distance and direction from a set point on the skin surface can be determined accurately. After assessing the direction and depth of the structure to be punctured the needle may be inserted with or without (free hand) ultrasonographic guidance *(26, 28, 48, 52, 54, 99).* The same technique can also be used for puncture or biopsy collection of veins suspected of containing septic thrombi or of any other abnormal masses *(48, 52, 54).*

Measurement of sole horn thickness and of digital fat cushions

An interesting application of ultrasound is the evaluation of the thickness of the claw sole horn, the underlying soft tissue layer, the digital fat cushion thickness and the assessment of changes of the distal pedal bone surface in relation with laminitis and loss of body condition score after parturition in dairy cattle *(10, 35, 56, 57, 71, 95, 100).*

Radiography of the bovine musculoskeletal system

Radiography has already been established as a standard diagnostic procedure in veterinary medicine for a long time *(8).* Nevertheless, up to now it has not become a routine procedure in bovine practice, particularly due to the high investments and the rather low frequency of application in practice *(52, 54).* Until now, only two textbooks have been published about diagnostic radiography in

cattle: the textbook of "Bovine Radiology" *(8)* and the recently published DVD "Bovine Radiology – Digital Diagnostic Atlas“ from the Vetsuisse-Faculty in Berne *(90).* However, there have been published several journal articles describing radiographic findings in various orthopedic disorders *(17, 18, 20, 21, 25, 39, 41, 51, 53-55, 85, 101, 102).*
In contrast to ultrasonography, a radiographic unit is not standard equipment for the bovine practitioner *(52, 54).* However, the imaging systems used in farm animals are the same as those in equine radiography. As well as the conventional film-screen combinations, digital imaging systems are being used more and more frequently *(54).* Portable machines with a performance of 3.5-4 kW are very practical for taking x-ray images of the distal limbs and the skull of adult cattle, as well as in calves. However, for radiography of the proximal limb skeleton with very thick layers of tissue, the technical and physical limits of the radiographic unit are reached very soon *(54, 90, 102).* Only with a powerful, mainly stationary radiological equipment, is it possible to produce reasonable radiographs of these proximal limb regions in adult cattle *(54, 83, 90, 102).*

Radiation protection

There are three main principle recommendations made by the International Commission on Radiological Protection (ICRP) to minimize the radiation exposure of people involved in x-ray studies, namely justification, optimization, and dose limitation. All these recommendations have to be strictly complied *(27, 54, 90),* and they are described in detail in the ICRP guidelines *(27)* and in other references *(54, 83, 90).* Accurate planning of a radiographic study is an important part of radiation protection *(54, 90)* and include to choose an adequate location for the exam (plane floor, dark room, concrete building), to avoid artifacts (e.g. brush off dirt from the animal’s coat), to sedate nervous animals in order to reduce the risk of movement blur, to position the animal very carefully in order to avoid unnecessary repetition of radiographs, and to apply optimal exposure settings for obtaining good quality radiographs *(27, 54, 83, 90).*

Radiography of bovine digits

The digital region is one of the most frequently radiographed regions in cattle. The most common indications are the suspicion of a deep septic process involving the pedal bone, the distal sesamoid bone, the distal interphalangeal (DIP), the proximal interphalangeal or the fetlock joint, and a fracture of pedal bone *(8, 17, 18, 39, 41, 51, 54, 83, 85, 90, 101).* As a standard procedure, a dorsal 65°proximal-palmaro-/plantarodistal and a lateral 30°dorsal-mediodistal oblique x-ray image will be taken. For these two views the plate has to be protected by a fiberglas tunnel. A further possibility of obtaining an image of the pedal bone and the DIP joint without superimposition, is the lateromedial or mediolateral projection with a screenless x-ray film placed in the interdigital space *(54, 83, 90).*
When suspecting a deep septic process in the digital region, the main interest lies in whether and to what extent the bones and the DIP joint are affected *(54, 90).* Osteitis of the pedal bone appears as an unclearly defined, irregular and heterogeneous radiolucency of the bone *(51, 54).* Periosteal new bone formation is often observed at the edges of the defect. Radiographic images of a DIP joint infection will show widening of the joint space as the first characteristic sign. In chronic cases the joint space may narrow down due to destruction of the articular cartilage *(54, 85).* The joint contours become more and more irregular, and when the infection keeps up for longer time, the subchondral bone of the second and third phalanx as well the distal sesamoid bone will be involved resulting in an osteitis and/or osteomyelitis *(17, 18, 54, 85, 86).*
Fractures of the pedal bone are usually clearly visible by the characteristic depiction of one or more radiolucent (fracture) lines, which may be more or less clearly defined. Evidence of an open fracture includes gas pockets and defects of the horn capsule *(51, 54).*

Radiography of long bones

Suspected fractures and sequester formation in long bones are the most common indications for radiography in adult cattle. Growth disorders (e.g. angular limb deformity in calves, epiphysitis in beef cattle) and infectious processes in the area of the growth plates are frequent indications for

radiography in young animals *(20, 25, 54, 70, 89, 90)*. As standard projections, dorsopalmar/dorsoplantar (craniocaudal) and lateromedial/mediolateral radiographs are taken, supplemented, if necessary, by oblique projections. All these radiographs are normally taken in the standing animal *(54, 90)*. In cooperative cattle, the humerus can be imaged in the standing animal. A procedure for radiography of the coxofemoral joint in the standing cow using laterodorsal-lateroventral views was described *(102).* However, this technique can be performed in specialized clinics only, because it requires a powerful radiographic unit and additional radiographic protection devices. However for imaging the humerus, the femur and the coxofemoral region, normally the patients have to be sedated and positioned in lateral or dorsolateral recumbency, and a mediolateral projection is usually taken *(54, 90, 102)*.
Fractures are characterized by interruptions in the continuity of bony structures, and fracture clefts are visible as radiolucent lines *(54, 70, 90)*. In order to determine the direction and the degree of dislocation, rotation, and angulation of fracture fragments, it is important to take at least two projections perpendicular to each other *(54, 70)*. The first signs of mineralized callus are radiologically visible at 7-10 days after the trauma *(8, 54, 70).*
Formation of a bone sequestrum is another pathology of long bones rather frequently diagnosed in adult cattle *(25).* In the acute stage of trauma, the sequestrum cannot yet imaged on the x-ray. Later on, after about 7 to 14 days and more, the typical radiographic signs of a sequestrum formation become evident. At least one non dislocated bone fragment becomes progressively demarcated (sequestrum), surrounded by a radiolucent area (cloaca). Massive periosteal reactions (involucrum) develop around the sequestrum. Afterwards a radiolucent band (sinus tract) can be identified in some cases reaching from the cloaca to the bone surface *(25, 54)*.
In calves, infections of the growth plates frequently occur *(17, 18, 20, 54, 101).* The characteristic signs in cases of an infection are a broadened physis, an unclearly delineated and irregular bone lysis, sclerotic zones around and a soft tissue swelling. Irregular, opaque new bone formation may appear at the edges of the growth plate *(18, 54, 101).* However, remember that these osteomyelitis lesions at the growth plates can even be detected by ultrasonography, if the area of bone lysis is located on the outer bone margins *(22, 41, 45, 48).*

Radiography of joints

For radiography of joints two projections perpendicular to each other are usually carried out *(54, 83, 90).* For complex joints like the carpus or tarsus, additional oblique radiographs have to be taken so that all joint edges and contours may be reliably evaluated. In adult cattle, all joints distal to elbow and stifle can be radiographed in standing position. It is possible to image the coxofemoral, stifle, shoulder and elbow joints in the standing animal, but the quality is mainly poor compared to those x-ray images taken with the animal recumbent *(54, 102).* Joints of calves are better radiographed with the calf sedated and recumbent *(54, 83, 102).*
In healthy cattle, the following joint structures should be routinely evaluated: the position of the bones constituting the joint, the width of the joint space, the appearance of the joint contours, the width of the subchondral bone plates, the joint edges and the periarticular soft tissues *(54, 90)*. Increased soft tissue opacity in the area of a joint may either be due to a space occupying process in the joint capsule and /or in the joint cavity and/or in the periarticular soft tissue *(41, 85, 101).* Important information concerning the integrity of collateral ligaments is provided by evaluating the position and angle of the joint-forming bones. Deviations from the axis indicate collateral ligament rupture. Such instabilities may be more reliably diagnosed by means of stress radiographs or when the limb is weight bearing *(54, 90)*. However injuries of collateral ligaments can be imaged easily even by ultrasonography *(48, 54).* The radiologically visible joint space comprises the joint cartilage, the synovial fluid and possibly present intracapsular ligaments or menisci. Narrowing of the joint space indicates destruction of the joint cartilage (e.g. in cases of advanced osteoarthritis), and widening of the joint space is a sign of joint effusion. The age of the animal has also be taken into account; calves have a thicker joint cartilage than adults *(54, 90)*. It is therefore often advisable to

produce a comparative x-ray image of the contralateral limb in growing animals, so that diagnostic doubts may be eliminated. If joint edges appear irregular due to new bone formation (osteophytes), this indicates a chronic joint instability; osteophytes are interpreted as signs of osteoarthritis *(54, 83, 90).*
Thickening or sclerosis of the subchondral bone plates is a sign of increased stress which typically appears when the joint cartilage is lost. There may be a generalized or localized reduction in the opacity of the subchondral bone. Localized increased radiopacity of the subchondral bone (lytic zones) frequently appears with septic arthritis or degenerative joint disease. A generalized reduction in the opacity or width of the subchondral bone plate can be seen in cases of long lasting reduction of weight bearing occurring following severe lameness or after application of a walking cast *(54, 55, 83, 90).*

CT and MRI in bovine orthopedics

Computer tomography (CT) is a specific, computerized type of X-ray examination. The most important advantage of CT versus conventional radiography is that CT provides sectional images of body regions without being obscured by overlaying structures *(68).* One main benefit of Magnetic resonance imaging (MRI) versus CT is the much more detailed contrast imaging of soft tissues *(15, 106).* Nevertheless the limitation of CT and MRI to well-equipped institutions, the high costs and the need of general anesthesia *(15, 68, 78),* these imaging techniques can be an option in highly valuable cattle *(91)* for achieving a comprehensive diagnosis, which cannot be made by radiography and ultrasonography, and for preoperative planning of a complex surgical intervention *(68).* However, technical restrictions such as the size of gantry aperture of the CT and the MRI units limit the applications in adult cattle to the examination of the head, cranial parts of the neck and the limbs *(15, 68).* In contrary, in calves depending on their size and age the entire body can be scanned *(68).* Indications for the use of CT and MRI have been reported and include mainly anatomical studies of bovine limbs *(15, 16, 35, 73, 74, 78, 97, 98).* Up to now, only rarely clinical applications of CT and/or MRI were reported such as spinal epidural abscesses, congenital malformations and orthopedic diseases *(20, 58, 68, 104, 106).*

Infrared thermography (IRT)

IRT has been introduced recently in bovine medicine to identify and determine thermal abnormalities by characterizing an increase or decrease in the surface temperature of their skin at an individual and herd level *(105).* Changes in blood flow had been used to detect lameness early *(3)* and to identify foot lesions under research conditions *(1, 2, 71, 93, 103)*. However, IRT is highly subjected to environmental thermal artefacts (wind, humidity, exposure to light), so that a controlled environment is a strict precondition before image scanning *(105).* None of these described indications has been established up to now as a routine examination procedure in bovine practice.

Conclusions

In combination with the determined clinical findings all the mentioned diagnostic imaging techniques are of great importance for making an exact diagnosis. However, ultrasonography is the imaging modality that can be applied anywhere and at any time in bovine practice allowing a rapid non-invasive differentiation of soft tissue structures of the bovine musculoskeletal system *(48, 54).* Ultrasonographic units with 5.0 to 7.5 MHz linear probes, commonly used in large animal reproduction, are well suited for rapid and straightforward differentiation of soft tissue swelling in the limbs too *(48, 54).* The costs for purchase and maintenance of a sonographic unit are just too high to limit its application to the bovine reproductive tract. In calves in particular, nearly all organ systems can be examined with 5 – 8 MHz rectal linear probes (Table 1), and even in cows these rectal probes can be used for imaging of pathologies in many joints, other limb regions, and for determination of the back fat thickness *(48, 52, 54, 72).* In addition, ultrasound can be very helpful for detection of foreign bodies in the limbs that cannot be diagnosed radiographically *(62).* Ultrasonography provides accurate information about the location and size of lesions or fluid-filled cavities, the surrounding tissues and the nature of the content making a puncture precise and safer *(28, 48, 52, 54, 99).* The physiological amount of fluid of normal synovial cavities in cattle cannot be imaged by ultrasound; visualization of effusion is easy and usually indicates an inflammatory process (Table 1). Therefore, ultrasonography allows the detection of early stages of inflammation of synovial cavities, based on an increased amount of effusion and distension of the synovial pouch *(48, 52, 54).* Regardless of the applied diagnostic imaging technique, an accurate anatomical differentiation of the (soft) tissue structures involved, a thorough preoperative inspection of the incriminated region of the musculoskeletal system, characterization of the lesions, and an early diagnosis are of enormous benefit for determining an accurate prognosis, in particular for decision making, and as well for planning treatment and surgery *(13, 52, 54)* in bovine patients.

References

1. Alsaaod M, Büscher W. Detection of hoof lesions using digital infrared thermography in dairy cows. J Dairy Sci 2012; 95: 735-742.
2. Alsaaod M, Syring C, Dietrich J, Doherr MG, Gujan T, Steiner A. A field trial of infrared thermography as a non-invasive diagnostic tool for early detection of digital dermatitis in dairy cows. Vet J 2014; 199: 281-285.
3. Alsaaod M, Schaefer AL, Büscher W, Steiner A. The role of infrared thermography as a non-invasive tool for the detection of lameness in cattle. Sensors 2015; 15: 14513-14525. doi:10.3390/s150614513.
4. Altenbrunner-Martinek B, Grubelnik M, Kofler J. Ultrasonographic examination of important aspects of the bovine shoulder – physiological findings. Vet J 2007; 173(2): 317-324.
5. Altenbrunner-Martinek, B., Starke, A., Heppelmann, M., Kofler, J. Disorders of the shoulder region in 21 cattle: clinical, ultrasonographic and radiographic findings. Berlin Münch Tierärztl Wschr 2017; DOI 10.2376/0005-9366-15084.
6. Anderson DE, St-Jean G, Morin DE, Ducharme NG, Nelson DR, Desrochers A. Traumatic flexor tendon injuries in 27 cattle. Vet Surg 1996; 25(4): 320-326.
7. Anderson DE, Desrochers A, St Jean G. Management of tendon disorders in cattle. Vet Clin North Am Food Anim Pract 2008; 24(3): 551-566.
8. Bargai U, Pharr JW, Morgan JP. Bovine Radiology. 1st ed: Iowa State University Press; 1989.
9. Bertagnoli A, Räber M, Morandi N et al. Tenovaginoscopic approach to the common digital flexor tendon sheath of adult cattle: technique, normal findings and preliminary results in four clinical cases. Vet J 2012; 191(1): 121-127.
10. Bicalho RC, Machado VS, Caixeta LS. Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of the prevalence of lameness and the thickness of the digital cushion. J Dairy Sci 2009; 92: 3175-3184.
11. Boppart J. Ultrasonographic examination of the interosseus muscle in cattle. Master Thesis Vetsuisse-Fakultät Zürich, Schweiz, 2013.

12. Borges NC, Weissengruber G, Huber J, Kofler J. Ultrasonographic examination of the elbow joint in calves and cows – normal appearance. Berlin Münch Tierärztl Wschr 2015; 128, 416–424.
13. Braun U. Ultrasound as a decision-making tool in abdominal surgery in cows. Vet Clin North Am Food Anim Pract 2005; 21: 33-53.
14. Dirksen G. Krankheiten der Bewegungsorgane. In: Dirksen G, Gründer H-D, Stöber M (eds). Innere Medizin und Chirurgie des Rindes. 4th edition. Berlin, Parey; 2002. 764-975.
15. Ehlert A, Ferguson J, Gerlach K. Magnetic resonance imaging and cross-sectional anatomy of the normal bovine tarsus. Anat Histol Embryol 2011; 40(3): 234-240.
16. El-Shafey A, Sayed-Ahmed A. Computed tomography and cross sectional anatomy of the metacarpus and digits of the one humped camel and Egyptian water buffalo. Int J Morphol 2012; 30(2): 473-482.
17. Farrow CS. Digital infections in cattle. Their radiologic spectrum. Vet Clin North Am Food Anim Pract 1985; 1(1): 53-65.
18. Farrow CS. The radiologic investigation of bovine lameness associated with infection. Vet Clin North Am Food Anim Pract 1985; 1(1): 67-81.
19. Flury S. [Ultrasonographic imaging of the tarsus in cattle]. 1996; Thesis: Veterinary Medicine, Bern, Switzerland.
20. Frei S, Braun U, Dennler M, Hilbe M, Stalder HP, Schweizer M, Nuss K. Border disease in persistently infected calves: radiological and pathological findings. Vet Rec 2014; doi: 10.1136/vr.102095.
21. Gantke S, Nuss K, Kostlin R. [Radiologic findings in bovine laminitis]. Tierärztl Prax 1998; 26(5): 239-46.
22. Gonçalves PVR, Silva LAF, Silva LH, Costa APA, Bragato N, Cardoso JR, Kofler J, Borges NC. Ultrasonography of the distal limbs in Nellore and Girolando calves 8 to 12 months of age. BMC Vet Res 2014; 10:102 doi:10.1186/1746-6148-10-102.
23. Grubelnik M, Kofler J, Martinek B, Stanek C. [Ultrasonographic examination of the hip joint and the pelvic region in cattle]. Berl Munch Tierärztl Wschr 2002; 115(5-6): 209-220.
24. Heppelmann M, Rehage J, Kofler J, Starke A. Ultrasonographic diagnosis of the septic arthritis of the distal interphalangeal joint in cattle. Vet J 2009; 179(3): 407-416.
25. Hirsbrunner G, Steiner A, Martig J. [Diaphyseal sequestration of the hollow bones in cattle]. Tierärztl Prax 1995; 23(3): 251-258.
26. Howard CB, Einhorn M, Dagan R, Nyska M. Ultrasound in diagnosis and management of acute haematogenous osteomyelitis in children. J Bone Joint Surg Br 1993; 75(1): 79-82.
27. ICRP. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Annals of the ICRP 2007; 37: 2-4.
28. King AM. Development, advances and applications of diagnostic ultrasound in animals. Vet J 2006; 171(3): 408-420.
29. Klee W, Hänichen T. [Epidemiologic, clinical and pathoanatomic studies of the inflammation of the carpal joint extensors in cattle] Schweiz Arch Tierheilk 1989; 131(3): 151-157.
30. Kofler J, Altenbrunner-Martinek B. [Ultrasonographic findings of disorders of the tarsal region in 97 cattle – arthritis, bursitis, tenosynovitis, periarticular abscess and vein thrombosis]. Berl Münch Tierärztl Wschr 2008; 121(3-4): 145-158.
31. Kofler J, Buchner A, Sendlhofer A. Application of real-time ultrasonography for the detection of tarsal vein thrombosis in cattle. Vet Rec 1996; 138(2): 34-38.
32. Kofler J, Buchner A. [Ultrasonic differential diagnostic examination of abscesses, haematomas and seromas in cattle]. Wien Tierärztl Mschr 1995; 82(5): 159-168.
33. Kofler J, Edinger H. Diagnostic ultrasound imaging of the soft tissues in distal bovine limb. Vet Radiol & Ultrasound 1995; 36(3): 246-252.
34. Kofler J, Hittmair K. Diagnostic ultrasonography in animals – continuation of the clinical examination? Vet J 2006; 171 (3): 393-395.

35. Kofler J, Kübber P, Henninger W. Ultrasonographic imaging and thickness measurement of the sole horn and the underlying soft tissue layer in bovine claws. Vet J 1999; 157(3): 322-331.
36. Kofler J, Kübber-Heiss A. Long-term ultrasonographic and venographic study of the development of tarsal vein thrombosis in a cow. Vet Rec 1997; 140(26): 676-678.
37. Kofler J, Martinek B, Kübber-Heiss A, Kübber P. Generalised distal limb vessel thrombosis in two cows with digital and inner organ infections. Vet J 2004; 167(1): 107-110.
38. Kofler J, Martinek B. [Ultrasonographic imaging of disorders of the carpal region in 42 cattle – arthritis, tenosynovitis, precarpal hygroma, periarticular abscess]. Tierärztl Prax 2004; 32(2): 61-72.
39. Kofler J, Osova A., Altenbrunner-Martinek B, Burgstaller J. Necrosis of the apex of pedal bone (toe necrosis) in 30 cattle – retrospective evaluation of surgical approaches and outcomes. Wien Tierärztl Mschr 2017; 104: 131-142.
40. Kofler J. [Sonography as a new diagnostic tool for septic tenosynovitis of the digital flexor tendon sheath in cattle – therapy and long term follow-up]. Deutsche Tierärztl Wschr 1994; 101(6): 215-222.
41. Kofler J. [Septic arthritis of the proximal interphalangeal (pastern) joint in cattle - clinical, radiological and sonographic findings and treatment]. Berlin Münch Tierärztl Wschr 1995; 108: 281-289.
42. Kofler J. [Description and determination of the diameter of arteries and veins in the hindlimb of cattle using B-mode ultrasonography]. J Vet Med A 1995; 42(4): 253-266.
43. Kofler J. Arthrosonography: The use of diagnostic ultrasound in septic and traumatic arthritis in cattle - a retrospective study of 25 patients. Br Vet J 1996; 152(6): 683-698.
44. Kofler J. Ultrasonographic imaging of pathology of digital flexor tendon sheath in cattle. Vet Rec 1996; 139(2): 36-41.
45. Kofler J. [Ultrasonography in haematogeneous septic arthritis, polyarthritis and osteomyelitis in calves]. Wien Tierärztl Mschr 1997; 84(5): 129-139.
46. Kofler J. Ultrasonographic examination of the stifle region in cattle - normal appearance. Vet J 1999; 158(1): 21-32.
47. Kofler J. Ultrasonographic examination of the carpal region in cattle - normal appearance. Vet J 2000; 159(1): 85-96.
48. Kofler J. Ultrasonography as a diagnostic aid in bovine musculoskeletal disorders. Vet Clin North Am Food Anim Pract 2009; 25(3): 687-731.
49. Kofler J. [Ultrasonographic examination of the musculoskeletal system in cattle]. Tierärztl Prax (G) 2011; 39(5): 299-313.
50. Kofler J. Orthopädischer Untersuchungsgang. In: Baumgartner W (ed), Klinische Propädeutik der Haus- und Heimtiere. 8th edn, Stuttgart, Enke; 2014; 216–281.
51. Kofler J. Pathogenesis and treatment of toe lesions in cattle (including non-healing toe lesions). Vet Clin Food Anim Pract 2017; 33 (2): 301–328.
52. Kofler, J., Franz, S., Flöck, M., Wittek, T. Diagnostic imaging in bovine medicine. Proceedings 29th World Buiatrics Congress, Dublin, Ireland 2016, 77-79.
53. Kofler J, Peterbauer C. Resection of a carpal bone row in a Pustertaler Sprinze cow with chronic purulent arthritis and osteomyelitis of the distal carpal bones and the proximal metacarpus. Tierärztl Prax (G) 2014; 42: 231–239.
54. Kofler J, Geissbühler U, Steiner A. Diagnostic imaging in bovine orthopedics. Vet Clin Food Anim 2014; 30: 11-53.
55. Kofler J, Wetchy G, Schöffmann G. Transfixation pinning and casting of a comminuted metacarpal fracture in a 870 kg bull. Vet Surg 2014; 43: 1014–1019.
56. Laven LJ, Laven RA, Parkinson TJ, Lopez-Villalobos N, Margerison JK. An evaluation of the changes in distance from the external sole surface to the distal phalanx in heifers in their first lactation. Vet J 2012; 193(3): 639-643.

57. Laven LJ, Margerison JK, Laven RA. Validation of a portable ultrasound machine for estimating sole thickness in dairy cattle in New Zealand. New Zealand Vet J 2012; 60(2): 123-128.
58. Lee KJ, Yamada K, Tsuneda R, Kishimoto M, Shimizu J, Kobayashi Y, Furuoka H, Matsui T, Sasaki N, Ishii M, Inokuma H, Iwasaki T, Miyake Y. Clinical experience of using multidetector-row CT for the diagnosis of disorders in cattle. Vet Rec 2009; 165: 559–562.
59. Léveillé R, Biller DS. Muscle evaluation, foreign bodies and miscellaneous swellings. In: Nyland TG, Mattoon JS (eds). Veterinary Diagnostic Ultrasound. Philadelphia, WB Saunders; 1998. 515-521.
60. Martinek B, Huber J, Kofler J, Bago Z. [Bilateral avulsion fracture (apophyseolysis) of the calcaneal tuber in a heifer]. Berlin Münch Tierärztl Wschr 2003; 116(7-8): 328-332.
61. Martinek B, Zoltan B, Flöck M, Hochsteiner W, Schilcher F, Kofler J. Chondrosarcoma in a Simmental cow - clinical, ultrasonographic, radiographic and pathological findings. Vet J 2006; 172(1): 181-184.
62. Mulon PY, Achard D, Babkine M. Ultrasonographic diagnosis of porcupine quill foreign bodies in the plantar flexor tendon sheath region in a heifer. Can Vet J 2010; 51(8): 888-890.
63. Munroe GA, Cauvin ER. The use of arthroscopy in the treatment of septic arthritis in two Highland calves. Br Vet J 1994; 150(5): 439-449.
64. Nuss K. [Septic arthritis of the shoulder and hip joint in cattle: diagnosis and therapy]. Schweiz Archiv Tierheilk 2003; 145(10): 455-463.
65. Nuss K, Boppart J, Geyer H. Clinical findings, treatment, and outcome in 11 dairy heifers with breakdown injury due to interosseous medius muscle rupture. Vet Surg 2017; 46: 197-205.
66. Nuss K, Maierl J. [Tenosynovitis of the deep flexor tendon sheath (M. flexor digitalis lateralis et M. tibialis caudalis) at the bovine tarsus (16 cases)]. Tierärztl Prax (G) 2000; 28(6): 299-306.
67. Nuss K, Ringer S, Meyer SW, Schade B. Olerth B. Lameness caused by infection of the subtendinous bursa of the infraspinatus muscle in three cows. Vet Rec 2007; 160(6): 198-200.
68. Nuss K, Schnetzler C, Hagen R, Schwarz A, Kircher P. [Clinical application of computed tomography in cattle]. Tierärztl Prax (G) 2011; 39(5): 317–324.
69. Nuss K, Räber M, Sydler T, Muggli E, Hässig M, Guscetti F. [Bursitis with severe tendon and muscle necrosis on the lateral stifle area in cattle]. Schweiz Archiv Tierheilk 2011; 153: 520–525.
70. Nuss, K., Spiess, A., Feist, M., Köstlin, R. Treatment of long bone fractures in 125 newborn calves - a retrospective study. Tierärztl Prax (G) 2011; 39: 15-26.
71. Oikonomou G, Trojacanec P, Ganda EK, Bicalho ML, Bicalho RC. Association of digital cushion thickness with sole temperature measured with the use of infrared thermography. J Dairy Sci 2014; 97(7): 4208-4215.
72. Pothmann H, Erlen A, Pichler M, Huber J, Drillich M. [Relationship and repeatability of body condition scoring and backfat thickness measurement in dairy cows by different investigators]. Berlin Münch Tierärztl Wschr 2015; 128: 319-325.
73. Raij AR, Sardari K, Mohammadi H. Normal cross-sectional anatomy of the bovine digit: comparison of computed tomography and limb anatomy. Anat Hist Embryol 2008; 37(3): 188–191.
74. Raji AR, Sardari K, Mirmahmoob P. Magnetic resonance imaging of the normal bovine digit. Vet Res Commun 2009; 33(6): 515-520.
75. Reisinger R, Altenbrunner-Martinek B, Kofler J. [Sternal recumbency after traumatic injury of the caudal thoracic spine with fracture of the dorsal spinous processes of the thoracic vertebrae 11 to 13 in a heifer]. Wien Tierärztl Mschr 2008; 95: 72-79.
76. Rohde C, Anderson DE, Desrochers A, St-Jean G, Hull BL, Rings DM. Synovial fluid analysis in cattle: a review of 130 cases. Vet Surg 2000; 29(4): 341-346.

77. Saule C, Nuss K, Köstlin RG, Maierl J, Matis U. [Ultrasonographic anatomy of the bovine carpal joint]. Tierärztl Prax 2005; 33(6): 364-372.
78. Schwarze I. [Computed tomography of the bovine tarsus]. Thesis Veterinary Medicine 1998, Faculty of Veterinary Medicine, LMU University Munich, Germany.
79. Scott PR. The role of ultrasonography as an adjunct to clinical examination in cattle practice. Irish Vet J 2008; 61: 256-260.
80. Seyrek-Intas D, Celimli N, Gorgul OS, Cecen G. Comparison of clinical, ultrasonographic, and postoperative macroscopic findings in cows with bursitis. Vet Radiol & Ultrasound 2005; 46(2): 143-145.
81. Shearer JK, Van Amstel SR, Brodersen BW. Clinical diagnosis of foot and leg lameness in cattle. Vet Clin Food Anim 2012; 28: 535-556.
82. Shepherd MC, Pilsworth RC. The use of ultrasound in the diagnosis of pelvic fractures. Equine Vet Educ 1994; 6(4): 223-227.
83. Siegrist A, Geissbühler U. Radiographic examination of cattle. Tierärztl Prax (G) 2011; 39: 331-340.
84. Smith RKW, Dyson SJ, Head MJ, Butson RJ. Ultrasonography of the equine triceps muscle before and after general anaesthesia and in post anaesthetic myopathy. Equine Vet J 1996; 28(4): 311-319.
85. Stanek C, Kofler J. [On the classification of radiological changes in septic arthritis of the distal interphalangeal joint in cattle: comparison of two scoring systems]. Wien Tierärztl Mschr 1995; 82: 390-396.
86. Starke A, Heppelmann M, Beyerbach M, Rehage J. Septic arthritis of the distal interphalangeal joint in cattle: comparison of digital amputation and joint resection by solar approach. Vet Surg 2007a; 36(4): 350-9.
87. Starke A, Herzog K, Sohrt J, Haist V, Höhling A, Baumgärtner W, Rehage J. Diagnostic procedures and surgical treatment of craniodorsal coxofemoral luxation in calves. Vet Surg 2007b; 36(2): 99-106.
88. Starke A, Heppelmann M, Meyer H, Rehage J. Diagnosis and therapy of septic arthritis in cattle. Cattle Pract 2008; 16(1): 36-43.
89. Steiner S, Gelfert CC, Kofler J. Bestandsproblem Epiphysitis bei Mastbullen – Fallbericht [Herd health problem of epiphysitis in beef cattle – a case report]. Klauentierpraxis 2009; 17 (2): 48-55.
90. Steiner A, Geissbühler U, Stoffel MH, Wegmüller M. Bovine Radiology - Digital Diagnostic Atlas. 1st ed. Bern, 2010; University of Berne, Switzerland.
91. Steiner A. Current concepts and future developments in surgery, anaesthesia and pain management. Proceedings/Keynote Lectures 27th World Buiatrics Congress. Lisbon, 2012; 137-138.
92. Steiner A, Anderson DE, Desrochers A. Diseases of the tendons and tendon sheaths. Vet Clin Food Anim 2014; 30: 157–175.
93. Stokes JE, Leach KA, Main DC, Whay HR. An investigation into the use of infrared thermography (IRT) as a rapid diagnostic tool for foot lesions in dairy cattle. Vet J 2012; 193: 674-648.
94. Taguchi K, Kudo K, Suzuki T, Hyakutake K. Ultrasonographic appearance of bovine coxofemoral luxation in different directions. J Vet Sci Technol 2011; S3:003. doi:10.4172/2157-7579.S3-003 .
95. Toholj B, Cincović M, Stevančević M, Spasojevic J, Ivetić V, Potkonjak A. Evaluation of ultrasonography for measuring solar soft tissue thickness as a predictor of sole ulcer formation in Holstein–Friesian dairy cows. Vet J 2014; 199: 290–294.
96. Tryon KA, Clark CR. Ultrasonographic examination of the distal limb of cattle. Vet Clin North Am Food Anim Pract 1999; 15(2): 275-300.

97. Tsuka T, Ooshita K, Sugiyama A, Osaki T, Okamoto Y, Minami S, Imagawa T. Quantitative evaluation of bone development of the distal phalanx of the cow hind limb using computed tomography. J Dairy Sci 2012; 95(1): 127–38.
98. Tsuka T, Murahata Y, Azuma K, Osaki T, Ito N, Okamoto Y, Imagawa T. Quantitative evaluation of the relationship between dorsal wall length, sole thickness, and rotation of the distal phalanx in the bovine claw using computed tomography. J Dairy Sci 2014; 97(10): 6271-6285.
99. Tucker R. Ultrasound-guided biopsy. In: Nyland TG, Mattoon JS (eds). Veterinary Diagnostic Ultrasound. Philadelphia, WB Saunders; 1998. 649-653.
100. Van Amstel SR, Palin FL, Rohrbach BW, Shearer JK. Ultrasound measurement of sole horn thickness in trimmed claws of dairy cows. J Am Vet Med Assoc 2003; 223(4): 492-494.
101. Verschooten F, Vermeiren D, Devriese, L. Bone infection in the bovine appendicular skeleton: a clinical, radiographic, and experimental study. Vet Radiol & Ultrasound 2000; 41: 250-260.
102. Wenzinger B, Hagen R, Schmid T, Nuss K. Coxofemoral joint radiography in standing cattle. Vet Radiol & Ultrasound 2012; 53(4): 424-429.
103. Wilhelm K, Wilhelm J, Fürll M. Use of thermography to monitor sole haemorrhages and temperature distribution over the claws of dairy cattle. Vet Rec 2015; 176: 146. doi: 10.1136/vr.101547.
104. Willemen M, Dik K. Bipartite distal sesamoid bones in a Holstein-Friesian calf. Vet Rec 1995; 137: 42–43.
105. Wood S, Lin Y, Knowles TG, Main DC. Infrared thermometry for lesion monitoring in cattle lameness. Vet Rec 2015; 176: 308. doi: 10.1136/vr.102571.
106. Zani DD, Romano L, Scandella M, Rondena M, Riccaboni P, Morandi N, Lombardo R, Di Giancamillo M, Belloli AG, Pravettoni D. Spinal epidural abscess in two calves. Vet Surg 2008; 37: 801–808.

<table>
<tr><th>Diagnostic Imaging Technique</th><th>Ultrasonography
Preferred frequency / type of probe</th><th>Radio-graphy</th><th>CT and MRI</th><th>Thermo-graphy (IRT)</th></tr>
<tr><td>Structures of the musculoskeletal system</td><td>Standing animal and lateral recumbency for distal limb structures;
In calves: 5 - 8 MHz linear for all structures of the MS system</td><td rowspan="10">views
LM, CC, O

LM, CC, O, DV</td><td rowspan="10">In adults:
CT and MRI only for distal limbs up to carpus & tarsus;

In calves:
CT and MRI for limbs up to stifle joint and the vertebral column</td><td rowspan="10">for detection of lameness, of various hoof lesions (under research conditions)</td></tr>
<tr><td>Joints</td><td>In adults: 3.5 or 5 MHZ convex for coxofemoral, shoulder joint;
all other joints: 5 - 8 MHz linear</td></tr>
<tr><td>Bone structures</td><td>5 - 8 MHz linear,
5 and 3.5 MHz convex</td></tr>
<tr><td>Pelvic girdle, vertebrae,
ribs, scapula (fractures)</td><td>5 - 8 MHz linear transrectal;
5 - 3.5 MHz convex transcutaneous
5 - 8 MHz linear transcutaneous</td></tr>
<tr><td>Tendons & tendon sheaths</td><td>5 - 8 MHz linear</td></tr>
<tr><td>Bursae</td><td>5 - 8 MHz linear</td></tr>
<tr><td>Muscles</td><td>5 - 8 MHz linear / 3.5 MHz convex</td></tr>
<tr><td>Large limb vessels</td><td>5 - 8 MHz Linear</td></tr>
<tr><td>Thickness of sole horn & digital fat cushions of claws</td><td>5 – 10 MHz linear</td></tr>
<tr><td>Back fat thickness</td><td>5 - 8 MHz linear</td></tr>
</table>

Table 1: Diagnostic imaging techniques recommended for the investigation of the bovine musculoskeletal system (MS); MHz: Megahertz; CT: Computer tomography; MRI: Magnetic resonance imaging; IRT: Infrared thermography; LM: latero-medial; CC: cranio-caudal or dorso-palmar/plantar; DV: dorso-ventral; O: oblique; The table content is based on the following references: *1-3, 8, 12, 23, 24, 35, 43, 44, 48, 52, 54, 70, 72, 78, 83, 86-88.*

Skin	Thin echoic line
Connective tissue	Echogenicity varies from hypoechoic to echoic, depending on the tissue density
Fat tissue	Echogenicity varies from nearly anechoic to hypoechoic
Muscle	Less hypoechoic with characteristic echoic to hyperechoic striations caused by the muscle septa in longitudinal planes; and small irregular, pinpoint, echoic to hyperechoic reflections of the septa in transverse planes
Tendon, ligament	Homogeneous echoic structure of varying size with a distinct, linear and parallel arrangement of the fiber bundles
Bone surface	Smooth hyperechoic reflective band with total acoustic shadowing distally
Growth plate in calves	Cartilaginous growth plates of long bones and the apophyseal growth plates of the olecranon, the greater tubercle of the humerus, calcaneus, tibial tuberosity and trochanter major appear as anechoic interruptions of the hyperechoic bone surface in the longitudinal plane.
Articular cartilage	Thin anechoic layer over the subchondral hyperechoic bone of the joint
Joint space	Narrow interruption of the hyperechoic bone surfaces with funnel-shaped inward-curved contours of the joint forming bones
Joint recess (pouch)	Normally, the joint cavity cannot be imaged; sometimes only very small anechoic zones at the level of the joint space can be identified
Joint capsule	Thin echoic structure lying close to the articular surface in healthy joints
Meniscus	Homogeneous echoic triangular-shaped structure
Vessels	Anechoic tubular or band-shaped structures enveloped by thin echoic lines; arteries show pulsations, veins can be compressed completely

Table 2: Normal ultrasonographic appearance of important structures of the musculoskeletal system; The table content is based on the following references: *4, 5, 19, 32, 33, 41-49, 61, 63-67, 69, 72, 86-88.*

Claw kinematics: Towards a better understanding of lesion development and prevention

Prof. Dr. Christoph Mülling

1 DIGITAL DERMATITIS

1 A Comparison Of Treponema Groups In Cows With Irregular Heel Skin From Digital Dermatitis Endemic And A Digital Dermatitis Free Dairy

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Introduction

Digital dermatitis (DD) remains a major animal welfare and production issue. Studies of the pathogenesis of DD support the hypothesis that DD appears to be a polybacterial disease (1) and Treponemes appear to play a role in pathogenesis (2,3). It is important to study this disease in differing management systems as well as herds that are free of clinical DD (4). Our previous work has identified a dairy free of clinical DD based on comprehensive foot trimming records and lame cow examinations; but several cows have irregular heel skin (5). The objective of this study was to compare Treponema groups recovered from irregular heel skin of animals from dairies endemic for clinical DD and to compare them with those from heel skin of animals from a dairy free of clinical DD.

Materials and Methods

Seven free stall dairies were enrolled in the study: six were endemic for clinical DD whilst one was negative. Heel skin biopsies were collected based on a random sample from ten animals with irregular heel skin from each dairy, except for the negative dairy from which only eight animals with irregular heel skin were selected. Genomic DNA extraction and PCR (2) was performed to identify Treponema present in lesions. All samples from the negative dairy were compared with a representative subset of ten samples from the endemic dairies. The number of biopsy samples that tested positive for each Treponema group were compared between disease status using Fisher's exact test (Stata 14.2, StatCorp, USA). Research was carried out in accordance with good animal care and husbandry practises as defined by the Canadian Council on Animal Care. This project was approved by the University of Saskatchewan Animal Research Ethics Board (Project number: 20140031).

Results

PCR has been performed on all samples with irregular heel skin (n = 8) from the negative dairy and a representative subset of samples from the endemic dairies (n = 10). The number of biopsy samples that tested positive for each Treponema group is detailed below.

	Treponema group		
Clinical disease status	*Denticola/putidum-like*	*Medium/vincentii-like*	*Phagedenis-like*
Endemic (n = 7)	4/10	5/10	9/10
Free (n = 1)	0/8	0/8	5/8
P-value	0.092	0.036	0.28

Discussion

These results indicate that the *Treponema phagedenis-like* group is present in irregular heel skin from cattle in the herd free of clinical disease. All three Treponema groups are present in irregular heel skin from animals in the herds endemic for clinical disease. We consider it likely that differences in the microbiota of heel skin are responsible for the observed difference in disease presentation. These results suggest that Treponema of the phagedenis-like group are insufficient to cause clinical DD and other Treponema groups are required. Our ongoing research is focusing on further characterizing bacterial populations present in the heel skin of dairy cattle from these herds using culture-independent methods.

Acknowledgements
We would like to acknowledge technical support provided by Karen Gesy and Larissa Goldsmith; and support from the foot trimmers and dairy farmers who took part in this study.

References
1. Krull AC, Shearer JK, Gorden PJ, Cooper VL, Philips GJ, Plummer PJ. Deep Sequencing Analysis Reveals Temporal Microbiota Changes Associated with Development of Bovine Digital Dermatitis. Infect Immun 2014 (82): 3359-3373

2. Evans NJ, Brown JM, Demirkan I, Singh P, Getty B, Timofte D, Vink WD, Murray RD, Blowey RW, Birtles RJ, Hart CA, Carter SD. Association of unique, isolated treponemes with bovine digital dermatitis lesions. J Clin Microbiol 2009 (47): 689-696

3. Dopfer D, Anklam K, Mikheil D, Ladell P. Growth curves and morphology of three Treponema subtypes isolated from digital dermatitis in cattle. Vet J 2012 (193): 685-693

4. Klitgaard K, Nielsen MW, Ingerslev H-C, Boye M, Jensen TK. Discovery of Bovine Digital Dermatitis-Associated Treponema spp. in the Dairy Herd Environment by a Targeted Deep-Sequencing Approach. Appl Environ Microbiol 2014 (80): 4427-4432

5. Epp MLS, Luby CD, Jelinski MD, Plummer PJ. A Comparison of Heel-Skin Microbiomes from Dairy Cows with Digital Dermatitis to those from a Disease-Free Herd. In: 10th International Conference on Lameness in Ruminants. Valdivia, Chile 2015; 156

Keywords: Digital Dermatitis, Treponema, Pathogenesis

2 Current Research On Digital Dermatitis: Lessons From The Model

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Introduction

Digital dermatitis is a major cause of lameness, affecting dairy cattle, beef cattle, sheep, goats, and was recently described in a population of wild North American elk. Digital dermatitis is associated with a mixed bacterial infection, including several *Treponema* species. A number of factors are thought to contribute to disease development and progression. In order to study host-bacterial interactions and develop effective therapeutics, a reproducible laboratory model of infection is required. Building on previous success with induction of bovine digital dermatitis lesions in a sheep model, experiments continued in efforts to delineate the model further.

Materials and Methods

Animal experiments were approved by the National Animal Disease Center Animal Care and Use Committee (Protocol 2790). A total of 120 crossbred sheep were used in this study. An area of skin above each heel bulb and below the dewclaws was abraded; feet were wrapped to create a moist, anaerobic environment, similar to that believed to predispose animals to infection. After 3 days, abraded areas were inoculated by exposure to previously frozen macerated lesion material from experimentally induced digital dermatitis in sheep. In order to examine histological and bacterial progression of the lesions, samples were collected at 4 days, 10 days, 14 days and 28 days post-inoculation (PI).

Results

All inoculated hind feet developed lesions indicative of infection. At 4 days PI (n= 12 sheep), 42 % of inoculated feet had mild lesions (failure to heal at/or slight increase in size of the abraded area) and 58% of inoculated feet had moderate lesions (raw or ulcerated areas less that 30% of total pastern area). By 9 days post-inoculation (n=13 sheep), 15% of inoculated feet had mild lesions, 35% moderate lesions and 50% severe lesions (raw or ulcerated areas greater than 30% of total pastern area, more than 25% of heel and/or sole surface eroded, ulceration greater than 1 cm along coronary band). At 14 days post-inoculation (n=15), 3% of inoculated feet had mild lesions, 30% moderate and 67% severe lesions. Histologic changes in dermis and epidermis were consistent with those described for bovine digital dermatitis, including erosion, ulceration, ballooning degeneration of keratinocytes and neutrophil dominated infiltrates. Steiner and Steiner silver stain of lesion biopsies at 4 days post-inoculation confirmed that spirochetes penetrated host tissue. Analysis continues in order to develop associations between microbial community development and histological changes in skin/hoof tissue.

Discussion/Conclusion

Digital dermatitis is an infectious disease that can be reproduced in experimentally inoculated sheep. In comparison to initial studies employing bovine lesion material as inoculum, serial passage within the sheep model appears to have shortened the time required for development of lesions. Studies are ongoing to evaluate alterations to the bacterial consortium or pathogenicity of in vivo passaged organisms. The continued development and refinement of this ovine model of bovine digital dermatitis will allow for novel insights into pathogenic mechanisms of infection.

Keywords: digital dermatitis, sheep, model, experimental disease

3 To Bandage Or Not Bandage: The Curative Effect Of Bandaging Digital Dermatitis Lesions

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Introduction

Digital dermatitis (DD) is an infectious claw disease that causes lameness among cows worldwide. Efforts to eradicate DD have been overly focused on treatment and less so on standardized maintance practices, like bandaging, to enhance the effects of treatment. In an attempt to examine the role of bandaging in the treatment of DD, this study has examined the effect of bandaging on wound size and locomotion among a sample of dairy cows receiving either antibiotic or non-antibiotic treatment.

Materials and Methods

This randomized clinical trial study included (n=162) Holstein Friesian dairy cows, diagnosed with ulcerative DD lesions (M2) upon the first examination (week 0). Cows, ranging from heifers to cows in their 4th lactation, were housed in a stable fitted with cubicles and with concrete flooring.

Treatment and Evaluation

All hoofs were cleaned and trimmed by a professional hoof trimmer or a veterinarian. The M2 lesions of cows in the first part of the study (n=85) were sprayed with CTC, a topical treatment containing chlortetracycline (WdT, Garbsen, Germany). Cows were then randomly assigned into either a non-bandaged (n=41, 48%, Group1) or bandaged group (n=44, 52%, Group 2). A topical non-antibiotic gel, containing activated copper and zinc chelate (Intra Hoof-fit gel [IHF], intra Care b.v), was applied to the M2 lesions of cows in the second part of the study (n=78). Cows were then randomly assigned into either a non-bandaged (n=40, 51%, Group 3) or bandaged group (n=38, 49%, Group 4). The bandaging process was standardized and applied by the same veterinarian for all groups. The process of wound healing was evaluated and scored once weekly (weeks 0, 1, 2, 3, 4) according to a visual inspection scheme described by Döpfer et al., 1997 and Berry et al., 2012. Photographs of lesions were taken and later, under the use of a special software package (Jalomed®), were used to track lesion size across observations. The healthy formed skin (M0) was judged as full recovery. Locomotion was also evaluated and scored weekly according to Sprecher et al., (1997) locomotion scheme.

Results

Table 1.

Groups	Treatment	No. of lesions week 0	No. of healed lesions* until week 4 (%)
Group 1	CTC	41	18 (43.9)
Group 2	CTC + bandaging	44	38 (86.36)
Group 3	IHF	40	12 (30)

Group 4	IHF + bandaging	38	27 (71.1)

* All transitions from painful M2 lesions to M0

CTC Chlortetracycline spray, IHF Intra Hoof-fit gel

A Survival Analysis concluded that healing was significantly higher for bandaged than non-bandaged cows following topical CTC treatment (Z = 4.653, p<0.001, 95% CI: 2.19 to 6.84). Furthermore, bandaged lesions were significantly less likely to transition into M4 lesions, the chronic DD (p<0.001). A Survival Analysis indicated that healing was significantly higher for bandaged than non-bandaged cows following topical non-antibiotic treatment with IHF (Z=3.352, p<0.001, 95% CI: 1.627 to 6.403). Moreover, bandaged lesions were significantly less likely to transition into M4 lesions, the chronic DD (p<0.001). A Wilcoxon Rank Sums Test indicated that bandaging had no effect on locomotion for either cows treated with CTC (W = 13601, p<0.27, CI: -4.58e-05 to 1.77e-05) or IHF (W = 14369, p<0.332, CI: 4.02e-05 to 5.77e-05). However, wound size was significantly larger for cows with locomotion scores between 3 and 5 than for cows with lower scores for both CTC (W = 8621, p<0.019, 95% CI: -2.08 to -0.03) and IHF treatment groups (W = 8051, p<0.001, 95% CI: -2.53 to -0.68).

Discussion

Results suggest that bandaging accelerated the healing of DD lesions, regardless of treatment type. Bandaged lesions were significantly less likely to develop into stage M4, the chronic stage of DD. Thus, our study indicates that covering DD lesions is advantageous to both the wound healing process and the cow's wellbeing.

References

BERRY, S. L., et al. (2012). Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. The Veterinary Journal 193.3: 654-658.

DÖFER, D., TER HUURNE, A. A. H. M., CORNELISSE, J. L., VAN ASTEN; A. J. A. M., KOOPMANS, A., MEIJER, F. A., BOSMA, R. B. (1997). Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Veterinary Record, 140(24), 620-623.

SPRECHER, D. J., HOSTETLER, D. E., & KANEENE, J. B. (1997). A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, 47(6), 1179-1187.

Key words: Digital Dermatitis, Bandaging, Healing process, Intra Hoof-fit gel, chlortetracycline

4 New Ways To Preserve Claw Health – Comparative Study On The Efficacy Of Antibiotics And Antibiotic-Free Treatments For Digital Dermatitis (Mortellaro Disease)

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Inroduction

Digital dermatitis (DD) is an international problem on beef and dairy farms and predominantly caused by Treponema spp. (Cornelisse, van Asten et al. 1997, Wilson-Welder, Alt et al. 2015). This most important infectious claw disease in cattle leads to damaged and infected skin with erosive and painful lesions (Read and Walker 1998). The typical defect is located on the hind legs at the coronary band. Due to the high number of infected animals a lot of drugs are in use. After topical treatment is judged as effective by positive clinical evaluation, many relapses occur throughout the herds, supposedly caused by encysted Treponema in the epidermal layers. To reduce the amount of dispensed drugs it is necessary to find an effective, pain reducing and sustainable treatment without a large pharmacological input into the environment.

Materials and Methods

A total of 100 cows out of 4 commercial dairy farms in Bavaria were included in the study. Every cow was scored at least 6 months prior to the start of the study to group the cows into type 1-3 cows. A modified DD lesion score was used to evaluate the feet. Every cow with an M2-lesion greater than 2 cm in diameter was trimmed on day one and randomly assigned to one of the 5 different treatment groups. The topical treatments include the single usage or combination of chlortetracycline, zinc- and copper chelates, a polyurethane wound dressing and salicylic acid. Every M2-lesion was wrapped after the treatment. The biopsies (ø 6 mm) were taken under local anesthesia and the cows were treated with an NSAID to avoid any additional pain. Punch biopsies and photographs were taken on day 1, day 14 and day 28 from the lesions. By looking at the lesions, the histology of the skin samples and the presence or absence of treponemes in the tissue, the healing process is evaluated. The cows were rechecked during the next regular on farm trimming. The experimental set up was evaluated and accepted by the District Government of Upper Bavaria and the number of approval is NTP-ID: 00007101-1-3.

Results

All 5 different treatments show the potential of a positive clinical outcome of the treated lesions but the success of the treatments deviate obviously between the groups. The histological evaluations present different cell reactions dependent on the treatment. By comparing the treatment groups, it is obvious, that also antibiotic-free treatments have the possibility to improve the stage of disease.

Discussions

Antibiotics seem not to be mandatory for the success of a topical treatment for digital dermatitis. An anti-inflammatory agent as an ingredient of the topical treatment may accelerate the healthy aspect of a cow's skin and it may improve animal welfare on the farms by reducing lameness events. By looking at the different resources necessary for treatment regarding costs for products, labor, the environmental impact and long term efficacy, a cost effective treatment without the risk of antibiotic resistance might be within reach.

References

Cornelisse, J., et al. (1997). "Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacterfaecalis." The veterinary record 140: 620-623.

Read, D. H. and R. L. Walker (1998). "Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings." Journal of Veterinary Diagnostic Investigation 10(1): 67-76.

Wilson-Welder, J. H., et al. (2015). "Digital Dermatitis in Cattle: Current Bacterial and Immunological Findings." Animals 5(4): 1114-1135.

Key words: cattle, digital dermatitis, histology, topical treatment, treponemes

P 1-1 Effectiveness Of Collective Treatments For The Control Of Bovine Digital Dermatitis. Where Is The Evidence?

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Introduction
The collective treatment (CT) of herds affected by digital dermatitis (DD) is commonly advised as a preventive strategy, but CT's are time consuming, expensive and risky practices. Most commercially available chemicals for CTs are supported by anecdotal evidence only in addition to clinical trials. The objective of this critical literature review was to evaluate evidence supporting use of CTs for prevention and treatment of DD in order to design improved high quality DD control trials.

Materials and Methods
The current body of literature about CT and DD prevention and control was screened using criteria for systematic reviews The current project resulted in a so-called 'critical review'. The clinical review question was: "Are collective treatments for dairy cows more effective at preventing and treating clinical lesions of DD compared to placebo or no preventive measures?". According to the preventive and treatment outcomes of the collected references, case and success definitions were identified for each study and summarized in numbers needed to treat (NNT). The NNT represent expected number of animals to be treated to observe one additional positive outcome, or to prevent one less negative outcome within a given time frame compared to controls. Evaluation of risk of bias, as well as factors affecting the quality of evidence was performed.

Results
Using search keywords, a total of 282 references were identified from literature as relevant to the clinical question. After the screening process, 9 references reporting 35 comparison groups were selected to be suitable for inclusion. Absence of negative controls and missing information were the main reasons for exclusion of abstracts from the review and metanalysis of evidence for effects of CT. Most of the studies were at low and unclear risk of bias. Heterogeneity between studies was suspected and small sample sizes of trials suggested imprecision bias. Overall quality of evidence, for both outcomes (prevention and treatment), was therefore found to be low. Most of CT regimens were applied under ideal conditions hard to extrapolate to field conditions. Among CTs assessed, only one of 16 preventive interventions was different (P<0.05) from the control: water in footbaths used for twice per day (NNT=2, 95%CI 1 to 30). Among treatment outcomes, 5 treatments out of 19 comparisons were found different (P<0.05) from control, i.e. (i) oxytetracycline in spray (NNT=2, 95%CI 1 to 18), (ii) soluble copper and other spray compounds (NNT=2, 95%CI 1 to 4), (iii) acidified ionized copper at 0,6% in footbaths (NNT=3, 95%CI 2 to 17), (iv) copper sulphate at 5% in footbaths (NNT=4, 95%CI 2 to 14), and (v) 50% copper and zinc chelate sprays (NNT=9, 95%CI 5 to 144).

Discussion
This critical review revealed insufficient published evidence to decide whether CT results in improved prevention of DD lesions in dairy cattle. Results supporting healing properties of CTs are present in the literature. However, the evidence remains insufficient in regard of its scientific quality. These findings highlight the importance of developing high quality controlled CT trials, that must include negative controls, to evaluate the effectiveness of CT for DD prevention and control.

Keywords: bovine digital dermatitis, collective treatment, meta-analysis, systematic review.

P 1-2 Quantification Of Vanilloid Receptor TRPV1 In Bovine Digital Dermatitis

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Introduction

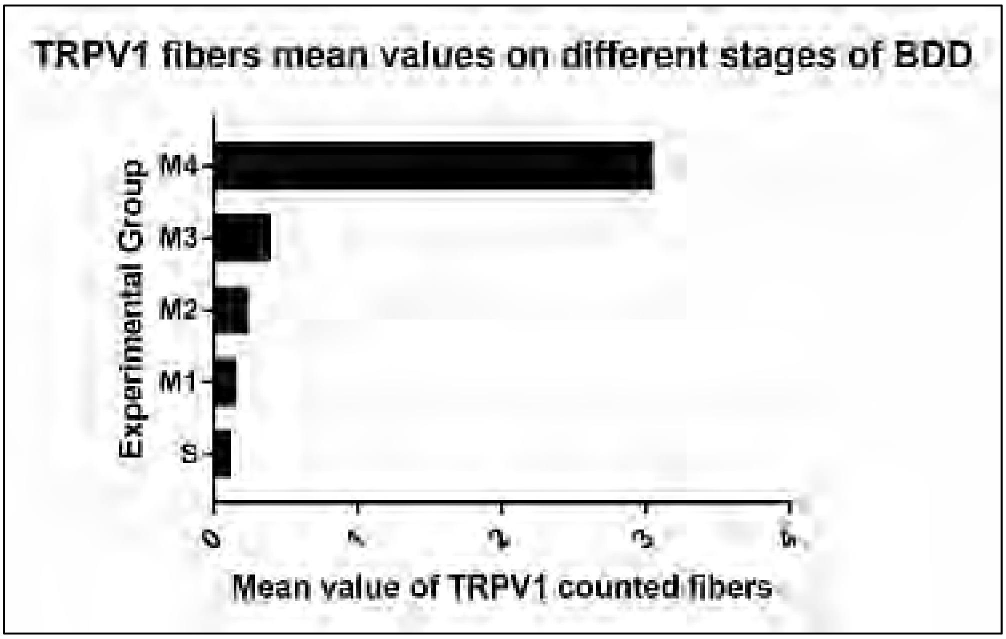
The Bovine Digital Dermatitis was described first in 1974, by Cheli and Mortellaro. The authors describe the disease as high claudication levels disease, causing milk and weight loss. The severe pain on the animal foot, and possible chronic stage characterize the BDD with a hyperalgesia clinical symptoms. Study in humans, mice and dogs, prove that in chronic painful disease, the new arrangement of some ionic channels in front of structural changes, can increase this way of pain transmission and modulating. These channels are expressed in fibers, most precisely the transient receptor potential vanilloid type 1, that are used in this study, is a thermo and pH active receptor, causing severe pain perception. The hypothesis is that BDD hyperalgesia could be caused by the TRPV1 improvement.

Methods

The study was approved by the Research Ethics Committee of São Paulo State University (UNESP), School of Agricultural and Veterinarian Sciences, protocol number: 20067/15. In this experiment was used 15 Holstein cows, mean age of 4.4 year, with all stages of BDD. Biopsies was taken after lesions identification and them, divided in 4 disease groups, according to the BDD stage (M1, M2, M3 and M4) and one healthy group (S), all with 5 samples each one. The samples were proceeded to a laboratory and the Immunohistochemistry was performed, using mouse anti-TRPV1 antibody (Chemicon – USA) and the fibers count realized in optic microscopic. Data were submitted to normality and homogeneity test and the results were compared between groups using the logarithmic scale, post-hoc Bartlett test ($p<0.001$).

Results

According to the statistic comparison between the 5 groups ($p<0,001$), only difference between M4 (chronic stage) and all other groups was funded. A column graphic with mean fibers count in each BDD stage (M1, M2, M3 and M4) and healthy samples (S) (Figure 1), show an increase on TRPV1 fibers during the disease course, mainly between the M3 and M4 stage.



Discussion

In human chronic diseases as describe EHNIS-PÉREZ et al. (2016), some kinds of dermatitis have a TRPV1 increased when compared with normal skin and a correlated hyperalgesia was described to. In animal science, the pain perception is based on nociceptive reactions, by the way, the human pain perception results correlated with TRPV1 increase, could be used to predict a similar reaction in animals. The majority study of BDD describe the disease like a very painful lesion, as the DÖPFER et al. (1997) related. In study using dogs with arthritis and some debilitation neoplasia, KARAI et al. (2004) related a high presence of TRPV1 with the hyperalgesia, giving support to our study. The significate difference between the chronic stage (M4) of BDD and high claudication level when compare with other species diseases, could be caused by TRPV1 fibers expression increase. This discovery is an improvement on BDD pathogenesis and a hole in a possible pain control alternative.

Acknowledgements

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Key words: hyperalgesia, ionic channel, Mortellaro, pain, thermoreceptor

References

Bennett DL and Woods CG 2014 Painful and painless channelopathies. *Lancet Neurology*, 13:587–599.

Caterina MJ, Schumacher MA, Tominaga M, Rosen TA, Levine JD, Julius D 1997 The capsaicin receptor: a heat-activated ion channel in the pain pathway. *Nature*, 389:816-824.

Dopfer D, Koopmans A, Meijer, FA, Szakáll I, Schukken YH, Klee W, Bosman RB, Cornelisse JL, Van-Asten AJ 1997   Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. *Veterinary Record*, 140(24): 620-623.

Ehnis-Pérez A, Torres-Álvarez B, Cortés-García D, Hernández-Blanco D, Fuentes-Ahumada C, Castanedo-Cázares JP 2016 Relationship between transient receptor potential vanilloid-1 expression and the intensity of sensitive skin symptoms. *Journal of Cosmetic Dermatology*, 15: 231–237.

Karai L, Brown DC, Mannes AJ, Connelly ST, Brown J, Gandal M, Wellisch OM, Neubert JK, Olah Z, Iadarola MJ 2004 Deletion of vanilloid receptor 1-expressing primary afferent neurons for pain control. *Journal of Clinical Investigation*, 113(9): 1344-1352.

P 1-3 Prospective Randomized Clinical Trial Comparing Therapeutic Interventions for Complete Healing of Advanced Bovine Digital Dermatitis Lesions in Dairy Cows

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Introduction

Digital dermatitis is among the most common causes of lameness in dairy cattle, and is therefore of great significance to the cattle industry (USDA 2009). While Treponema spp are the earliest proposed etiologic agent (Read & Walker 1994, Walker, et al. 1995), subsequent studies address the association of DD lesions with a number of bacterial agents, response of lesions to antibiotics, ineffective single agent vaccines, and metagenomics analysis, which together indicate a polymicrobial disease process (Brandt, et al. 2011, Krull, et al. 2014, Laven & Logue 2006, Logue, et al. 2005, Trott, et al. 2003). While a single treatment with topical oxytetracycline results in some level of improvement of lesion score in most animals, it rarely results in complete healing (Krull, et al. 2016). This study seeks to determine whether three applications of topical therapy result in a higher clinical resolution rate than a single treatment.

Materials and Methods

Cows with active DD lesions (ISU stage 3 or 4) were enrolled and randomized to one of two treatment groups. One group received a single topical application of oxytetracycline powder applied to the lesion followed by a light wrap. The other received three sequential topical applications at approximately 1-week intervals. Cattle were identified during routine foot trimming procedures and were excluded from the study if they received any additional antibiotic therapy beyond the topical oxytetracycline. Digital photographs, locomotion score and algometer score (pain threshold at lesion site) were recorded at enrollment, 7, 14, 30, 60, and 120 days post enrollment. Biopsies were collected for metagenomics analysis at enrollment and days 14, 30, and 120 post enrollment. The study was approved by Iowa State University's Institutional Animal Care and Use Committee (IACUC Log # 12-14-7912-B).

Results

Analysis of the existent data indicates that, while both single and triple treatments eliminate significant lameness attributed to DD, there is no significant difference between lesion scores in the two treatment groups on either day 60 or day 120 post-enrollment. Likewise, there is no significant difference between pressure algometer scores in the two treatment groups on day 120 post-enrollment. Analysis of metagenomic data suggests that it is possible to predict treatment success with topical oxytetracycline with an 80% accuracy using metagenomic evaluation. The majority of lesions did not heal completely during the study period, and those that appeared healed (or nearly healed) at 60 days generally redeveloped by 120 days. More cases are being enrolled to supplement the existent data.

Discussion

Results indicate that neither a single treatment, nor three consecutive treatments appear to offer consistent, long-term resolution of advanced digital dermatitis lesions. It is apparent in nearly all cases that a scab forms shortly after treatment, suggesting that the lesion is in the process of resolving; however, in most cases, the lesion remains present (and in many cases, progresses) long after the scab is gone. The potential for metagenomic evaluation of treatment efficacy warrants further study.

Acknowledgements

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References

Brandt S, Apprich V, Hackl V, Tober R, Danzer M, Kainzbauer C, Gabriel C, Stanek C, and Kofler J 2011 Prevalence of bovine papillomavirus and Treponema DNA in bovine digital dermatitis lesions. *Veterinary Microbiology* 148: 161-167.

Krull AC, Shearer JK, Gorden PJ, Cooper VL, Phillips GJ, and Plummer PJ 2014 Deep sequencing analysis reveals temporal microbiota changes associated with development of bovine digital dermatitis. *Infect Immun* 82: 3359-3373.

Krull AC, Shearer JK, Gorden PJ, Scott HM, and Plummer PJ 2016 Digital dermatitis: Natural lesion progression and regression in Holstein dairy cattle over 3 years. *Journal of Dairy Science*.

Laven RA, and Logue DN 2006 Treatment strategies for digital dermatitis for the UK. *The Veterinary Journal* 171: 79-88.

Logue DN, Offer JE, Laven RA, and Ellis WA 2005 Digital dermatitis – The aetiological soup. *The Veterinary Journal* 170: 12-13.

Read D, and Walker R Papillomatous digital dermatitis and associated lesions of dairy cattle in California: pathologic findings. *Proceedings of the* Proceedings of the 8'"International Symposium on Disorders of the Ruminant Digit, Banff, Canada pp 156-158.

Trott DJ, Moeller MR, Zuerner RL, Goff JP, Waters WR, Alt DP, Walker RL, and Wannemuehler MJ 2003 Characterization of Treponema phagedenis-like spirochetes isolated from papillomatous digital dermatitis lesions in dairy cattle. *Journal of Clinical Microbiology* 41: 2522-2529.

USDA 2009 Dairy 2007, Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, In: USDA:APHIS:VS C (ed), Fort Collins, CO

Walker R, Read D, Loretz K, and Nordhausen R 1995 Spirochetes isolated from dairy cattle with papillomatous digital dermatitis and interdigital dermatitis. *Veterinary Microbiology* 47: 343-355.

Keywords: bovine digital dermatitis, topical treatment, treponemes

P 1-5 Comparison Of Topical Thiamphenicol Vs. Oxytetracycline Treatment On Cure Of Digital Dermatitis In Dairy Cattle

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Introduction

Digital dermatitis (DD) is considered an important cause of infectious lameness (Manske et al., 2002) and therewith serious economic consequences and impact on animal welfare. DD lesions typically develop on the plantar skin of the hind feet, whereby 5 stages of DD can be distinguished, M0 – M4. The ulcerative M2 stage tends to be very painful and is the most infectious stage (Dopfer et al., 1997). The objective of this study was to evaluate the therapeutic effect (cure rate) of a new antibiotic treatment with thiamphenicol (TAF) as active substance in comparison with oxytetracyclin (ENG) on painful M2 DD lesions.

Material and Methods

The efficacy of 2 topically treatments of painful ulcerative stage DD lesions was compared in a case-control study on 5 dairy farms during the autumn of 2015. A total of 109 cows with an ulcerative (M2) stage of DD were randomly appointed to a treatment according manufacturer prescription (without bandages) with an antibiotic based spray for 3 consecutive days, containing TAF or ENG as active ingredient. The experimental unit for this study was the hind claw with an ulcerative DD lesion. At D0, claws were trimmed, cleaned, photographed and thereafter treated randomly either with TAF or ENG. Cure was defined as the transition of an ulcerative lesion into a chronic (M4) or into a healed (M0) stage at D28. A Fisher exact test was used to compare the cure rate of TAF with ENG both for each herd separately and for comparing the overall crude Risk Rate (RR). The overall RR was finally corrected for the effect of herds, by applying the Mantel-Haenszel test.

Results

The cure rate at D28 lesions treated with TAF was 89% (95% CI: 0.78 to 0.94), and for ENG 75% (95% CI: 0.67 to 0.86), which was a difference in cure rate of 14% (P= 0.04; 95% CI: 0.00 to 0.27), so TAF had a significant better curative effect on DD M2 lesions, compared with ENG.

Discussion

Data presented in this study indicated a cure rate of TAF at D28 after the start of treatment of 89%, which is better compared to the cure rates of antibiotic treatments in other studies. In other recent studies, investigators tested non-antibiotic products like copper and zinc-chelate (Holzhauer et al., 2012) and salicyl-acid (Fiedler et al., 2015; Kopfler et al., 2015). Results of these studies were more in line with our results, in the 2012 Dutch study cure rates of 92% were scored at D28 and in the Austrian study 76% pain-free at D21, However, cure rates are influenced by different other factors also (e.g. production level of cows, cleanliness of floors, ratio number of cows/cubicles, correct size of the cubicles) and therefore it is important to have a control group within the same herd.

References

Döpfer D, Koopmans A, Meijer FA, Szakáll I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten AJ, ter Huurne AA. 1997. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Vet Rec. 140: 620-3.

Fiedler A, Sauter-Louis C, Maierl J. 2015. Polyurethane dressing, tetracycline and salicylic acid use for treatment of digital dermatitis in cattle. A comparative study. Tierarztl Prax Ausg G Grosstiere Nutztiere. 43: 350-8.

Holzhauer M, Brummelman B, Frankena K, Lam TJ. 2012. A longitudinal study into the effect of grazing on claw disorders in female calves and young dairy cows. Vet J. 193: 633-8

Kofler J, Innerebner C, Pesenhofer R, Hangl A, Tichy A. 2015. Effectiveness of salicylic acid paste for treatment of digital dermatitis in dairy cows compared with tetracycline spray and hydrotherapy. Berl Munch Tierarztl Wochenschr. 128: 326-34.

Manske T, Hultgren J, Bergsten C. 2002. Prevalence and interrelationships of hoof lesions and lameness in Swedish dairy cows. Prev Vet Med.54: 247-63.

P 1-6 Evaluation Of The Prevalence Of Digital Dermatitis In Beef Feedlot Cattle Under Organic Trace Mineral Supplementation

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Introduction

Lameness in production animals is a major animal welfare issue as it is a sign of pain and it inhibits the animal's ability to behave naturally (Larson, et al. 2014). Digital dermatitis (DD) is a disease of great significance because the disease can lead to lameness (Evans, et al. 2016). Lameness and the pain associated with DD in beef cattle need to be addressed and evaluated as they represent an underestimated animal welfare issue and they are likely contributing to economic losses. This project explored the role of an organic trace mineral (OTM) supplementation program containing increased amounts of zinc and iodine for the reduction of DD and associated symptoms in feedlot cattle. The impact of DD on feedlot cattle at the live animal and carcass level are evaluated by analyzing production, carcass, and health data.

Methods

A longitudinal field trial was conducted to compare prevalence and effects of DD in steers given a diet supplemented with OTMs (TX group) or a diet supplemented with trace minerals from inorganic sources (CON group). A total of 1077 steers from a commercial feedlot in the Upper Midwest of USA were enrolled in the study. Multiple observations of DD lesions in individual steers were evaluated and classified according to M-stages (Dopfer, et al. 1997) for 4 months. Steers were assigned to one of two treatment groups: pens in barn B were assigned to the OTM group and pens in barn A were assigned to the CON group. Study phase 'before' completion of 60 days on the different diets and 'after' 60 days on the different diets were defined. Data were analyzed using multiple variable logistic and linear regressions. All steers were followed to slaughter and individual carcass information was obtained. Animal use was approved by the University of Wisconsin Animal Care and Use Committee protocol V01525.

Results

Overall, the relative risk of seeing an increase in steers with DD lesions after being on the respective diets for 60 days compared to before was significantly higher in the CON group compared to the TX group. The final regression models highlighted an interaction between time and supplement group in which the TX group after 60 days on supplementation had significantly less increase in steers with DD lesions compared to the CON group during the after period. Production parameters of average daily gain, hot carcass weight, and final live weight were all negatively impacted when steers were observed to have M2 lesions compared to steers with no M2 lesions over the study period.

Discussion

This study analyzes data from a field trial with interventions targeted at reducing DD. The results of this study show promise regarding the prevention of DD by supplementing the finishing diet of beef cattle with an OTM. Overall, negative impacts on production could amount to large economic losses and can occur even if the animal only suffers from one active M2 lesion during the finishing period. Increased education about DD for those involved in the care of feedlot cattle is warranted.

Acknowledgements

Thanks to the Zinpro Corporation for their generous funding support. Also thanks to the owner and personnel of the study feedlot for all their assistance and cooperation with the trial.

References

Dopfer D, Koopmans A, Meijer FA, Szakall I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, vanAsten A, and terHuurne A 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. *Veterinary Record* 140: 620-623.

Evans NJ, Murray RD, and Carter SD 2016 Bovine digital dermatitis: Current concepts from laboratory to farm. *Vet J* 211: 3-13.

Larson C, Tomlinson D, Branine M, Mulling C, Dopfer D, and Edwards T 2014 *Cattle Lameness: Identification, prevention and control of claw lesions*. Zinpro Corporation

Keywords: Digital dermatitis, Beef cattle, Feedlot, Organic trace minerals

P 1-7 A Field Study On The Treatment Of Non-Healing White Line Disease With A Topical Spray Containing Chelated Copper And Zinc

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Introduction

White line disease (WLD) in dairy cattle is characterized by separation of the outer claw wall. The disease typically starts with physical damage of the horn, followed by infection of the underlying corium by opportunistic bacteria. When a WLD lesion becomes infected with pathogenic bacteria, e.g. treponemes that are associated with bovine digital dermatitis (BDD), the lesion may transform into a non-healing (nhWLD) variant (2). (nh)WLD causes serious lameness, resulting in reduced animal welfare and less milk production. Standard treatment of WLD consists of proper hoof trimming in combination with application of a block on the partner claw to relief pressure. For nhWLD, this approach appears to be insufficient. It has been demonstrated that BDD can be treated effectively with a non-antibiotic gel or aerosol spray containing chelated copper and zinc (1, 3). The goal of this practical field study was to evaluate the potential curative effects of this spray on cases of nhWLD.

Materials and Methods

On a 266 dairy cow farm, animals were selected that had received standard treatment for WLD 46 – 21 days before the start of the field study. Hoofs were inspected and lesions were scored as 0 (closed), 1 (small), 2 (moderate), and 3 (severe). All cases of nhWLD were randomly divided in standard hoof trimming including a block (standard treatment, n=9), or standard treatment in combination with a topical spray containing chelated copper and zinc (Intra Repiderma, spray treatment, n=9). On day 3 and 7, all hoofs were inspected again, lesion severity was scored, and, if necessary, the spray was applied again.

Results

On day 3, the average score after standard treatment had improved 0.2 points (from 2.3 to 2.1), the score after spray treatment had improved 0.5 points (form 2.6 to 2.1) (Table 1). On day 7, the improvement was 1.1 points for standard treatment (from 2.3 to 1.2) and 1.3 points for spray treatment (from 2.6 to 1.3), respectively. In the spray-treated group, one severe lesion (score 3) had even changed into completely healed horn (score 0) within 7 days. Such dramatic change was not observed in the standard treated group.

Table 1. Average nhWLD score on the days of inspection.

	Standard treatment (n=9)	Spray treatment (n=9)
Day 0	2.3 (1 – 3)	2.6 (2 – 3)
Day 3	2.1 (0 – 3)	2.1 (1 – 3)
Day 7	1.2 (0 – 3)	1.3 (0 – 3)
Improvement	1.1 (0 – 2)	1.3 (0 – 3)

Discussion and conclusion

Proper hoof trimming and pressure relief by application of a block appears in practice to be insufficient for the permanent treatment of nhWLD. Therefore, it has been hypothesized that treatment requires the additional application of a spray containing chelated copper to eliminate pathogenic bacteria, and chelated zinc to stimulate healing of the corium. Seven days after treatment, the average lesion scores improved, one spray-treated lesion even changed from severe into completely closed. Study follow-up will further evaluate the long-term effects of the treatments.

Acknowledgements

We would like to thank the dairy farm family for their assistance and hospitality.

References

1. Dotinga A, et al. A randomised clinical trial on the effect of antibiotic or non-antibiotic topical treatment of digital dermatitis in dairy cattle. In: 10th International Conference on Lameness in Ruminants. Valdivia, Chile 2015; 74.

2. Evans NJ, et al. Association between bovine digital dermatitis treponemes and a range of 'non-healing' bovine hoof disorders. Vet Rec 2011; 168 (8): 214.

3. Holzhauer M, et al. Curative effect of topical treatment of digital dermatitis with a gel containing activated copper and zinc chelate. Vet Rec. 2011; 169 (21): 555.

Keywords: Non-healing white line disease, non-antibiotic, copper, zinc

P 1-8 Monitoring Farm And Cow Level Prevalence Of Bovine Digital Dermatitis In New Zealand

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Introduction

Bovine digital dermatitis (BDD) has been found all over the world, particularly in countries with developed dairy industries (1). Nevertheless, it has not been seen as a significant problem on dairy farms in NZ (2). Concerns about BDD on pasture-based farms in Chile led to the development of a pilot study in Taranaki, a region on the west coast of the North Island (NI) of New Zealand. In that study (BDD) was found in 64% of 224 herds (2). These findings prompted the development of a country-wide project to identify the prevalence of BDD across New Zealand. This paper describes the initial findings of that study.

Materials and Methods

Four regions across New Zealand were chosen - Waikato and Manawatu in the NI and West Coast and Canterbury in the South Island (SI). These regions, alongside Taranaki, encompass most of the dairying systems used in New Zealand. The initial phase of data collection started in the Waikato and moved south following the seasonal pattern of calving to ensure that the great majority of the herd were milking at the farm visit. Visual inspection of the hind feet of all cattle in the milking herd was performed during milking. During the inspection, cows' rear feet were hosed carefully, after which a hand torch was used to observe the feet. Only the rear feet of cattle were inspected as lesions are very rarely seen on front feet only (4). In this initial phase, two farms were inspected per day.

Results

The results for the initial phase are summarised in Table 1 alongside the data from the Taranaki pilot study. No BDD was found on the West Coast on any farm; however the disease was present in the other regions. In two of these regions the proportion of infected farms was similar to that seen in Taranaki but in the Manawatu the proportion of infected farms was much lower, nevertheless the proportion of affected cows on infected farms was similar across the three regions to that seen in Taranaki.

Parameter	Taranaki	Waikato	Canterbury	West Coast	Manawatu
No. farms inspected	224	21	19	18	14
No. farms with BDD (%)	143 (64)	18 (86)	14 (74)	0 (0)	3 (21)
No. cows inspected	60455	7700	15803	7343	4742
No. of cows with BDD	707	121	337	0	23
Cow level % (all cows)	1.2	1.6	2.1	0	0.5
Cow level % (infected farms only)	1.7	1.7	2.9	N/A	1.3
Average herd size	270	367	832	408	339

Table 1: Farm and cow-level prevalence of BDD in 5 regions of New Zealand

Conclusions

The preliminary results suggest that there are significant regional differences across New Zealand in the proportion of farms with BDD; however these differences were not reflected in the proportion of cattle with lesions on BDD-positive farms is similar. The second phase of the study will focus on confirming these differences and identifying the underlying reasons for these regional differences, as well as the differences between risk factors for BDD at the herd level and at the cow level.

Acknowledgements
Thanks to the veterinarians and technical staff in the four regions of the study for their help with finding the farms and arranging the visits. Thanks also to the farmers and farm staff for their assistance with the survey.

References
Palmer, M.A., O'Connell, N.E. *Digital dermatitis in dairy cows: A review of risk factors and potential sources of between-animal variation in susceptibility*. Animals. 2015; 5(3); 512-535

Yang D, Heuer C, Laven R, Vink D, Chesterton RN. *Prevalence of bovine digital dermatitis of dairy cattle in New Zealand: a survey of farms in the North Taranaki region.* Proceedings of 18th International Symposium and 10th Conference on Lameness in Ruminants. 2015; 71

P 1-9 Antimicrobial Photodynamic Therapy For Digital Dermatitis

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Introduction

Digital dermatitis (DD) is one of the most common problems in dairy herds worldwide, has a high impact on animal welfare and causes economic losses (1). Topical oxytetracycline is one of the most effective treatments of DD, however, the use of antibiotics favors an increased risk of residues in animal products, environmental contamination and selection of resistant microorganisms. Antimicrobial photodynamic therapy (APDT) has been investigated in different areas of health sciences (2) and veterinary medicine (3, 4), and has shown great potential for inactivating different pathogens (2,5). The APDT combines a harmless photosensitizer (PS), i.e., a light-sensitive substance, with visible light at proper wavelength (λ), and molecular oxygen. The combination produces the stimulation of the PS, resulting in the formation of reactive oxygen species (ROS), which in turn damage subcellular structures that are fundamental to the survival of microorganisms, and without known microbial resistance. The purpose of this study was to determine whether treating DD with APDT could be functional and effective, compared to topical oxytetracycline.

Materials and Methods

The procedures were performed in accordance with the ethical standards and animal care utilization (protocol 3633030214). Twenty acute and chronic previously non treated DD lesions from Holstein cows were randomly selected and divided in two groups: G1 - 10 lesions treated with topical oxytetracycline (500mg; Tetrabac® 20%; Bayer), and G2 - 10 lesions treated by APDT with topical methylene blue (300µM) as a PS, followed by irradiation with a portable red LED cluster (Vet Light® DMC; 350mW/LED; λ = 660nm ± 10nm; irradiance point, 120mW/cm^2; total area, 13,20 cm^2) after 5 min of incubation, to allow MB uptake by the cells. All treatments were repeated after 14 days and covered solely with bandages. Pictures were taken with a digital camera on days 1 (day of the first treatment), 7, 14, 21, and 28. The lesions were M-classified (6) and the recovery was evaluated by the Image J software (7). Comparisons were made using Proc Mixed post hoc Bonferroni test and significance was assessed when $p<0.05$.

Results and Discussion

The lesions at day 1 were: 30% M2 (G1=20%; G2=40%), 40% M3 (G1=50%, G2= 30%), 30% M4 (G1=30%; G2=30%). The lesions presented progressive recovery after the treatments, there were no difference between the groups ($p=0.628$) and all treated animals responded to the proposed protocols at day 28, exhibiting complete healing of the lesions, despite their stages at day 1 (Table 1). However APDT offers the additional advantage of avoiding any risk of milk antibiotic residues, and the lack of selection of microbial strains. Time has influenced the recovery ($p<0.001$), being significant between days 1 and 7 ($p=0.002$), and days 14 and 21 ($p=0.03$), indifferent to the treatments applied and the lesion stage. The APDT was easily performed in farms with a portable device, confirming its feasibility and its efficacy. To our knowledge, this study is the first to evaluate the effect of APDT in the treatment of DD.

Table 1 – Area of the lesions and recovery according to the treatment (mean ± standard deviation)

Days	Area (cm²)		Mean (cm²)
	Oxytetracycline (G1)	APDT (G2)	
1	3.86 ± 2.7	3.06 ± 1.78	3.46 ± 2.3
7	1.99 ± 2.14	1.34 ± 1.65	1.66 ± 1.2
14	0.65 ± 0.89	1.11 ± 1.04	0.88 ± 0.9
21	0.33 ± 0.71	0.32 ± 0.58	0.32 ± 0.6
28	0	0	0
Mean	**1.36 ± 2.12**	**1.16 ± 1.58**	**1.26 ± 1.8**

Time <0.001; Treatment = 0.628; Time*treatment = 0.426

References

1. Evans NJ, Murray RD, Carter, SD. Bovine digital dermatitis: Current concepts from laboratory to farm. The Veterinary Journal 2016 (211): 3-13.

2. Hamblin, MR, Hasan, T. Photodynamic therapy: a new antimicrobial approach to infectious disease? Photochemical & Photobiological Sciences 2004 (3): 436–450.

3. Wardlaw, JL, Sullivan, TJ , Lux, CN, Austin FW. Photodynamic therapy against common bacteria causing wound and skin infections. Veterinary Journal 2012 (192): 374–377.

4. Sellera FP, Gargano RG, Della Libera AMMP, Benesi FJ, Azedo MR, Sá LRM, Ribeiro, MS Baptista, Pogliani FC. Antimicrobial photodynamic therapy for caseous lymphadenitis abscesses in sheep: Report of ten cases. Photodiagnosis and Photodynamic Therapy 2016 (13): 120–122.

5. Sellera FP, Sabino CP, Ribeiro MS, Gargano RG, Benites NR, Melville PA, Pogliani FC. In vitro photoinactivation of bovine mastitis related pathogens. Photodiagnosis and Photodynamic Therapy 2016 (13): 276–281.

6. Döpfer D, Koopmans A, Meijer FA, Szakáll I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, Van Asten AJ, Ter Huurne AA. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. The Veterinary Record 1997 (40):620-623.

7. http://rsbweb.nih.gov/ij/download.html

Keywords: Digital dermatitis, Oxytetracycline, Antimicrobial photodynamic therapy

P 1-10 Comparison Of Treatment Of Digital Dermatitis With Two Antibiotic And Two Non-Antibiotic Products

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Introduction

There are several treatment strategies to control digital dermatitis used in German dairy farms.

Material and Methods

The efficacy of two antibiotic sprays, containing Chlortetracyclinhydrochloride (CTC) and Thiamphenicol (TAM), a Salicylic Acid containing paste (SA, Novaderma®) and a Polyurethane Adhesive (PA, MortellaHeal®) were tested in a field trial. 143 affected feet of 112 dairy cows with different stages of the Mortellaro Disease were randomly treated in 3 commercial dairy farms. CTC and TAM were sprayed twice each, the second application was performed 30 seconds after the first time. A bandage was not used. Novaderma® was applied under bandage for 5 days, the MortellaHeal® adhesive for 14 days. 14 days after the treatment all claws were examined.

Results

All over the groups the diameter of lesions decreased (CTC -0,74 cm[a], TAM -2,47 cm[bc], SA -2,14 cm[bc], PA -1,80 cm[b]). Also, changes of the M-stages were documented before the treatment and on day 15. Changes to M0 and M3 were interpreted as “improved” (CTC 50 %, TAM 89%, SA 78 %, PA 68%), changes to M2 or M4 stages as “worsened” (CTC 12 %, TAM 0%, SA 8%, PA 8 %). At stage M1 we saw the efficacy of the SA and the TAM treatment (85% vs. 80% “improved”), at stage M2 TAM and SA induced the best results (95% vs 93%). The Polyurethane Adhesive and TAM were the most effective therapies for the small amount of M4 lesions (63% vs 80%).

Conclusion

The use of Thiamphenicol, Salicylic Acid and Polyurethane Adhesives are effective treatment alternatives compared to Chlortetracyline. While the differences between all treatments at stage M1 were not significant, at stage M2 CTC spray was significantly less effective than TAM,.salicilic acid and the polyurethane adhesives.

References

Döpfer D, Koopmans A, Meijer FA, Szakáll, ISchukken Y H, Klee W, Bosma R B, Cornelisse J L, vanAsten AJAM & ter Huurne AAHM; Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis; Veterinary Record 140; 1997; 620-623

Fiedler A; Sauter-Louis C; Maierl J.; Polyurethane dressing, tetracycline and salicylic acid use for treatment of digital dermatitis in cattle; Tierärztliche Praxis Großtiere, 6/2015; 2015; 350-358

Schulz N, Capion N; Comparison of the effect of salicylic acid and tetracycline for treatment of digital dermatitis; Proc. 17th Int. Symp. & 9th Conf. on Lameness in Ruminants, Bristol, Großbritannien; 2013; 205

Key Words: claw, treatment digital dermatitis, tetracycline, salicylic acid, polyurethane, thiamphenicol

P 1-11 Modelling The Temporal Pattern Of Bovine Digital Dermatitis In Taranaki, New Zealand Using A Semi-Parametric Approach

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Introduction

As part of a longitudinal study of BDD in Taranaki, NZ, prevalence and /incidence data were collected at five periods throughout lactation (see Yang et al for details). However, simply comparing the prevalence and incidence at those five timepoints did not produce a clear overview of seasonality of BDD. We therefore used a semi-parametric approach using time as a continuous rather than a categorical variable to model the temporal pattern of BDD in the pasture-based dairy system of NZ after accounting for variability of farm management.

Materials and Methods

The number of BDD counts in i^{th} farm at j^{th} time, was defined from a finite mixture that included 0 with a parameter $1-\pi_{ij}$ (probability of a farm being negative) and a truncated Poisson distribution with a parameter λ_{ij} (mean counts in a positive farm). z_{ij} and x_{ij} were used to denote the predictor vectors (from the farm management factors) associated with farm level infection and BDD counts in positive farms. For the model we then have $\text{logit}(\pi_{ij})=\alpha^*z_{ij}+\mu_i+g(t_{ij})$ and $\log(\lambda_{ij})=\beta^*x_{ij}+\nu_i+f(t_{ij})$, where α and β are the vectors of regression coefficients for z_{ij} and x_{ij}, respectively; and μ_i and ν_i are two correlated random effects following bivariate normal distribution (1). The baseline non-linear time effects g(t) and f(t) were modelled by piecewise quadratic polynomials with degree two B-splines (2).

Results

Farm level prevalence had two peaks - one in late spring and the other in autumn. The average within-farm prevalence started at a relatively high level and then decreased, but was followed by further peaks in late spring and late summer (see Fig 1). No management practices were found to be associated with farm level infection. In contrast, for BDD prevalence within positive farms, more BDD was detected in a rotary shed (RR: 1.71, 95%CI: 0.95-3.09); hoof trimming by external staff significantly increased the prevalence (RR: 1.81, 95%CI: 1.02-3.21); young stock movement showed a protective effect (RR: 0.49, 95%CI: 0.28-0.84), and more BDD cases were found in smaller herds (RR for one SD decrease [137 cows] =: 0.74, 95%CI: 0.56-0.98). The variability of infected farms (variance=0.676, p=0.001) and that of farm level infection (variance=2.819, p=0.015) were both significant and they were positively correlated (0.91).

Discussion

After controlling for farm management practices, there was a clear temporal pattern to BDD in New Zealand. Most positive farms and most positive cows within positive farms were found in the period 50 to 90 days after the start of herd screening (i.e. in mid-October to early December 25/09) herd screening started. The reasons for the temporal pattern are unclear; the management factors were included in the model as confounders rather than risk factors as they were assumed to be constant throughout the study period (as they were only recorded once). Further research is required to establish the factors driving the seasonality of BDD on pasture-based farms in New Zealand.

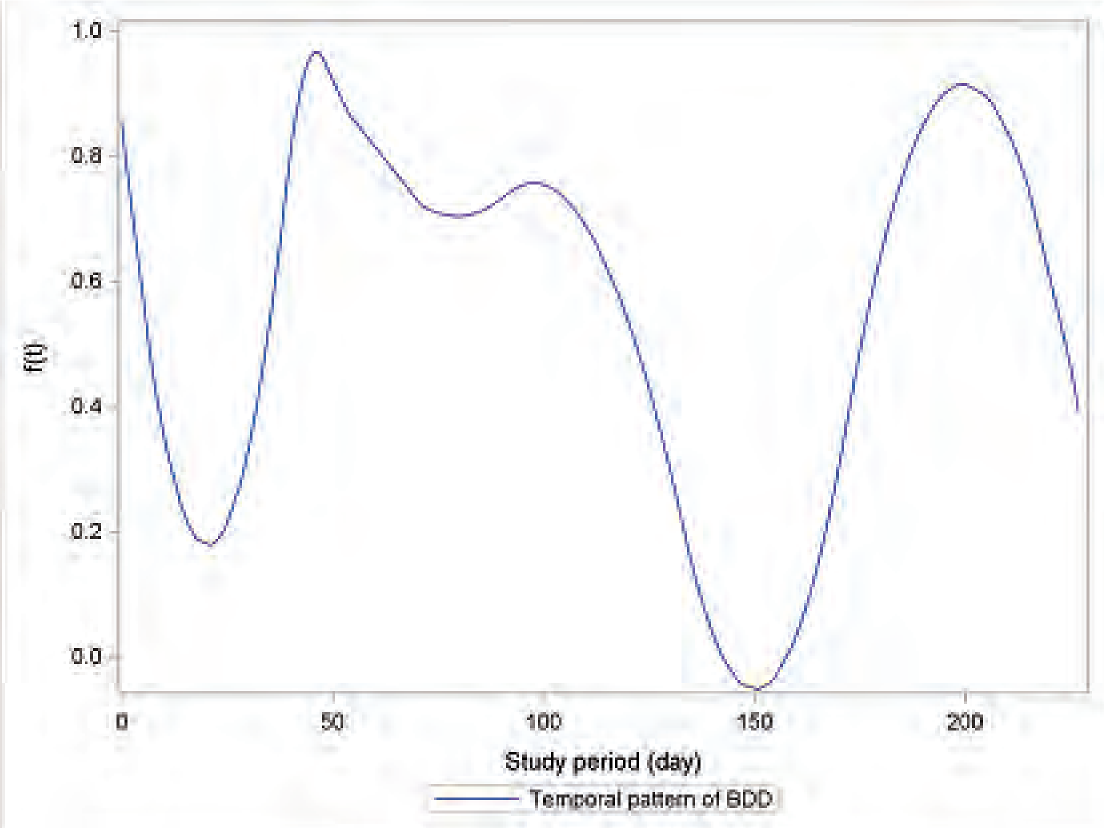

Figure 1: Temporal pattern of within-herd prevalence bovine digital dermatitis in Taranaki, 2015-2016

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References

1. Min Y, Agresti A. Random effect models for repeated measures of zero-inflated count data. Statistical Modelling. 2005;5(1):1-19.

2. Buu A, Li R, Tan X, Zucker RA. Statistical models for longitudinal zero - inflated count data with applications to the substance abuse field. Statistics in medicine. 2012;31(29):4074-86.

Keywords: Temporal pattern, Zero-inflation, Longitudinal observation

P 1-12 Bayesian Poisson-Gamma Approach To Investigate Effect Of Farm Management On Bovine Digital Dermatitis In Taranaki, New Zealand

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Introduction

A longitudinal study in Taranaki, NZ recorded BDD counts within 57 farms on five occasions across lactation. Although the analysis showed that BDD prevalence changed with time; the predictors for BDD that were recorded were constant as they were long lasting farm management factors and were therefore not suitable for directly explaining seasonality, However they were suitable for assessing one aspect of the longitudinal study – the number of new occasions on which BDD was observed, i.e. the total sum of new or recurrent lesions observed at each of the five time points.

Materials and Methods

A new case was defined as BDD in a cow which had not been positive before, a persistent case was one which had been positive before and stayed positive (counted only once when first appeared); and a recurrent case was one which had been positive but was negative at previous examination (counted every time it recurred). The number of records of BDD (Y_i) on farm i followed Poisson-Gamma distribution: with the expected count per lactation $\mu_i = \alpha/\beta_i = \exp(\gamma^* X_i)$, where γ denoted the vector of the regression coefficients and X_i was the predictor vector including shed type, young stock movement, hoof trimming by external staff, feed pad usage, and herd size (> or < 270). Partially informative priors (from expert opinion) were used (see Table 1).

Table 1. Priors for Bayesian Poisson-Gamma model.

Scenario	Priors	Corresponding distribution
Closed herd without feed pad	mean=10, 95% sure <30	log-normal (2.30, 0.45)
Herd with young stock movement	mean=15, 95% sure <40	log-normal (0.41, 0.36)
Herd with young stock movement and feed pad	mean=18, 95% sure <45	log-normal (0.18 0.31)
Herd with young stock movement, feed pad and hoof trimming by external staff	mean=20, 95% sure <60	log-normal (0.11, 0.45)

The model was run for 36000 iterations after discarding burn-in period of 4000. Sensitivity analyses were carried out using more precise priors.

Results

The model suggested that young stock movement reduced BDD (incidence ratio [IR]: 0.64, 95%CI: 0.4-1.05), but using a feed pad had no effect (IR: 1.26, 95%CI: 0.76-2.15). More BDD was recorded if external staff came to do hoof trimming (IR: 1.74, 95%CI: 1.02-2.90). Two confounders shed type (IR: 1.64, 95%CI: 0.97-2.80) and herd size (IR: 1.47, 95%CI: 0.88-2.43) were forced into the model. The sensitivity analyses, based the range of reasonable priors, suggested the model outputs were robust

Discussion

In this study, hoof trimming by external staff increased the records of BDD in a farm, consistent with previous findings (1). Using a feed pad had no effect on BDD; probably because the time spent on the feed pad (and thus exposure to of the feet to urine and faeces on concrete) was not long enough to increase transmission between animals. The effect of young stock movement was an unexpected finding and needs replication.

Acknowledgements
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References

1. Sullivan L, Blowey R, Carter S, Duncan J, Grove-White D, Page P, et al. Presence of digital dermatitis treponemes on cattle and sheep hoof trimming equipment. Vet Rec. 2014;175(8):201.

Keywords: Bayesian, Farm management, Poisson-Gamma

P 1-13 Organotypic Co-Culture Of Bovine Keratinocytes And Fibroblasts As A 3D Skin Model For Studying The Pathogenesis Of Digital Dermatitis.

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Introduction

Bovine digital dermatitis (DD) is a worldwide occurring, infectious disease in cattle primarily affecting the plantar skin above the coronary band of hind feet (1, 2). Painful ulceroproliferative lesions lead to behavioral changes and lameness (3). Hence, DD has an extraordinary impact on animal welfare and is associated with large economic losses because of decreased milk yields and high treatment costs (4). Substantial efforts in investigating the etiology of the disease revealed a synergistic origin with essential involvement of *Treponema* spp. (5, 6). In order to understand the cellular and molecular events during *Treponema*-infection of bovine skin, an organotypic in vitro skin model, which can be challenged with the causative agent, was established.

Materials and Methods

Bovine keratinocytes and fibroblasts were isolated from plantar skin samples from cattle within 1 hour after slaughtering. Tissue samples were obtained, cleaned and disinfected, all dermal and subcutaneous parts were removed. Keratinocytes were separated from the remaining tissue by over-night incubation in trypsin-EDTA. The cells were suspended in Keratinocyte-SFM growth medium (Gibco) supplemented with FBS, growth factors and antibiotics and cultured with 5% CO_2 at 37°C. Fibroblasts were plated in a DMEM-based growth medium and cultured as mentioned above. Primary cells were differentially trypsinized to obtain pure cell cultures. The dermal compartment of the skin model consisted of bovine collagen type I gel pads (4 mg/ml; Biochrom GmbH) with embedded post-mitotic (i.e. Mitomycin C-treated) fibroblasts (in 12-well cell culture inserts). Keratinocytes suspended in K-SFM were seeded on top of the collagen pads. Two days later, the level of keratinocyte growth medium was lowered to induce keratinocyte differentiation. This air-liquid-interface culture was maintained for three weeks. The bacterial strains *T. denticola*-like 1-9185MED and *T. phagedenis*-like CR2220RR CV were used for initial experiments in which skin models were exposed to spirochetes for different time periods (10min to 4h). The skin models were paraformaldehyde-fixed and processed for histological (HE staining) and immunohistological evaluation (anti-PanCK, anti-K10, anti-K14, anti-Ki67, anti-Dsg1, anti-Vimentin) according to standard protocols.

Results

Primary bovine keratinocytes and fibroblasts were reliably and reproducibly isolated from the site of infection. Appropriate cell culture media for long-term cultivation and storage of the skin cells were identified. A procedure, in which keratinocytes were directly seeded on top of dermal equivalents, i.e. bovine collagen type I pads with embedded post-mitotic fibroblasts, gave rise to promising organotypic skin equivalents. The incorporated post-mitotic fibroblasts showed the characteristic cell morphology with intact nuclei. The terminal differentiation of the keratinocytes on top of the dermal equivalent was shown with anti-K14 and anti-Dsg1 immunofluorescence. First in vitro *Treponema*-infection experiments revealed that spirochetes invaded the skin models very similar to the in vivo situation (6, 7).

Discussion

The results of initial *Treponema*-experiments proved that this skin equivalent is a suitable model to study the pathogenesis of DD. Future in vitro co-infection experiments with other bacteria, the usage of cells from genetically predisposed animals and an enzymatic manipulation of primary cells will broaden our knowledge about the underlying mechanisms during *Treponema*-infection of bovine skin.

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References

1. Cheli R, Mortellaro CM. La dermatite digitale del bovino. In: 8th International Conference on Diseases of Cattle. Piacenza, Milan, Italy 1974; 208–213.

2. Read DH, Walker RL. Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. J Vet Diagn Investig Off Publ Am Assoc Vet Lab Diagn 1998 (10): 67-76.

3. Argáez-Rodríguez FJ, Hird DW, Hernández de Anda J, Read DH, Rodríguez-Lainz A. Papillomatous digital dermatitis on a commercial dairy farm in Mexicali, Mexico: incidence and effect on reproduction and milk production. Prev Vet Med 1997 (32): 275–286.

4. Zinicola M, Lima F, Lima S, Machado V, Gomez M, Döpfer D, Guard C, Bicalho R. Altered Microbiomes in Bovine Digital Dermatitis Lesions, and the Gut as a Pathogen Reservoir. PLoS ONE 2015 (10).

5. Collighan RJ, Woodward MJ. Spirochaetes and other bacterial species associated with bovine digital dermatitis. FEMS Microbiol Lett 1997 (156): 37–41.

6. Döpfer D, Huurne AA ter, Cornelisse JL, Asten AJ van, Koopmans A, Meijer FA, Schukken YH, Szakáll I, Klee W, Bosma RB. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. Vet. Rec. 1997 (140): 620–623.

7. Döpfer D, Anklam K, Mikheil D, Ladell P. Growth curves and morphology of three *Treponema* subtypes isolated from digital dermatitis in cattle. Vet J Lond Engl 1997 2012 (193): 685–693.

Keywords: digital dermatitis, cell culture, organotypic skin model

2 TRIMMING

5 Inter-Observer Agreement Between Foot Trimmers On Foot Lesions In Cattle.

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Introduction

The majority of lameness cases are caused by foot lesions and it has been suggested to target lesion-specific causes of lameness in a herd, rather than making generalised preventative changes. Drawing conclusions about the epidemiology and risk factors for specific lesions from existing studies is problematic. In order to research the epidemiology and risk factors for specific causes of lameness further, a standardised protocol for categorising foot lesions is needed. The aim of this study was to evaluate the inter-observer agreement between five foot trimmers from one vet practice when recording foot lesions in cattle.

Materials and Methods

A variety of photographs of foot lesions was obtained from several archives belonging to the authors and in total included 13 different lesions with 6 pictures of each type. 5 hoof trimmers working for the veterinary practice with varying years of experience were gathered together and shown each picture for up to 1 minute and asked to write down the name (colloquial terms were accepted) of the main lesion they observed. The results of each observer were compared with a 'gold standard' diagnosis which was made by an experienced veterinary practitioner. The percentage agreement (sensitivity), specificity and kappa statistic were calculated for each lesion and the strength of agreement was determined.

Results

The kappa value is a means of measuring the agreement between individuals with a maximum score of 1 indicating perfect agreement. On the basis of the kappa values, sensitivity and specificity the strength of agreement for each lesion was classified excellent, substantial or poor. Results indicated that the trimmers had good agreement (excellent or substantial) for the identification of solar ulceration, white line disease, toe necrosis, sole haemorrhage and horizontal and vertical wall fissures but poor agreement for digital dermatitis, interdigital necrobacillosis, heel horn erosion, interdigital hyperplasia, sole penetration, sole separation and 'bulb infection'.

Discussion

Finding poor observer agreements is useful in alerting us to the need to improve training for foot trimmers or redefine the categorisation of these lesions. The variable results between lesions emphasises the importance of recording inter-observer agreement when carrying out studies focussing on specific foot lesions. The specificity of the lesion scoring was high, suggesting when a lesion is identified, it is identified correctly. The low sensitivity for some lesions suggests that some lesions may be missed by the foot trimmer but may also reflect the limitations of assessing a lesion by looking at a picture.

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References

Burn CC, Pritchard JC, Whay HR. 2009 Observer reliability for working equine welfare assessment: problems with high prevalence of certain results. Anim Welfare 18:177-187

Keywords: Lameness, Lesions, Agreement, Foot trimmers, Inter observer

6 A Prospective Cohort Study Of Digital Cushion Thickness, Body Condition And Claw Horn Lesions In Holstein Dairy Cattle

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Introduction

The digital cushion contains adipose tissue and is thought to play a role in dissipating forces through the foot during foot-strike, reducing risk of contusion leading to claw horn disruption lesions (CHDL: sole ulcer, sole haemorrhage and white line disease). It has been shown to be thicker in fatter cows (1) and both having a thin digital cushion and body condition score (BCS) loss are risk factors for CHDL (2–4). The aims of this study were to determine (i) how the digital cushion changes with body fat change (ii) and whether change in digital cushion thickness predisposed to CHDL and lameness.

Materials and Methods

A prospective cohort study examined 179 cows from two high yielding housed herds at 5 assessment points between -8 and +29 weeks relative to calving*. At each assessment point, sole soft tissue (SST) thickness (which included the digital cushion) was measured ultrasonographically on each hind claw (5). BCS, back fat thickness (BFT) and lesion presence were also recorded. Cows were locomotion scored fortnightly. Firstly, a 4-level linear regression model explored associations between SST and explanatory variables, which included BFT, lesion occurrence and stage of lactation. Secondly, multilevel logistic regression survival analyses assessed the effects of SST and BFT on the likelihood either a leg becoming lame or a CHDL developing on a claw later in the lactation.

Results

The overall mean of SST was 4.99mm (SE: 0.02). SST was thickest 8 weeks prior to calving (5.22mm) and thinnest one week post-calving (4.68mm); the nadir of BFT was at 9-17 weeks post calving. The linear regression model showed that BFT was positively correlated with SST, with a small effect size. Cows that developed a sole ulcer or severe haemorrhage during the study had thinner SST, except when an ulcer was present on a claw, when SST were thickened. SST also varied with farm, stature and claw (lateral versus medial). The logistic regression models showed that thin SST, thin BFT and thinning of BFT increased the likelihood of subsequent CHDL and lameness, and effects of BFT and SST were independent of each other. Change in SST between assessment points did not influence the likelihood of future lesions or lameness.

Discussion

The association between BFT and SST could indicate that fat is mobilised from the digital cushion during negative energy balance. Thin SST around calving could represent previously suggested physiological effects of peri-parturient hormones on the suspensory apparatus of the foot (6). The thickening of SST with sole ulcer presence could indicate inflammation, highlighting the importance of early detection and treatment of lameness. The strong relationship between thin SST and subsequent lameness and CHDL could be causal if thin SST results in poorer dissipation of forces within the foot. Multiple variables were associated with SST and could consequently impact upon CHDL, although this study reports relationships and not causality. The relationships highlight how factors could influence the position of the distal phalanx within the hoof capsule and how this might influence future CHDL and lameness.

Key words: digital cushion, sole soft tissues, claw horn disruption lesion, body condition score

**The study was approved by the School of Veterinary Medicine and Science Ethical Review Committee. When ethical approval was granted in 2013, projects were identified by name and date rather than unique approval numbers.*

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References

1. Bicalho RC, Machado VS, Caixeta LS. Lameness In Dairy Cattle: A Debilitating Disease Or A Disease Of Debilitated Cattle? A Cross-Sectional Study Of Lameness Prevalence And Thickness Of The Digital Cushion. J Dairy Sci. 2009; 92 (7): 3175-3184.

2. Lim PY, Huxley JN, Willshire JA, Green MJ, Othman AR, Kaler J. Unravelling The Temporal Association Between Lameness And Body Condition Score In Dairy Cattle Using A Multistate Modelling Approach. Prev Vet Med. 2015; 118 (4): 370-377.

3. Green LE, Huxley JN, Banks C, Green MJ. Temporal Associations Between Low Body Condition, Lameness And Milk Yield In A UK Dairy Herd. Prev Vet Med. 2014; 113 (1): 63-71.

4. Randall L V, Green MJ, Chagunda MGG, Mason C, Archer SC, Green LE, Huxley JN. Low Body Condition Predisposes Cattle To Lameness: An 8-Year Study Of One Dairy Herd. J Dairy Sci. 2015; 98 (6): 3766-3777.

5. Kofler J, Kubber P, Henninger W. Ultrasonographic Imaging And Thickness Measurement Of The Sole Horn And The Underlying Soft Tissue Layer In Bovine Claws. Vet J. 1999; 157 (3): 322-331.

6. Knott L, Tarlton JF, Craft H, Webster AJF. Effects Of Housing, Parturition And Diet Change On The Biochemistry And Biomechanics Of The Support Structures Of The Hoof Of Dairy Heifers. Vet J. 2007; 174 (2): 277-287.

7. Newsome RF, Green MJ, Bell NJ, Mason CS, Whay HR, Huxley JN. A Prospective Cohort Study Of Digital Cushion And Corium Thickness, Part 1: Does Body Condition Loss Really Lead To Thinning Of The Digital Cushion? J Dairy Sci. 2017; In Press.

8. Newsome RF, Green MJ, Bell NJ, Mason CS, Whay HR, Huxley JN. A Prospective Cohort Study Of Digital Cushion And Corium Thickness, Part 2: Does Thinning Of The Digital Cushion Lead To Lameness And Lesions? J Dairy Sci. 2017; In Press.

7 Evaluation Of A Modified Claw Trimming Method On Different Floors

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Introduction

About 90% of cases of lameness are related to claw lesions, thus many investigations concerning claw trimming and stable flooring have been carried out (2, 3). The "Dutch method" for claw trimming is gold standard but has been questioned by some authors due to changes in dairy cow housing (10, 8). The claws of cattle kept on pasture develop a prominent edge around the tip and the abaxial wall of the claw (1, 7). This is beneficial for the animal as the wall horn is the hardest and most resistant part of the claw and should therefore carry most of the bodyweight (5). In this study a thin foil based pressure measurement system was used to show the pressure distribution patterns of claws trimmed with a modified method mirroring "pasture claws" on different floorings.

Materials and Methods

10 isolated distal hind limbs of pluriparous Holstein Friesian dairy cows were prepared to be attached to a load applicator via the metatarsus. After trimming the claws according to the functional trimming method ("Dutch method") (10, 4, 6) the sole was trimmed so that a 2 mm edge remained around the tip and the abaxial wall of the claw. Metatarsi were positioned perpendicular to the ground surface and loaded with approx. 150 kg. To imitate in vivo conditions the deep digital flexor tendon was loaded with 50 kg and the digital extensor tendons with 5 kg (9). 4 different flooring surfaces (concrete and 3 different rubber mats: KARERA, KURA, profiKURA; KRAIBURG Holding GmbH & Co. KG, Waldkraiburg, Germany) were used. A thin sensor foil (M3200E, Hoof™ System, Tekscan Inc., Boston, MA, USA) was placed between flooring surface and claw and 4 measurements per floor were performed. Maximum pressure, average pressure and contact area were analyzed.

Results

Results show that contact area was 29.6±2.5 cm^2 on concrete flooring and 50.4±1.6 cm^2 max. on rubber mats. Average pressure was 50.5±6.7 N/cm^2 on concrete and 32.8±2.1 N/cm^2 max. on rubber mats (Table 1). Maximum pressure was located in the bulb area of the claw. Average ratio of weight distribution between lateral and medial claw was 2.7 on concrete and 2.2 on rubber.

Table 1: Contact area and average pressure on 4 different floorings

		overall		lateral		medial	
	Flooring	Contact area	Average pressure	Contact area	Average pressure	Contact area	Average pressure
Mean	Concrete	**29.6**	**50.5**	**18.5**	**59.3**	**11.1**	**36.8**
SD		2.5	6.7	1.2	9.3	3.0	5.5
Mean	KARERA	**43.4**	**32.8**	**27.7**	**36.0**	**15.6**	**27.4**
SD		1.5	2.1	4.2	3.0	5.1	3.3
Mean	KURA	**44.7**	**32.0**	**28.4**	**34.2**	**16.3**	**27.5**
SD		2.9	2.0	2.4	3.7	5.0	3.6
Mean	profiKURA	**50.4**	**28.4**	**32.1**	**30.3**	**18.3**	**24.9**
SD		1.6	1.2	5.3	1.3	4.8	2.8

Discussion

The results show a great benefit in pressure distribution patterns with the described modified trimming method. Most of the applied weight is located on the weight bearing margin of the claw which relieves the sensitive sole. Concrete flooring proves disadvantageous to claw health as it increases maximum and average pressure and decreases contact area. Comparison of the modified trimming method with claws trimmed according to the "Dutch method" is part of a follow-up study.

Acknowledgements

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References

1. Benz, B. (2002): Elastische Beläge für Betonspaltenböden in Liegeboxenlaufställen. Dissertation. Universität Hohenheim, Hohenheim. Institut für Agrartechnik.

2. Bergsten, C.; Herlin, A. H. (1996): Sole haemorrhages and heel horn erosion in dairy cows: the influence of housing system on their prevalence and severity. In: Acta Vet Scand 37 (4), S. 395–408.

3. Carvalho, V. (2006): Effects of trimming on dairy cattle hoof weight bearing surfaces and pressure distributions. In: Braz J Vet Res Anim Sci 43 (4), S. 518–525.

4. Fiedler, A.; Maierl, J.; Nuss, K. (2004): Funktionelle Klauenpflege. In: A. Fiedler, J. Maierl und K. Nuss (Hg.): Erkrankungen der Klauen und Zehen des Rindes: Schattauer, S. 44–62.

5. Franck, A.; Cocquyt, G.; Simoens, P.; Belie, N. de (2006): Biomechanical Properties of Bovine Claw Horn. In: Biosyst Eng 93 (4), S. 459–467.

Key Words: dairy cow, pressure distribution, claw trimming

8 Do Dorsal Wall Lengths Of 7.5cm Result In Inadequate Sole Thickness?

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Introduction

Foot disease is responsible for 92% of cattle lameness (1). The Dutch Five Step Method (DFSM) has been shown to result in lower levels of lameness (2). The dorsal wall length (DWL) of the DFSM has come under review (3, 4, 5) with recent research suggesting a minimum length of 8.5cm for a stepped claw when measuring to the top of the perioplic horn (6). This study's aim is to investigate the relationship between DWL and sole thickness (ST); ultimately assessing the minimum DWL for Holstein-Friesians.

Materials and Methods

Ethical approval reference URN 2016 1507 by the Clinical Research and Ethical Review Board (Royal Veterinary College). A cross-sectional prospective study undertaken at 11 farms in Southwest England. Inclusion criteria were: breed (Holstein, Holstein-Friesian, and Friesian), parity ≥1, recordable DWL and ST. Hind claws were measured by inspection following trimming by qualified claw trimmers (NPTC3/Dutch Diploma). DWL of the medial hind claw was measured from the claw tip to the point at which the horn becomes unyielding to digital pressure. ST was measured at the apex of the third phalanx using ultrasound. One hind foot was randomly selected per cow to account for lack of independence. Data was standardised using simple trigonometry to enable comparison and a 5mm 'step' was added to untrimmed claws. ST data was validated with ultrasound and CT imaging on a prospective cadaver cohort population.

Results

22 cadaveric feet were used to validate ST measurements. 174 Holstein-Friesian cattle met inclusion criteria. 18.4% of the cows had ST <5mm when trimmed to a DWL of 7.5cm. Seven cows had ST < 0cm implying that soft tissue structures would be transected when applying the DFSM. A length of 8.5cm was required to ensure >95% of the population were trimmed appropriately. 61.5% of cows were 'inspected', with no DWL alteration and only minor modelling.

Discussion

DWL was measured at the landmark commonly used by foot trimmers when trimming according to DFSM – namely where the claw horn goes palpably hard. Other DWL landmarks sometimes used include the coronary band and hairline. This study found 18.4% had ST <5mm at a DWL of 7.5cm. If >5mm ST is the goal and a standard DWL is adopted, we recommend a minimum DWL of 8.5cm in stepped claws, consistent with recent studies using various DWL landmarks (6,7). However, it may be possible to safely use shorter DWL and identify those cows requiring greater DWL. It has been assumed <5mm ST at the toe is too thin. It is possible that ST <5mm cause no pathology and allows for a steeper foot angle. However, it was the author's observation that soles of <5mm thickness were often not pliable to digital pressure, indicating the possible risk of creating thin soles without awareness and resulting iatrogenic claw lesions (8). We conclude that 18.4% of cows require a DWL >7.5cm and that 8.5cm may be a more appropriate guide for safety in some animals on some herds, reaffirming the point that a farm factored approach should be used when trimming to the DFSM.

Acknowledgements

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References

Murray RD, Downham DY, Clarkson MJ, Faull WB, Hughes JW, Manson FJ, Merritt JB, Russell WB, Sutherst JE and Ward WR 1996 Epidemiology of lameness in dairy cattle: description and analysis of foot lesions. *The Veterinary Record* 138: 586–591.

Manske T, Hultgren J and Bergsten C 2002 The effect of claw trimming on the hoof health of Swedish dairy cattle. *Preventive Veterinary Medicine* 54: 113–129.

Tsuka T, Murahata Y, Azuma K, Osaki T, Ito N, Okamoto Y and Imagawa T 2014 Quantitative evaluation of the relationship between dorsal wall length, sole thickness, and rotation of the distal phalanx in the bovine claw using computed tomography. *Journal of Dairy Science* 97: 6271–6285.

Bell NJ 2015 Evidence-based claw trimming for dairy cattle. *Veterinary Record* 177: 220–221.

Blowey R and Inman B 2012 Is there a case for reassessing hoof-trimming protocols?. *Veterinary Record* 171: 592–593.

Key words: Sole, Dutch 5 step, Ultrasound

9 Evaluating The Effect Of Two Hoof Trimming Techniques On Lesion Incidence

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Introduction

Lameness is detrimental to the well-being and productivity of dairy cattle (1,2). One recommended procedure to prevent lameness is hoof trimming (HT) (3). However, the scientific research surrounding the efficacy of HT is limited. There are currently 2 studies that have investigated the efficacy of HT techniques (4,5). The first study compared functional HT to an adaptation of the functional HT method that results in more modeling of both claws. The second study compared extensive modeling of the weight bearing claw to no trimming. The first study did not identify a difference between modeling both claws and the functional HT technique (4). However, preliminary data of the second study (5) showed a reduction in sole ulcers and hemorrhages when cows were trimmed with more modeling of the weight bearing claw only. The objective of this project was to compare the functional HT method (LIT) to an adaptation with more modeling of the weight bearing claw (BIG) on lesion presence at mid-lactation.

Materials and Methods

This project was approved by the University of Minnesota IACUC (Protocol ID 1412-32099A).This randomized clinical trial was conducted on a convenience sample of 3 farms that used free-stall housing, recycled sand bedding and had a regular HT schedule. Hoof trimmers were trained on the techniques at the start of the study. Cows with no hoof lesions were allocated to different treatments on a weekly basis at the time of their dry off trim and were evaluated for the presence of hoof lesions at 100-150 DIM of their next lactation. The outcome was either a lesion occurring before mid-lactation or one being present at the time of mid-lactation evaluation. Logistic regression was used to evaluate the effect of trim (BIG/LIT) on the odds of lesion development. Significance was assessed at $P < 0.05$.

Results

A total of 382 cows from one study farm were used in this preliminary analysis (LIT = 201; BIG= 190). Cows were examined for lesions on average at 114 DIM with an average lactation of 3. The incidence of lesions was 15% in the LIT group and 13% in the BIG group. The final logistic regression model included treatment, breed and lactation, and showed that BIG decreased the odds of having a lesion by 24% (OR=0.76, CI= 0.42-1.38, P=0.39). Crossbreds had a 1.94 (CI= 1.08-3.63, P =0.03) higher odds of a lesion being present when compared to Holsteins. Second lactation and greater was associated with a 1.32 (CI= 1.05-1.70, P=0.02) higher odds of a lesion being present.

Discussion

These preliminary results indicate that the BIG technique decreased the odds of lesions at mid-lactation. Though this result was not statistically significant, a large reduction in odds of lesion was observed, which is biologically significant for the welfare of the animal. The effect this procedure has on locomotion score, culling risk, and milk yield still needs to be determined, to establish which procedure is more efficacious.

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References

1. Bicalho RC, Vokey F, Erb HN, Guard CL. Visual locomotion scoring in the first seventy days in milk: impact on pregnancy and survival. *J Dairy Sci*. 2007;90:4586-4591.

2. Green LE, Hedges VJ, Schukken YH, Blowey RW, Packington AJ. The impact of clinical lameness on the milk yield of dairy cows. *J Dairy Sci*. 2002;85:2250-2256.

3. Shearer JK, van Amstel SR. Functional and corrective claw trimming. *Vet Clin North Am Food Anim Pract*. 2001;17:53-72.

4. Ouweltjes W, Holzhauer M, van der Tol PPJ, van der Werf J. Effects of two trimming methods of dairy cattle on concrete or rubber-covered slatted floors. *J Dairy Sci*. 2009;92:960-971.

5. Gomez, A., N.B. Cook, N. Kopesky, J. Gaska, and D. Dopfer. Should we trm heifers before calving? *American Association of Bovine Practitioners.* 2013:226.

Key Words: “Hoof Trimming” “Technique” “Locomotion”

P 2-1 The Effect Of Earlier And More Frequent Hoof Trimming On Hoof Conformation Of Dairy Goats

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Introduction

Regular hoof trimming is important for hoof health and conformation in dairy ruminants (Hill *et al* 1997; Manske *et al* 2002). However there are little data investigating early life hoof trimming regimes. Recent literature has reported that hoof growth due to a lack of trimming may adversely impact hoof conformation (Moleman *et al* 2006). If conformational changes occur early in life this could increase future injury risk and lameness (Kroekenstoel *et al* 2006). Nonetheless, it is common farm practice on New Zealand dairy goat farms to start hoof trimming after kidding (12-13 months of age) which may be too late to prevent detrimental changes to hoof conformation. Therefore, the aims of this trial were to determine: 1) if earlier and more frequent trimming impacts hoof conformation 2) if hoof conformation is altered by the trimming process.

Materials and Methods

Sixteen Saanen X goat kids were enrolled after weaning (5-6 months of age) on a commercial farm. They were randomly assigned to one of two hoof trimming regimes: A) first trimming at 5 months of age, then trimmed at 9 and 13 months, B) first trimming at 13 months of age. Each of the goats had radiographs taken immediately before and one day after trimming at 13 months of age. Radiographs were taken of the left front and left hind distal limb in a lateromedial direction and analysed using eFilm 3.3.0 software. The following parameters were determined: 1) the angle of deviation of the third phalanx (P3) from a vertical 180^{o} reference point, 2) the height (cm) of P2/P3 joint (JH3).

Results

There was no difference between the two trimming regimes in P3 angle or JH3 height evaluated at 13 months of age, however these parameters were altered by the process of trimming. In both groups the angle of P3 decreased after trimming for the front ($F_{1,14} = 87.88$, $P < 0.001$) and hind hooves ($F_{1,14} = 63.92$, $P < 0.001$). Similarly, the height of JH3 decreased after trimming for the front ($F_{1,14} = 6.50$, $P < 0.05$) and hind hooves ($F_{1,14} = 24.02$, $P < 0.001$). No interaction between trimming regime and the effect of trimming was observed.

Discussion

The data presented are a subset of goats from an ongoing trial. No effects of the earlier, more frequent trimming regime were found compared to common farm practice. The effects of trimming on hoof conformation found in this study, highlight the importance of hoof trimming. The removal of overgrown horn decreased the deviation of P3 and the height of JH3. Similar results have been reported in horses where hoof growth altered the angle of the third phalanx/P3 bone (Moleman *et al* 2006). The altered angles and conformation of the hoof that occur without trimming increase the loading of soft tissue in the distal limb, predisposing animals to injury and lameness later in life (Kroekenstoel *et al* 2006; Kummer *et al* 2006). This study will continue in order to determine the longer term impacts of delayed trimming in dairy goats.

Acknowledgements

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References

Hill NP, Murphy PE, Nelson AJ, Mouttotou LE, Green LE, Morgan KL 1997 Lameness and foot lesions in adult British dairy goats. Veterinary Record 141: 412-416

Kroekenstoel A, Heel MV, Weeren PV, Back W 200. Developmental aspects of distal limb conformation in the horse: the potential consequences of uneven feet in foals. Equine Veterinary Journal 38: 652-656

Kummer M, Geyer H, Imboden I, Auer J, Lischer C 2006 The effect of hoof trimming on radiographic measurements of the front feet of normal Warmblood horses. The Veterinary Journal 172: 58-66

Manske T, Hultgren J, Bergsten C 2002 The effect of claw trimming on the hoof health of Swedish dairy cattle. Preventive Veterinary Medicine 54: 113-129

Moleman M, Heel M, Weeren P, Back W 2006 Hoof growth between two shoeing sessions leads to a substantial increase of the moment about the distal, but not the proximal, interphalangeal joint. Equine Veterinary Journal 38: 170-174

Keywords: welfare, radiograph, angle, hooves

P 2-2 Cortisol - Concentration Before, During And After Hoof Trimming In German Holstein Cows – Testing Of Different Substrates

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Introduction

Measurement of blood cortisol has been widely used as a method to assess the activity of the hypothalamic-pituitary-adrenocortical (HPA) axis in cattle. As non-invasive alternative to blood, cortisol may also be measured in milk, saliva, lacrima and their metabolites in faeces. Therefore, objective of the present study was to examine the relationship between changes in cortisol concentrations in different matrices following the activation of the HPA axis. The applied stress model was claw trimming in a walk-in crush.

Materials and Methods

The present study was conducted between April 2013 and March 2014, including 43 pluriparous German Holstein cows (age 4.9 ± 1.3 years, milk yield 34.4 ± 7.2 kg/day, body weight 626 ± 70 kg; mean ± standard deviation). The concentration of cortisol was assessed during a time span of ten days, with blood cortisol considered as the gold standard. For repeated blood sampling an indwelling venous catheter was introduced into the left jugular vein one day prior to sampling period. Samples of blood, saliva, lacrima and faeces were taken daily between 08 am – 10 am (except day four: collection between 05 am – 06.30 am). Milk samples were collected during the daily milking routine between 1 pm – 2 pm. During claw trimming on day four blood and lacrima samples were taken at minute 0, 15, 25, 30, 40, 60, 80 (blood always prior to lacrima sample). Faecal samples were collected at minute 480, 540, 600 and 660, respectively.

Results

Cortisol levels measured in the current study are similar to those in the literature. The blood cortisol concentrations exhibited a decrease from day one to day two. This decrease was also mirrored in lacrima, saliva and faeces cortisol concentrations. During the claw trimming on day four an increase in blood and lacrima cortisol concentrations was observed. The blood, saliva and faeces cortisol concentration exhibited and increase on day five, compared to their reference sample in the morning of day 4. However, still remaining under the blood cortisol levels observed on day one. Further, also the concentrations observed on day 10 in blood, lacrima, saliva and faeces remained below their respective levels at day one. Milk cortisol concentrations exhibited peaks at day two, four and then, always exceeding the concentrations on day one.

Discussion

In this study blood cortisol concentrations were only partially mirrored in lacrima, saliva and feaces. When collecting samples for assessing cortisol levels, the sample collection itself needs to be considered stress-free. We concluded that only the collection of a milk sample guarantees a minimum handling of the animal, however does not reliably mirror blood cortisol concentrations, since the sample collection is bound to the milking routine. It was therefore concluded that in this trial none of the tested matrices can be considered a valid substation of the blood sampling from an indwelling catheter.

Key words: stress, cortisol, pain management, dairy cattle, hoof trimming

P 2-3 A Practical View For Effect Of Hoof Trimming As A Treatment On Sole Hoof Lesions In Pilot Study In Estonia

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Introduction

During another hoof health trial we measured the effect of hoof trimming on milk yield in Estonian University farm in winter 2016-2017. The farm included two units of cows, 60 were milked in the milking parlor and about 50 in robot. Because during our trial we had a good quality hoof trimmer in Estonia, we were interested what kind of effect hoof trimming can have on hooves in the farm with 20% prevalence of DD and 35% prevalence of sole ulcer.

Material and Methods

All cows were hoof trimmed on November (and will be in March) and these preliminary results contain milk yield from cows that were milked all the time in the robot and available cows from milking parlor (n=79 and 63 cows with all milk yield information from early lactation). Milk yield was measured 7d before hoof trimming, on hoof trimming day, 7, 14, 21 after trimming. The statistical analyses for the effect of trimming were performed by Stata IC version 14 (Stata Corporation, Texas, USA) by calculating the change of milk yield on the days mentioned before with DIM in hoof trimming day, a number of lactation, breed, total milk yield, group (more cows exist in milking parlor side) and presence of sole ulcer, DD, or WLD. Total milk yield was grouped into three(<8000, 8000-10000 and >10000) because the yield was measured from 290d, 292d or 305 days.

Results

In the preliminary data only sole ulcer (one week after trimming), and sole ulcer and WLD (two weeks after trimming) demonstrated a significant effect on milk yield. Total milk yield, number of lactation, DIM and group were kept in the model because of confounding and model improvements. We noticed that milk yield went down in spite of good trimming still 1 and 2 weeks after trimming and the change was about 5kg per day, (p.0.002 and 0.015 respectively). Cows that had WLD had trend to ooze more milk 2 weeks after trimming.

Discussion

The Estonian trimmer did good quality trimming but he did not use blocks nor did cows receive pain medication during the trimming. It seems as discussed by Huxley in Lameness conference in Chile 2015 (and H.J. Thomas et al. from same group in Vet Rec 2016) that hoof trimming itself is not so effective in helping cows. The loss of milk was huge and gives us good reason to think more. Nowadays milk price is 0,32c/kg in Estonia. In simple calculation we found that these cows with sole ulcer (n=42) could have lost up to 900 euros during these two weeks comparing to the time before hoof trimming (they were not lame). In the future we have a plan to advice the hoof trimmer and see if we get different result by using blocks and pain medication during trimming.

P 2-4 Dorsal Wall Length Gauge Makes Hoofrimming Easier

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Introduction

Living creatures are not like manufactured goods. None of them are the same size when you examine exactly. But, we can estimate the size roughly and that will do. Now I'd like to write about dorsal wall length of the claw. Dutch method says it is 7.5cm fixed, though we can see some bigger claws usually. In this case we should trim longer than 7.5cm or we would give cattle serious trouble. How do we understand the size of the claw? Which part of the claw do we measure? To solve this problem we made a gauge.

Materials and methods

The main part of the gauge is a V-shape ruler to measure the width of the hoof. A rectangular attachment is hinged to decide the dorsal length of the claw. 100 Holstein normal hind cadaver feet were examined. First of all the width of the coronary band was measured by the gauge. Second the dorsal wall length was decided by the gauge also and then cut the toe perpendicular to the sole of the claw. Sagittal section of the claw was made by a band saw. The distance L from the edge of the wall to the apical part of the corium was measured. And L is classified more than 12mm is A, from 12mm to 2mm is B, less than 2mm is C

Results and Conclusion

12mm<A: 35 feet. 2mm<B<12mm: 58 feet. C<2mm: 7 feet. The gauge gave us a fine results though some feet were shorter. Especially one foot in C is apparently too short. But 45 feet would be in trouble if you'd trim those by 7.5cm. The gauge made hooftrimming better and easier.

P 2-5 Effect of housing on sole thickness and toe angle in a pasture-based dairy system

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Introduction

Hoof conformation is strongly associated with lameness risk (1). This association is probably mediated through the impact of the environment, with housing being particularly important (1). In New Zealand even on farms that have housing available, cattle are often housed on a reactive basis based on the risk of pasture damage as grazing grass is the cheapest way to feed dairy cattle. However, there are no data on the impact of this sort of housing use on the hoof conformation of dairy cattle. This study therefore compared the post-partum changes in hoof conformation in cattle that could be housed with those of cattle kept at pasture during the same period of time.

Materials and Methods

This study was undertaken in two herds on a spring-calving dairy farm in the North Island. Herd 1 was fed twice daily in the house but only housed if soil moisture deficits were low (2), while herd 2 was kept at pasture but fed twice daily on a concrete pad. In October 2015, ten late calving cows were selected from each herd for standard conformation measurements (3) as well as sole thickness (distance to distal phalanx [ST]) using ultrasound (4). Both claws of the right hind foot were assessed. Measurements were repeated at monthly intervals until April 2016 (six examinations). Data were analysed using a repeat measures mixed model with herd, claw and time (and their interactions) as the fixed effects, cow age as a covariate, and cow as random effect.

Results

Only the results for toe angle and distance to distal phalanx are presented (further analysis is ongoing). The results (for lateral claw only) are summarised in Figure 1. For toe angle, herd, time and claw were all significant (P ≤0.001) as were interactions between herd and time and time and claw (p<0.001 and 0.041, respectively). For ST, time, claw and the interaction between time and herd were significant (P= <0.001, 0.044 and 0.005, respectively). No effect of herd was found (P=0.26).

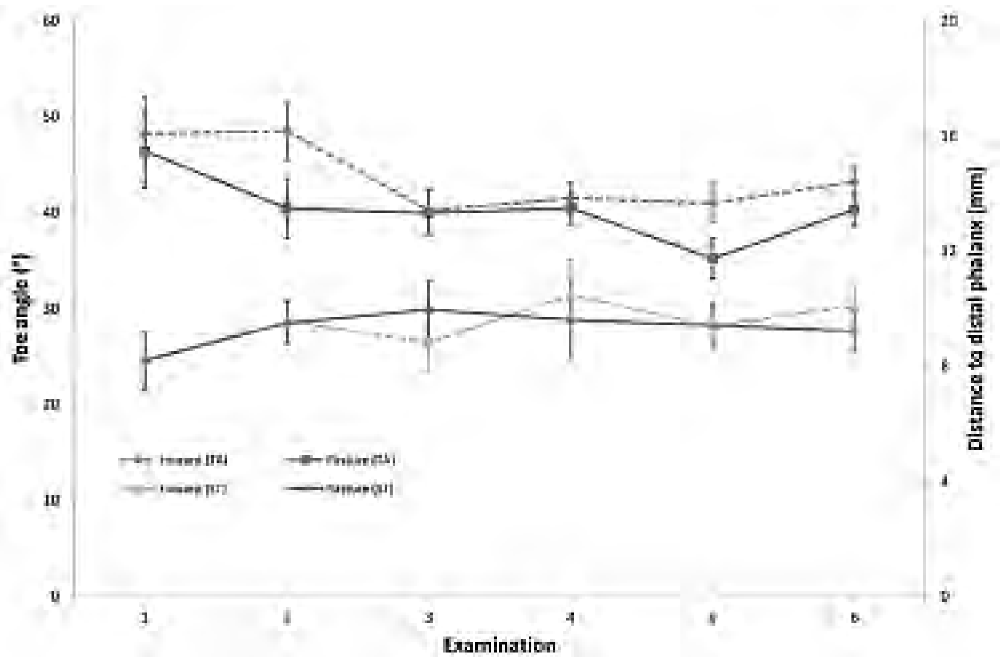

Figure 1: Effect of herd and time on toe angle (TA) and distance to distal phalanx (ST) of right hind claw (examination monthly: 1= October 2015, 6 = April 2016)

Discussion

Although the housed cattle were rarely housed for 24 hours a day and most such occasions were in the spring (i.e. from before the first examination to the time of the second examination), there were differences in these two measures, with both toe angle and ST changing differently over time depending on herd. However, although toe angle was consistently higher in housed cows compared to pasture cows (probably reflecting the increased contact with abrasive concrete), the effect on ST was less consistent, suggesting net sole growth was not consistently higher in pasture or in housing. These differences were small compared to those seen in different housing systems which suggests that on many NZ farms having housing available is likely to have only a small effect on hoof conformation (and perhaps lameness risk).

Acknowledgements

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References

Bergsten C. Effects of conformation and management system on hoof and leg diseases and lameness in dairy cows. Vet Clin North Am Food Anim Pract. 2001;17(1):1-23.

Müller KR, Laven R. Effect of housing on hock lesion prevalence and severity in a pasture-based dairy system. Abstract 19th International Symposium on Lameness in Ruminants, Munich, Germany 2017.

Laven LJ, Wang L, Regnerus C, Laven RA. Measuring Claw Conformation in Cattle: Assessing the Agreement between Manual and Digital Measurement. Animals (Basel). 2015;5(3):687-701.

Laven LJ, Margerison JK, Laven RA. Validation of a portable ultrasound machine for estimating sole thickness in dairy cattle in New Zealand. N Z Vet J. 2012;60(2):123-8.

Keywords: Hoof conformation, housing, pasture

P 2-6 Effect Of Different Ground Conditions On Pressure Distribution Under The Bovine Claw – An Ex Vivo Study

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Introduction

Dairy cows kept on hard flooring systems are subjected to a significantly higher risk of developing lameness and claw diseases (9). Therefore, the effects of different flooring on pressure load of bovine claws have been investigated in the past (1, 6, 8). As most surveys used stationary pressure measuring plates no direct influences of flooring to the claw could be captured (3). In this study, a thin pressure sensitive sensor was used to explore the direct effects of different flooring conditions on claw biomechanics.

Materials and Methods

Four different flooring types were evaluated including concrete and three different types of rubber mats: KARERA (**KAR**), KURA (**KUR**) and profiKURA (**proK**) (Gummiwerk KRAIBURG GmbH&Co. KG, Waldkraiburg, Germany). Ten isolated distal right hindlimbs of adult Holstein Friesian dairy cows from the slaughterhouse were separated below the tarsometatarsal joint. All claws were trimmed according to the Dutch method (7). The medulla of each metatarsus was replaced by Demotec®95 (Demotec Demel e.K., Nidderau, Germany) in order to fix a bolt into the medullary canal and attach the limb to a load applicator. Metatarsi were positioned perpendicular to the ground surface. The claws were loaded 4 times with 150 kg on each of the different flooring types. To mimic the in vivo situation as close as possible the deep digital flexor tendon and the digital extensor tendons were tensed in ratio 10:1 (5) with 500 and 50 N respectively. Analysis of the pressure distribution was performed with a foil-based pressure measurement system (M3200E, Hoof™System, Tekscan Inc, Boston, MA, USA) which was placed between flooring and claw. The loaded surface of the claws was subdivided into 5 segments (2) in order to assess the difference in pressure distribution patterns on the 4 floorings (Fig. 1).

Results

Load was distributed unevenly across all tested floorings between the lateral and medial claw with 70 to 30%, respectively. Also the contact area was more than twice as large underneath the lateral claw (Fig. 1). While the contact area on concrete amounted to 32,5±2,9 cm², rubber floorings showed larger contact areas with increasing flooring softness (KAR 46,3±3,6 cm²; KUR 48,6±3,4 cm²; proK 54,6±3,5 cm²). Coincidently the difference in contact area dimensions between medial and lateral claw decreased. The average pressure was up to 40% lower on rubber floorings than on concrete. The assessment of pressure distribution between the 5 segments is still in progress.

Discussion

In this laboratory setup standardised measurements were performed by excluding environmental influences. Thus, the direct interaction of different flooring conditions with the claw floor contact area could be analyzed by the pressure sensitive sensor foils. Collected data so far showed a considerable decrease in mechanical exertion of bovine claws on soft rubber floorings in comparison to concrete which has been shown by finite element analysis (4). In addition, the obtained values agree with findings of previous in vivo trials (1,8). In a next step we will apply the sensor foils to live animals to validate the ex vivo findings.

Acknowledgements

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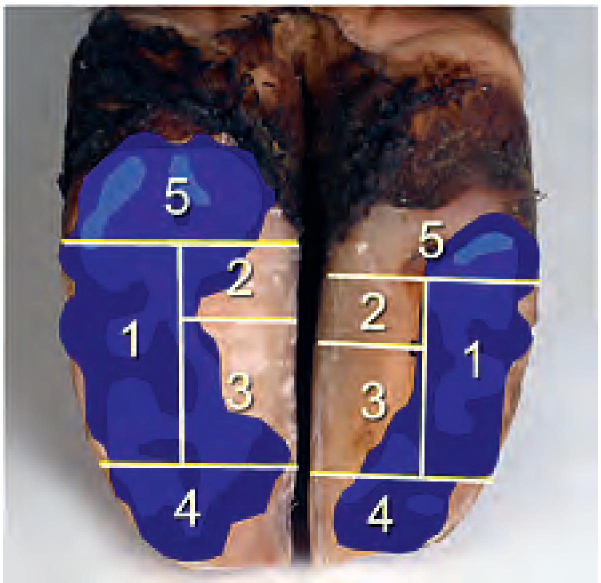

Figure 1

Example of the pressure distribution on the KURA rubber mat with Segmentation (adapted, (2))

References
1. Bergsten C, Telezhenko E, Ventorp M. Influence of Soft or Hard Floors before and after First Calving on Dairy Heifer Locomotion, Claw and Leg Health. Animals 2015; 5 (3): 662–686.

2. Carvalho V, Nääs IA, Bucklin RA, Shearer JK, Shearer L, Massafera V JR, de Souza SRL. Effects of trimming on dairy cattle hoof weight bearing surfaces and pressure distributions. Braz J Vet Res Anim Sci 2006; 43 (4): 518–525.

3. Franck A, De Belie N. Concrete Floor–Bovine Claw Contact Pressures Related to Floor Roughness and Deformation of the Claw. J Dairy Sci 2006; 89 (8): 2952–2964.

4. Hinterhofer C, Ferguson JC, Apprich V, Haider H, Stanek C. A finite element model of the bovine claw under static load for evaluation of different flooring conditions. N Z Vet J 2005; 53 (3): 165–170.

5. Riemersma DJ, van den Bogert, AJ, Schamhardt HC, Hartman W. Kinetics and kinematics of the equine hind limb: in vivo tendon strain and joint kinematics. Am J Vet Res 1988; 49 (8): 1344–1352.

6. Telezhenko E, Bergsten C, Magnusson M, Ventorp M, Nilsson C. Effect of different flooring systems on weight and pressure distribution on claws of dairy cows. J Dairy Sci 2008; 91 (5): 1874–1884.

7. Toussaint-Raven E. The principles of claw trimming. Vet Clin North Am Food Anim Pract 1985; 1 (1): 93–107.

8. van der Tol PPJ, van der Beek SS, Metz J, Noordhuizen-Stassen EN, Back W, Braam CR, Weijs W A. The Effect of Preventive Trimming on Weight Bearing and Force Balance on the Claws of Dairy Cattle. J Dairy Sci 2004; 87 (6): 1732–1738.

9. Vokey FJ, Guard CL, Erb HN, Galton DM. Effects of alley and stall surfaces on indices of claw and leg health in dairy cattle housed in a free-stall barn. J Dairy Sci 2001; 84 (12): 2686–2699.

Keywords: Biomechanics, Dairy Cattle, Pressure distribution, Concrete, Rubber Floor

P 2-7 A Retrospective Analysis Of Field Data To Investigate The Prevalence Of Foot Lesions In Dairy Cows In The South West Of England. A Comparison From 2008 To 2015

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Introduction

The recording of both incidence and prevalence of lameness of the bovine on a farm level is poor across the world with a limited ability to meaningfully collate data across multiple herds as well as relying on repeatable lameness nomenclature and recording system. This study retrospectively analyses the data from a large veterinary practice in the South West of England employing 7 trained veterinary-led foot trimmers. The study also compares the most recent lesion prevalence with similar analyses performed in both 2008/9 and 2012 to the results from 2014/5

Materials and Methods

Seven qualified foot trimmers (certified to a Dutch Diploma or NPTC Level 3) were equipped with bespoke technology to record lesions from foot trimming sessions on farm at the zonal level on the cow's foot. The trimmers met regularly to standardise both nomenclature as well as trimming technique. The records from all sessions were analysed to investigate the prevalence of the major foot lesions recorded by the foot trimmers. These results were then also compared with two similar prevalence summaries carried by the same authors in 2008/9 (UK Cattle Lameness Conference) and again in 2012 (International Cattle Conference, Bristol) as well as other published data (Barker, 2007 and Murray et al., 1996).

Results

For the 12 months to the end of December 2015, 1209 trimming sessions were carried out on 142 farms. 26,230 cows were presented for foot trimming of which 19,281 had all four feet examined. Lesions were recorded on 14,260 (54%). Bruising of the sole (26.7%) was the most recorded 'lesion' on the foot. However, excluding bruising, the predominant lesions that are recognised to cause lameness in cattle were White Line disease (WLD) (15%), Digital dermatitis (DD) (14%) and Sole Ulceration (SU)(9.3%). Claw horn lesions believed to be associated with treponemes such as Toe necrosis and other so called 'non healing' lesions accounted for 5% of the lesions. Following further training the recording of sole fracture has risen to 3% of all lesions.

Discussion

There has been a shift in prevalence of lesions identified at foot trimming sessions since the inclusion of bruising as an input field. This has reduced the overall significance (in percentage terms) of the big 3 lesions (WLD,SU,DD). However this highlights the number of cows that do have bruising recorded at foot trimming sessions. This may also suggest that farmers are being more proactive at putting cows forward for foot inspection (compared to trimming). However, consistently over the 3 years of this study, the percentage of cows with a recordable lesion is 68% (2008), 53% (2012) and 54% (2015). Unfortunately cows are not recorded for their mobility status at the time of foot trimming and so it is not possible to relate lesions to mobility score (lameness). There is a pressing need for a UK wide database recording lesions in a consistent way.

Acknowledgements

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References

1. Barker ZE. Epidemiology of lameness in dairy cows: PhD Thesis, University of Warwick.2007.

2. Burnell MC and Reader JD. A Retrospective Analysis of Field Data to Investigate the Prevalence of Foot Lesions in Dairy Cows in Somerset and Dorset 2006-2008. In: Proceedings of 1st Cattle Lameness Conference. Loughborough, Leicestershire 2009.

3. Burnell MC and Reader JD. A Retrospective analysis of field data to investigate the prevalence of Foot Lesions in Dairy Cows in Somerset and Dorset a comparison of 2008 and 2012. In: Proceeding of International Lameness Conference, Bristol.2013.

4. Murray RD, Downham DY, Clarkson MH, Faull WB, Hughes JW, Manson FJ, Merritt JB, Russell WB, Sutherst JE, Ward WR. Epidemiology of lameness in dairy cattle: Description and analysis of foot lesions. Veterinary Record 1996: 138:586-591.

Keywords: Para professional, Foot trimming, Lesions, Prevalence

P 2-8 Use Of Polyurethane Compound In Blocking Cows

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Introduction

Wood blocks are widely used in the therapy of claw lesions. Since this material becomes thinner as cows walk on hard surfaces, a thick block is necessary to grant weight bearing on sound claw. Aim of this work is testing a thin, longer polyurethane block in cows affected by sole ulcer (SU), white line disease (WLD) and toe necrosis (TN). Moreover we wanted to evaluate the healing time and the reduction of problems on joints/ ligaments / tendons due to missed removal or not proper wearing of wooden blocks.

Materials and Methods

Patient population
About 500 Holstein Frisian shoving SU, WLD or TN housed on free stall barns with cubicles, walking on concrete or slatted floor, fed by unifeed.

Inclusion criteria
Presence of the lesion
Random allocation in test or control group.
Locomotion score
Lesion score

Blocks are stuck to claws after trimming by polyurethane glues .
A dry, flat surface is needed, respecting the physiological shape and angle of the hoof.

Functional evaluation
. Block loss within 24 hours
. block loss after 28 days
. locomotion and lesion score after 28 days
. Hoof angle after 28 days
. Healing after 60 days
. Missed block removal
. Evaluation of damage on joints after 3 months

Results

The test group shows, at the end of January, good healing from SU and WLD.
no lesions on tendons and joints are detected on test group, treated with polyurethane compound.
Joint problems are found at this moment only on cows walking on wood blocks.

Discussion

Since this field trial started in November 2016 and lasts until April 2017, a complete statistical evaluation is not possible at this time. A final evaluation is necessary to correctly state the performance of the two systems.

References

J Maierl et al. 2013 Wedge-shaped Blocks, wood and Flexible, advance a Good Locomotion Performance. In: 17th International Symposium and 9thInternational Conference on Lameness in Ruminants

Gonzales Sagues, A. 2002 The biomechanics of weight bearing and its significance with lameness. pp 117-121. In: Proc. 12th Int. Symp. Lameness in ruminants, Orlando FL

Sprecher, D.S, Hostetler D.E. et al. 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performances. In: theriogenology. 47(6): 1179-1187

Telezhenko, E. and Bergsten C. 2005 Influence of floor type on the locomotion of dairy cows. In: Applied animal behavior science. 93(3-4): 183-185

Van Der Tol, P.P.J., Metz M.M et al 2002 The pressure distribution under the bovine claw during square standing on a flat substrate. In: journal of dairy science 85(6) 1476-1481

Keywords: block, polyurethane, joint, locomotion score

P 2-9 Trimming On Demand – Evaluation Of The Optimal Point In Time For Functional Claw Trimming By Using A Pressure Measurement Mat

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Introduction

The functional claw trimming by Touissant-Raven (1985) (1) is the commonly used method to prepare claws of dairy cows resulting that such prepared, they are presented with significantly less claw lesions and therefore more often sound. (2; 3). However, there is a recent discussion about the ideal point in time for claw trimming as well as proper claw dimensions concerning dairy cattle (4). To approach these questions in the following, we used a pressure measurement mat related to ones, used by van der Tol et al. (2002; 2004) (5; 6) who evaluated the effect of preventive claw trimming on the pressure distribution under the bovine claw. Giving another example for the usage of such mats might be the automatic detection of digital dermatitis in cows by analyzing the decreasing pressure distribution under the claws of affected animals (7). Furthermore, measured parameters are showing a respectable correlation towards identifying lame cows and therefore they might be potentially useful to identify them automatically (8; 9).

Material und Methods

The measurements were performed by HR Mat® (Tekscan) which was installed in a regular trimming chute, with the advantage, that each of the twelve examined cows were in a proper, constantly standing position on the mat. The first measurement was performed right before the first trimming was carried out. Then repeated every ten days throughout a period of six months. A software recorded and converted the measurements into an image with a colored range regarding the pressure load and distribution. The measurements were carried out on dirty claws 4 times in a row for 10 seconds with a frequency of 100 Hz. Afterwards the claws were cleaned so the influence of manure was minimized, and the measurements were repeated according to the above. Additionally we measured claw dimensions on the clean claws. The images were analyzed manually with help of a software tool.

Results

Overall we gained and evaluated over 1000 measurements from 28 days. After the functional claw trimming the contact area increases by a mean of 20.9% (SD: 5,34 - 45.11%) and the average pressure decreases by 5.7 % (SD: -7.8 - 24,86 %). Moreover the peak load and area of peak-load decreases. On the left hind limb, ratio of contact surface between lateral and medial claw changed from 61:39 previous to functional claw trimming to 58:42. On the right hind limb it changed from 61:39 to 58:42, respectively. On average it took 95,88 days (SD: 7 - 166 days) for reaching the contact surface which appeared on first claw trimming intervention. Furthermore we were able to show differences between lame and sound cows.

Discussion

We were able to proof earlier studies right, that functional claw trimming has a positive influence on biomechanics of the bovine claw (6). Yet the point in time for carrying out is cow related much more individually than expected and the recommended six month interval suggests (10). However the spread of contact surface at the beginning of our study shows that each cow entered the study under very different circumstances. Additionally, two cows needed special treatment for lesions, found on their claws. Though, we proofed our hypothesis that a cow should undergo functional claw trimming, when she reached the status right before the first claw trimming. The force plate seems to be able to reliably detect lame cows. Nevertheless there is need for further studies with a larger subject group. Further, the evaluation of measurements, done manually, must rely on an automated process because of its time consuming aspect.

Acknowledgment
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References

1. TOUSSAINT RAVEN, E. 1985. The principles of claw trimming. In: Vet. Clin. North Am.

Food Anim. Pract. 1, 93-107.

2. Manske, T., Hultgren, J., und Bergsten, C. 2002. The effect of claw trimming on the hoof health of Swedish dairy cattle. Prev. Vet. Med. 54(2):113-129.

3. Eilers, T. G. 2008. Langzeitbeobachtungen zur Klauengesundheit in vier Milchviehbetrieben im nordwestlichen Niedersachsen unter Berücksichtigung ausgewählter Risikoindikatoren auf Einzeltier- und Herdenebene. in FU Berlin.

4. T. Tsuka, 1 Y. Murahata , K. Azuma , T. Osaki , N. Ito , Y. Okamoto , and T. Imagawa. 2014

Quantitative evaluation of the relationship between dorsal wall length, sole thickness, and rotation of the distal phalanx in the bovine claw using computed tomography. J. Dairy Sci. 97 :6271–6285

5. van der Tol, P. P. J., Metz, J. H. M., Noordhuizen-Stassen, E. N., Back, W., Braam, C. R., und Weijs, W. A. 2002. The pressure distribution under the bovine claw during square standing on a flat substrate. Journal of Dairy Science 85(6):1476-1481.

6. van der Tol, P. P. J., van der Beek, S. S., Metz, J. H. M., Noordhuizen-Stassen, E. N., Back, W., Braam, C. R., und Weijs, W. A. 2004. The effect of preventive trimming on weight bearing and force balance on the claws of dairy cattle. Journal of Dairy Science 87(6):1732-1738.

7. Almeida, P. E., Mullineaux, D. R., Raphael, W., Wickens, C., and Zanella, A. J. 2007. Early detection of lameness in heifers with hairy heel warts using a pressure plate. Animal Welfare 16(2):135-137.

8. Kujala, M., Pastell, M., und Soveri, T. 2008. Use of force sensors to detect and analyse lameness in dairy cows. Veterinary Record 162(12):365-368.

9. Bicalho, R. C., Cheong, S. H., Cramer, G., und Guard, C. L. 2007a. Association between a visual and an automated locomotion score in lactating holstein cows. Journal of Dairy Science 90(7):3294-3300.

10. Lischer, C.; Geyer, H.; Ossent, P.; Friedli, K.; Näf, I.; und Pijl, R. Handbuch zur Pflege und Behandlung der Klauen beim Rind. 2., erw. Aufl.-Berlin: Parey, 2000: S. 71

Keywords: claw trimming, pressure distribution, trimming interval

3 ANIMAL WELFARE

10 The Effects Of Social Environment During Transition On Claw Health In Primiparous Cows

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Introduction

Lameness poses a major welfare challenge for the dairy industry; claw horn lesions (CHL) are among the most common causes (1). As the biomechanical resistance in the suspensory apparatus decreases around parturition (2), the claw might be particularly sensitive to mechanical damage during this period. Social interactions are a likely cause of mechanical stress to the claw. Thus the objective of this study was to determine the effect of a low-stress social environment on the development of CHL. We focused on primiparous cows as these animals are less likely to have a previous history of lesions.

Materials and Methods

The study was performed under UBC's Animal Care Committee protocol A14-0040. Heifers previously unexposed to multiparous cows were alternately assigned either to a dynamic low-stocked fresh pen (≤4 animal/12 stalls and feed-spaces) with familiar primiparous cows (LS, n=21), or to an identical pen with unfamiliar multiparous cows and 100% stocking density (CON, n=20). Behaviours were measured during the first 72 h for a subsample of animals (LS n=12, CON n=11) using 5 min scan sampling; aggressive interactions at the feed bunk were measured using continuous video for 90 min after feeding during the same period. Severity of CHL were recorded using an 8-point ordinal scale (3) at wk -6, 6 and 12 relative to calving; lesions were then categorised as severity <3 or ≥3. Behaviours and relationships between dichotomous variables were analysed using Mann-Whitney U test and Fisher exact test respectively. The relationship between aggressive interactions and claw lesions were tested with univariate logistic regression.

Results

Of the animals that displaced other cows at the feed bunk (LS: 6/11, CON; 8/10), LS were more frequently successful (LS: 2.5, CON: 0.71 animals/h present at feed bunk, U=40.5, n_1=6, n_2=8, p=0.04). CON were displaced 5.3 times and LS 2.4 times per h present at feed bunk (U=94, n_1=n_2=11, p=0.03). Time lying (LS: 547±121, CON: 580±152 min/day (mean±sd)), and perching (LS: 149±76, CON: 189±125 min/day) did not differ between treatments. In wk 6 there was a tendency for more CON to have WLH ≥3 (LS: 4/20, CON; 9/19, p<0.1), but not at in wk 12 (LS: 9/20, CON; 11/19, p=0.8). An increase in the number of aggressive interactions an animal was involved in did not increase the odds of developing WLH ≥3 at wk 6 (OR 0.98, 95%CI 0.86-1.10).

Discussion

These results suggest that a socially competitive environment is a contributing factor for CHL. We found no evidence that this risk was mediated through an increase in standing time, perching time, or aggressive interactions at the feed bunk. Being housed in a low-stress fresh pen for 3 weeks had no long-term protective effect against WLH, possibly because the period was not long enough for the biomechanical properties of the suspensory apparatus to normalise after calving (2). Future research should focus on identifying what aspects of the social environment negatively affect claw health.

Acknowledgements

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References

1. Hernandez J, Shearer JK and Webb DW. Effect of lameness on the calving-to-conception interval in dairy cows. J. Am. Vet. Med. Assoc. 2001 (218): 1611–1614. doi:10.2460/javma.2001.218.1611.

2. Tarlton JF, Holah DE, Evans KM, Jones S, Pearson GR and Webster AJF. Biomechanical and histopathological changes in the support structures of bovine hooves around the time of first calving. Vet. J. 2002 (163): 196–204. doi:10.1053/tvjl.2001.0651.

3. Leach KA, Logue DN, Randall JM and Kempson SA. Claw lesions in dairy cattle: methods for assessment of sole and white line lesions. Vet. J. 1998 (155): 91–102. doi:10.1016/S1090-0233(98)80043-9.

Keywords: Behaviour, Claw horn lesion, Primiparous, Social environment

11 Effects Of Low Stress Cattle Handling In Hoof Trimming On Animal Welfare, Human Safety, And Farm Efficiency

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Introduction

The objective of this paper is to investigate the effects of applying the practice of low stress cattle handling (LSCH) by T. Grandin and M. Parker not only in slaughter plans and handling facilities, but in an adapted manner also in cattle hoof care. Herein this paper takes up on the research by Grandin demonstrating the similarity in cattles' psychological stress level and pain during slaughter and on-farm handling. The paper presents the hypothesis that animal welfare, safety for humans, and economic efficiency at farms can be improved, when the sensory perception of cattle is considered in the handling of cattle before, during and after hoof trimming. Concrete recommendations for the handling of cattle are offered.

Materials and Methods

The research is founded on the scientific and practical work of Grandin and Parker on LSCH. Primary findings are drawn from investigations and practical tests during 20 years of work as a professional hoof trimmer on farms in northern Germany.

Results

Applied at least half an hour before (time it takes to calm cattle after a high level of arousal), during and directly after hoof trimming, LSCH leads to following results:

- Use of an electric prod on less than 25% of cattle.
- Less than 3% of cattle slip and less than 1% fall during handling.
- Reduction of the number of cattle with Radialis Nerv Paralysis from one case in 1.250 cows to zero.
- Less violence against cattle during the hoof trimming.

These results reflect an improvement not only in animal welfare, but also in safety of humans and economic efficiency of the farm. They can already be recognized after the first treatment. Some of the results present guidelines Grandin uses to assess the success of LSCH in slaughter plans.

Discussion

This study was conducted by one cattle hoof trimming professional on farms in Northern Germany. In order to generate further insights into the effects of LSCH applied in cattle hoof care further research on a greater number and diversity of farms and hoof trimming techniques needs to be undertaken. In the end, the instructions by Parker and Grandin need to be applied not only during hoof trimming, but the entire handling of cattle on a farm. Cattle enter the hoof trimming treatment from the farm environment and are released to it afterwards. Only a holistic approach can lead to the success of LSCH and thus improved animal welfare, human security and farm efficiency.

Acknowledgements

I would like to thank my clients and employee for their cooperation in applying the practices of LSCH during our hoof trimming treatments. And my wife Bärbel Wendtland for her patience during the hours I spend working on this research. Deserving a special mention are Jan-Willem Böttjer and Anna Wendtland for their help in organizing my thoughts.

References

Albright, J. L. and Fulwider, W. K. Dairy Cattle Behaviour, Facilities, Handling, Transport, Automation and Well-being. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 109–133.

Ewbank, R. and Parker, M. Handling Cattle Raised in Close Association with People. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 76–89.

Grandin, T. Handling Facilities and Restraint of Range Cattle. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 90–108:

Grandin, T. Handling and Welfare of Livestock in Slaughter Plants. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 329–353.

Grandin, T. Behavioural Principles of Handling Cattle an Other Grazing Animals under Extensive Conditions. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 44–64.

Grandin, T. Cattle Slaughter Audit Form (Updated October 2001) Based on American Meat Institute Guidelines. www.grandin.com/cattle.audit.form.html; 29.12.2016.

Parker, M. Improving cattle handling for Better Returns. Eblex Beef BRP Manual 2015 (3): 2-4 and 9-11.

Stookey, J. M. and Watts, J. M. Low-stress Restraint, Handling and Weaning of Cattle. In: Livestock Handling and Transport, 3rd edition, CAB International, Oxfordshire, UK: Grandin 2007; 65–76.

Key words: Low stress cattle handling, hoof trimming, hoof care, cattle behavior

12 Lameness And Claw Lesion Prevalence In Cows From Compost Bedded Dairy Barnsin Austria

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Introduction

Compost bedded dairy barns (CBB) are alternative loose housing systems for dairy cattle, consisting of a large bedded pack area separated from a feed alley with concrete or slatted floor (*Lobeck et al. 2011*). This system allows cattle freedom of movement and the ability to lie down and rest in a large lying area. The bedding material consists of dry, fine wood shavings and sawdust, which is aerated once or twice daily with a cultivator to incorporate faeces and to start the compost process. This system is widely used in many countries, and in 2015 the total number of compost dairy barns in Austria was approximately 30.

Materials and Methods

Claw health and lameness data from cows of five dairies with compost bedded barns (n: 201 data sets) were evaluated and compared with the cow data from five dairy herds housed in freestall cubicle barns (FCB) (n: 297 data sets). The predominant cattle breed was Fleckvieh in CBB (95.7%) and FCB herds (93.2%). The mean herd size was 28.2 dairy cows in CBB and 29.6 dairy cows in FCB herds. Herds were matched for having the same cow numbers, flooring type and similar milk yield. The prevalence of lameness, claw lesions and their severity grades were analysed. Two claw health indicators, the Cow-Claw-Score (CCS) and the Farm-Claw-Score (FCS) (*Kofler et al., 2013*), were calculated using a computerised claw trimming database programme. To identify differences in lameness and claw lesions according to bedding material and flooring system, a cumulative link mixed model (CLMM) was determined for each score at the animal level.

Results

There was no significant difference in overall lameness prevalence in cows from five CBB (18.7%) compared to cows from five FCB herds (14.9%). A cumulative link mixed model did not show significant differences in locomotion between different types of bedding material, flooring system, breed, visit number, observer and time since last trimming, but the locomotion score was significantly influenced by CCS. Another CLMM test showed significant influence of flooring type, visit number and cattle breed on CCS. Statistically significant differences in the prevalence of claw disorders between compost bedded and freestall cubicle barns were found for white line disease (20.4% and 46.6%, respectively), heel horn erosion (26.9% and 59.9%, respectively), concave dorsal wall as a result of chronic laminitis (6.5% and 15.9%, respectively) and for interdigital hyperplasia (0.2% and 3.1%, respectively). In CBB herds, 92.6% were mild claw lesions (score 1), whereas cows in FCB herds had only 77.2% score 1 lesions.

Discussion

The mean prevalence of lame cows in CBB and FCB herds in this study (18.7% vs. 14.9%) is significantly lower compared to reports of other housing systems (*Dippel et al., 2009; Kofler et al., 2013*) in Austria and it is comparable to other studies from compost dairies (*Lobeck et al., 2011*). The results of this study indicate that compost dairy barns are a good alternative to common cubicle housing systems in terms of lameness, claw health and animal welfare.

References

Dippel, S., Dolezal, M., Brenninkmeyer, C., Brinkmann, J., March, S., Knierim, U., Winckler, C 2009 Risk factors for lameness in cubicle housed Austrian Simmental dairy cows. *Prev. Vet. Med., 90*: 102; 102-112.

Kofler, J., Pesenhofer, R., Landl, G., Sommerfeld-Stur, I., Peham, C 2013 Monitoring of dairy cow claw health status in 15 herds using the computerized documentation program Claw Manager and digital parameters. *Tierärztl. Prax., 41 (G):* 31–44.

Lobeck, K.M., Endres, M.I., Shane, E.M., Godden, S.M., Fetrow, J 2011 Animal welfare in cross-ventilated, compost-bedded pack, and naturally ventilated dairy barns in the upper Midwest. *J. Dairy Sci., 94:* 5469-5479.

Key words: Claw health, compost bedded dairy barns, freestall cubicle barns, computerised claw trimming database programme

13 Effect Of Floor Type On Characteristics Of Locomotion Comfort

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Introduction

The locomotion comfort of dairy cows depends on the floor of the walking alleys (1). The optimal locomotion comfort is given when cows walk on pasture.The cow pedogram allows for characterization of various variables of the gait cycle (2). This study examined the characteristics of locomotion behavior on pasture (gold standard with optimal locomotion comfort) and compared it with those of cows walking on mastic asphalt and solid rubber mats. Our hypothesis was that gait variables were significantly different between pasture versus mastic asphalt and of mastic asphalt versus rubber.

Materials and Methods

The study protocol was approved by the animal experimentation committee of the canton of Bern, Switzerland (permission # 25162). Twenty four dairy cows kept in a tie-stall facility, allowed daily access to pasture during the grazing season (April to October) and weekly access to an outside pen during the winter feeding season (November to March) were enrolled in this experimental trial. Three flooring types were tested in the same artificial passageway (1.5 m wide x 15 m long): mastic asphalt, solid rubber (Type Kura G®; called now Kura Flex®, Gummiwerke Kraiburg, DeLaval) and pasture (gold standard). The pedogram was measured using two stand-alone 3D accelerometers (400 Hz), which were fitted at the level of the metatarsus to both hind limbs. The extracted pedogram variables included temporal events (kinematic outcome = gait cycle, stance phase and swing phase duration) and peaks (kinetic outcome = foot load, toe-off). The cows were further video-recorded to calculate walking speed and stride length. Locomotion score (LS) according to Flower and Weary (2006) (3) was performed on asphalt floor to enroll only non-lame cows (LS <3). For comparison between different floor types, repeated measures analysis of variance was performed with cow as a subjective variable, session time of measurement as within factor variable and flooring type as a fixed effect.

Results

The results of this study showed that the rubber flooring - as compared to mastic asphalt - does not reveal a significant improvement of the evaluated variables of locomotion comfort that are evident in dairy cows on pasture

Discussion

Using cow pedogram analyses and video-recordings allows to differentiating between floors with minor and such with good locomotion comfort. The locomotion comfort variables detected in cows walking on pasture were significantly different from those of cows walking on mastic asphalt or solid rubber. This suggests that regular pasturing is an important management procedure to improve locomotion comfort of dairy cows.

Acknowledgments

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References:

1. Bergsten, C., E. Telezhenko, and M. Ventorp. Influence of Soft or Hard Floors before and after First Calving on Dairy Heifer Locomotion, Claw and Leg Health. Animals (Basel). 2015 (5):662-686.

2. Alsaaod M., M. Luternauer, J. T. Hausegger, R. Kredel, and A. Steiner.The cow pedogram – analysis of the gait cycle parameters allows for detection of lameness and foot pathologies. J Dairy Sci. 2016 (100):1–10.

3. Flower, F. C. and D. M. Weary.. Effect of hoof pathologies on subjective assessments of dairy cow gait. J Dairy Sci 2006 (89):139-146.

Key words: accelerometer, dairy cow, locomotion comfort, floor

14 Using Video Footage To Identify And Measure Ten Behavioral Responses Of Cows To Pressure Handling

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Introduction

Impatient behavior of people has been identified as a risk factor for lameness in pasture based dairy farms (1, 2). In 93% of herds investigated with lameness problems by the author, stock handling behavior of people had been consistently scored as “medium to high risk”. Studies have shown that long term herding pressure in the form of slapping and shouting results in measurable raised levels of the stress hormone, cortisol (3). “Impatient handling” describes human behavior. However, using the behavioural responses of cattle to increasing herding pressure may give a more objective measure. The aim of this study was to be a first step in proposing objective, repeatable, measures of pressure herding in dairy cattle using cow behaviour parameters.

Material and Methods

Video footage of the herding of dairy cattle on 95 farms was collected over a 10 year period by the author from both housed and pasture systems. 115 videos clips were used to score behavioural changes of cows to increasing herding pressure. 35 videos were clips of herding management on walkways, and 80 were clips of management in the collecting yard. First, an overall score of the management pressure on either the walkway or in the collecting yard was assigned to each herd by the author (1= no pressure, 5 = severe pressure). Then ten different cow responses to pressure herding that could be objectively scored, were chosen, see Table 1. For each of the ten responses a linear 5-point scale was decided. So for example, one of the responses observed, “heads raised”, was scored as 1 = no heads raised (low pressure), and 5 = >20% heads raised (high pressure). The scores were collated and scanned for correlations to the overall subjective score of pressure. The average variation from the subjective score was also calculated.

Results

All the behaviours chosen gave strong positive correlation with the subjective score, and varied generally less than one point from the subjective score, see Table 1.

Table 1 Correlation of 10 cow behaviours visible in the video footage, with the author's subjective score of pressure whilst herds were being herded on walkways and handled in collecting yards.

	On Walkways		In Collecting yards	
Cow behaviour	Correlation with subjective score	Average variation from subjective score (range,std dev)	Correlation with subjective score	Average variation from subjective score (range,std dev)
a. space between cows	0.90	0.29 (0 – 1, 0.46)	0.83	0.46 (0 – 2, 0.62)
b. following	0.82	0.57 (0 – 2, 0.61)	0.84	0.61 (0 – 2, 0.63)
c. sideways touching	0.90	0.31 (0 – 1, 0.47)	0.85	0.51 (0 – 1, 0.50)
d. cows reversing	0.78	0.74 (0 – 3, 0.78)	0.77	0.56 (0 – 4, 0.75)
e. turning around	0.71	1.09 (0 – 3, 0.89)	0.67	0.71 (0 – 4, 0.89)
f. heads up	0.87	0.63 (0 – 2, 0.65)	0.81	0.55 (0 – 3, 0.61)
g. ears up	0.75	0.63 (0 – 3, 0.74)	0.76	0.64 (0 – 2, 0.67)
h. herd at back of yard	N/A	N/A	0.66	0.87 (0 – 3, 0.81)
i. facing crowd gate	N/A	N/A	0.64	0.93 (0 – 3, 0.81)
j. chewing cud	N/A	N/A	0.66	0.63 (0 – 2, 0.69)

Discussion

In this study the gold standard was a subjective score by the author. The author has had 30 years of experience observing pressure herding as a common risk factor for lameness. All ten cow behaviours selected were strongly indicative of the pressure score by the author. Some of the variation may be accounted for by the fact not all of the behaviours were present or visible in every video clip observation. For this reason, using a range of behaviours to indicate pressure herding should give a more dependable result. This was a preliminary study designed to test the use of cow behavioural signs as indications of pressure herding. It is planned to replicate this with independent observers. It is hoped, in the future, that even an inexperienced observer (or a camera with crowd image analysis software), with the correct criteria, may be able to quantify herding pressure more objectively.

References

Chesterton RN, Pfeiffer DU, Morris RS, Tanner CM. Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds – a case control study. New Zealand Veterinary Journal 1989 (37):135-142.

Ranjbar S, Rabiee A, Gunn A, House J. Identifying risk factors for lameness in pasture based dairy farms across NSW, Australia. In: 18th International Symposium and 10th International Conference on Lameness in Ruminants. Valdivia, Chile 2015; 103

Hemsworth P. Stockmanship and animal welfare, with reference to lameness. In: 16th International Symposium and 8th conference on Lameness in Ruminants. Rotorua, New Zealand 2011 http://www.ivis.org/proceedings/rumlameness/2011/oral/hemsworth.pdf

P 3-1 Slipperiness Of Rubber Floorings In Dairy Cow Barns

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Introduction

Lameness is an important welfare, health, and productivity problem in dairy farming. There is evidence of associations between lameness and flooring type and its slipperiness (*Dembele et al. 2006; Telezhenko and Bergsten 2005).* Rubber mats are considered to have a higher coefficient of friction in comparison to concrete. However manure, slurry and wet flooring conditions may increase floor slipperiness. Aim of the study was to compare the grip of different rubber mats during usage in a stable.

Materials and Methods

The study was approved by the Ethical Committee of the Veterinary University Vienna (ETK-04/05/2016). In the University Teaching Farm Kremesberg (cubicle freestall barn) used by 65 dairy cows, a walkway equipped with a scraper was covered by rubber mats (reference I) KURA Flex Gummiwerk Kraiburg GmbH Germany. Four rubber elements (II to V) of 100 cm length were replaced by samples of different rubber compositions, additives and surface profiles. The mats were installed in a row to be equally exposed to wear and slurry. Grip was tested with a custom-made grip tester consisting of a natural claw of typical size and conformation. Vertical force was 630N evoked by a compressed gas spring. By 45° turning the loaded claw on the floor the maximum torque that is proportional to the friction coefficient was measured ten times with a torque tester (Checkline DTW-100f). Measurements of samples (II –V) and the reference (I) was performed at the day of installation (M1, baseline) and after 8 weeks (M2) and 17 weeks (M3) respectively. As reference grass and concrete were also tested accordingly. Mean and standard deviation were calculated and data were tested for normal distribution by a Kolmogorov-Smirnov test and analysed by a Student´s t-test ($p<0.05$ was considered significant).

Results

The max torques of the measurements and samples are depicted in figure 1. Torque of the samples in M2 and M3 ranged between 20.13±3.64 Nm and 9.5±1.24Nm. Grass (20.87±1.65 Nm) and concrete (12.31±4.30 Nm) was determined as reference values. Torque of rubber mats was lower in dirty conditions than initially (M1; wet but clean). Probe V showed a significant lower torque at M2 due to the presence of dry manure crusts caused by slurry accumulation on the rough surface. This phenomenon could be confirmed by visual inspection and by cleaning and re-test which restored the baseline value.

Discussion

The results suggest that dry manure can significantly reduce the friction coefficient on rubber surfaces. It disables the properties of the material, additives and profiles. A more rough surface profile promotes the accumulation of slurry. Hence a more raw profile does not necessarily improve the grip of a rubber mat and requires regular cleaning to maintain the initially favourable properties of rubber surfaces.

Conflict of Interest

The study was funded by Gummiwerk Kraiburg GmbH.

References

Dembele I, Spinka M, Stehulova I, Panama J, Firla P 2006 Factors contributing to the incidence and prevalence of lameness on Czech dairy farms. Czech J. Anim. Sci., 51:102–109

Telezhenko E, Bergsten C 2005 Influence of floor type on the locomotion of dairy cows Appl. Anim. Behav. Sci., 93: 183–197

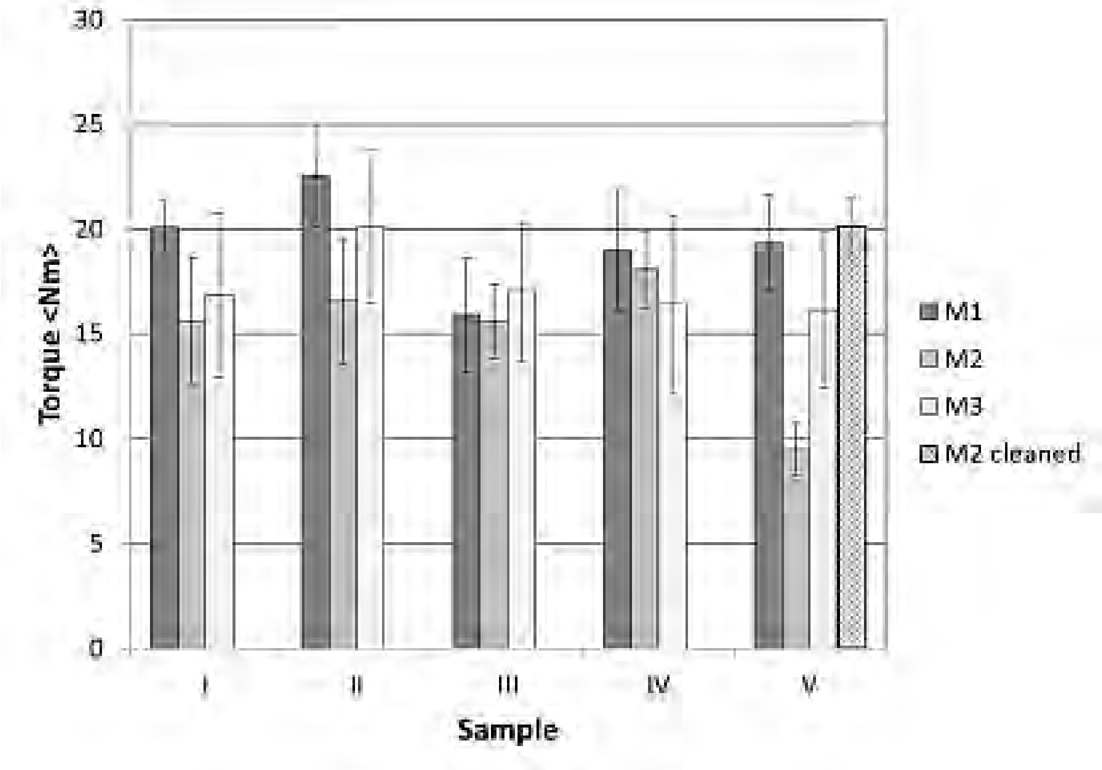

Figure 1: Maximum torque of rubber surfaces I-V measured with a Grip tester with a claw at a normal force of 630N. Measurements took place at day of installation (M1), 8 weeks later (M2) and 17 weeks later (M3) under the influence of wear and slurry. Sample V was cleaned also (M2cleaned).

Key words: Freestall dairy barn, flooring quality, rubber mat, grip, friction coefficient

P 3-3 Effects Of Restricted Walkways On Behaviour, Activity, Heart Rate And Heart Rate Variability Parameters Of Dairy Cows

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Introduction

The welfare of dairy cows is more and more a matter of particular interest, especially for consumers, but also for dairy farmers, farm advisers and veterinarians. Housing conditions have a significant influence on the health of dairy cows. For the improvement of housing systems, various indicators/assessment systems can be used to evaluate well-being: The Welfare Quality® Assessment Protocol, Animal Welfare Index, DLG-Checklists, etc. Especially for high-yielding dairy cows, the monitoring and reduction of stress is highly relevant for animal welfare and production, as cows are highly sensitive to environmental factors (Kovacs et al., 2014). In the course of this study, different data from sensors on the animal are used to assess stress in animals. With the help of innovative sensor systems and intelligent analytical methods, objective access to internal conditions of animals should be enabled. The sensors can be assigned to three levels:

- Movement and behaviour data (CowView tracking data, activity, lying time, running track, feed and water intake frequency)
- Data for assessment of the cardiovascular system (heart rate (HR), heart rate variability (HRV))
- Performance data (milk yield, milk components, feed and water intake)

With the help of this data, the influence of housing conditions on the behaviour and welfare of dairy cows will be assessed objectively (the important parameters referring to the welfare of the cows are shown in table 1). The aim of the entire survey is to establish a model for the assessment of the animal welfare status under different housing conditions. The objective of this investigation was to clarify if changings of the activity area lead to stress in the animals and a decrease in their welfare.

Materials and methods

Data of 60 dairy cows from the research station Frankenforst were collected for analysis over a period of 44 days in summer 2016. The herd was divided into two groups and in each group the walkways were restricted (that means one of the two walkways leading to the feeding area was closed) in different trial periods. All animals were equipped with the CowView tracking system and pedometers from the company GEA Farm Technologies GmbH (Bönen, Deutschland). Furthermore, the barn is equipped with weighing troughs (Co. Insentec Marknesse, Netherlands) to measure feed and water intake. The 13 focus animals were equipped with a heart rate sensor from the company POLAR Electro GmbH (Büttelborn, Deutschland) and accelerometers (Co. Gulf Coast Data Concepts, USA). Using t-tests, the data were analysed for differences between the two groups, mixed models were calculated for the analysis of the temporal progressions in the different trial periods (significance level $p \leq 0.1$).

Results

Concerning performance data, the cows in the herd were between the first and eight lactation and average milk yield was 32.6 ± 8.8 kg per day. More than half the herd was in the phase of high lactation during the trial period. On average, the animals consumed 42 ± 8.4 kg fresh matter per day with a total feeding time of 218 ± 57 minutes a day and 54 ± 23 separate feeds. While analysing the movement, behaviour and cardiological data, we found some effects and reactions of the cows concerning the changed housing conditions in group comparisons (table 1). The results in the table (t-test) are one step of repeated measurement analyses (mixed models).

Table 1: Examination of the movement, behaviour and cardiological data in the trial period based on differences between experimental and control group.

Characteristics	*units*	*n*	*animals without restricted walkways Mean ± SD*	*animals with restricted walkways Mean ± SD*
Heartrate	[S/min]	13	80.83 ± 5.99	82.01 ± 10.35
*HRV parameter RMSSD**	[ms]	13	11.8[a] ± 8.8	13,7[b] ± 10.5
Activity rate (pedometers)	[sum/day]	60	317.50[a] ± 95.96	326.12[b] ± 108.28
Lying times (accelerometer)	[h/day]	13	10:00 ± 03:21	09:35 ± 03:44
Distance (accelerometer)	[m/day]	13	818.73 ± 246.99	875.05 ± 201.23
Time in cubicle (CowView)	[min/day]	60	807.5[a] ± 283.4	781.7[b] ± 284.4
Time at the feeding area (CowView)	[min/day]	60	183.3 ± 101.1	181.2 ± 100.9

*(Root Mean Square of Successive Differences); a, b= means within a line with different letters are significantly different

Discussion

The general experiment design has proven its worth in this study and is carried out in the same way in follow-up experiments. As documented in the literature, the parameters concerning the cardiovascular system are meaningful for evaluation of welfare (von Borell et al., 2007). The difference in the cardiological data (HRV) shows that the cows are in an adaption reaction to the changed housing condition. The way an animal adapts to prevailing situations has different consequences for its own well-being (Broom, 1991). Notable in this context is that, in the group with the restricted walkways, the parameter RMSSD has a higher value, and the higher the RMSSD, the faster an organism can relax (von Borell et al., 2007). The difference in the RMSSD corresponds to the significantly higher activity rate and the lower time spend in cubicle of the experimental group. The other parameters of the levels movement, behaviour, cardiological and performance data were not significantly different during the period with restricted walkways. One reason for this could be that the walkways in the test barn are very wide. In summary, it can be said, that in this case the walkway restriction did not have a negative influence on the welfare status of the cows.

Acknowledgements

Data collection and analysis are part of a research project called CowSoft. It is funded for three years by the Federal Ministry of Food and Agriculture within the innovation-support programme and the Landwirtschaftliche Rentenbank. The data collection took place at the research station Frankenforst of the University of Bonn.

References

Broom DM 1991 Animal welfare: concepts and measurement. *Journal of Animal Science* 69: 4167-4175

Kovacs L, Jurkovich V, Bakony M, Szenci O, Poti P, Tozser J 2014 Welfare implication of measuring heartrate and heart rate variability in dairy cattle: literature review and conclusions for future research. *Animal* 8: 316-330

Von Borell EH, Langbein J, Despres G, Hansen S, Leterrier C, Marchant-Forde J, Marchant-Forde R, Minero M, Mohr E, Prunier A, Valance D, and Veissier I 2007 Heart rate variability as a measure of autonomic regulation of cardic activity for assessing stress and welfare in farm animals – a review. *Physiology & Behavior* 92: 293-316

Keywords: welfare, cattle, HRV, behaviour, feeding alley

P 3-4 Effect Of Housing On Hock Lesion Prevalence And Severity In A Pasture-Based Dairy System

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Introduction

Hock lesions characterized by hair loss, scabbing, ulceration or swelling are significant lesions in housed dairy cattle, and a positive correlation between hock lesion prevalence and severity and lameness within a herd has been demonstrated (1, 2, 3). However, under New Zealand conditions where cattle are usually based at pasture, hock lesions are not commonly recorded. The objectives of this longitudinal study were to assess the prevalence and severity of hock lesions in housed and pasture-based dairy cattle on the same NZ dairy farm, and to investigate the influence of housing hours and soil moisture deficit on those lesions.

Materials and Methods

Starting in October 2015 and continuing monthly until dry-off in May 2016, all cattle in a 400-cow dairy herd were examined for hock lesions while being milked on a rotary platform. In this herd, 200 cows were managed on a traditional pasture-based system while the other 200 cows were housed in a freestall barn with mattresses for varying periods (0-24 hours/day), depending on soil moisture deficit. The lateral and medial aspects of both hocks were examined and lesions were scored as per Potterton et al. 2011 (4) on a categorical 4-point scale for hair loss, ulceration, and swelling.

Results

Hock lesions were generally more frequent and severe in the housed group than in the pasture group (Fig.1). In housed cows, lesion prevalence was highest in October (78.1%, vs. 9% in pasture cows, $P<0.001$) after a period of intensive housing (average daily housing hours 21.6) in September. For the housed group, lesion prevalence was correlated with average housing hours in the previous month ($R^2 = 0.74$) while in the pasture group lesion prevalence was strongly correlated with soil moisture deficit in the same month ($R^2= 0.95$). Hair loss was identified on 463 out of 2,712 hocks in the pasture group (mild: 7.8%, moderate: 7.9%, severe: 1.5%) and on 885 out of 2,716 hocks in the housed group (mild: 13.1%, moderate: 17.0%, severe: 2.6%). 244 hocks in the pasture group had areas of ulceration (mild: 6.4, moderate: 2.4, severe: 0.3%) and 384 hocks in the housed group were ulcerated (mild: 10.7%, moderate: 3.2%, severe: 0.3%). Lesions were more common on the lateral than the medial surface of the hock (96.7 v. 8.9 per cent in pasture group, 99.7 v 4.0 per cent in housed group). The percentage of medial hock lesions increased in the housed group in December and January when average daily housing hours were 0.

Acknowledgements

The study received financial support from NZ Ministry for Business, Innovation & Employment; DairyNZ; Beef + Lamb NZ; and Fonterra through the P21 research programme. Thanks to the participating farm and Karma Wangmo who assisted with data entry.

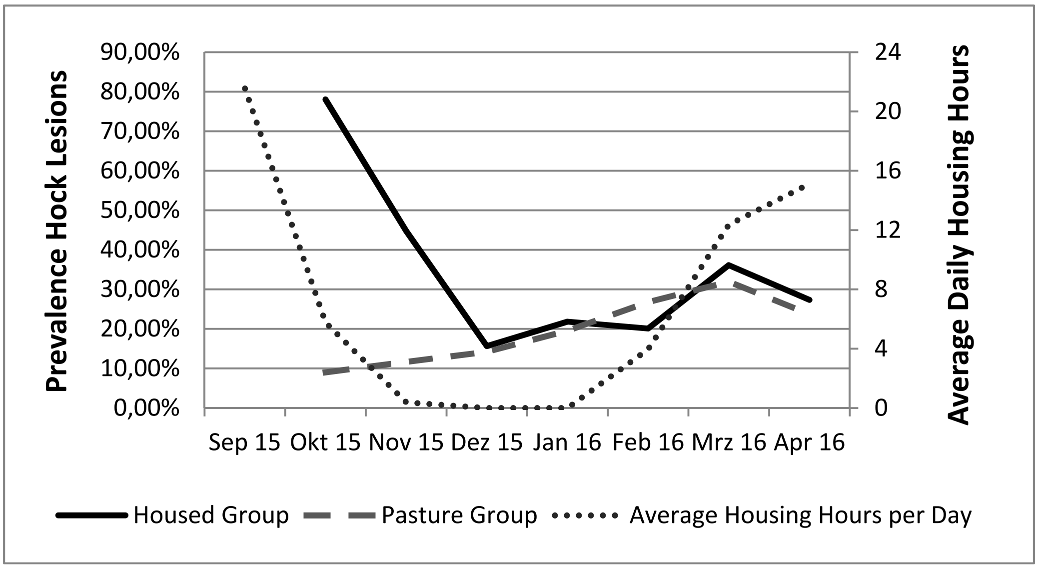

Figure 1: Progress of hock lesion prevalence in housed and pasture group with the effect of average daily housing hours

References

Haskell MJ, Rennie L J, Bowell VA, Bell MJ, Lawrence AB. Housing system, milk production, and zero-grazing effects on lameness and leg injury in dairy cows. J Dairy Sci 2006 (89): 4259-4266.

Kielland C, Ruud LE, Zanella AJ, Østerås, O. Prevalence and risk factors for skin lesions on legs of dairy cattle housed in freestalls in Norway. J Dairy Sci 2009 (92): 5487-5496.

Kester E, Holzhauer M and Frankena K. A descriptive review of the prevalence and risk factors of hock lesions in dairy cows. The Veterinary Journal 2014 (202): 222–228.

Potterton SL, Green MJ, Millar KM, Brignell CJ, Harris J, Whay HR, Huxley JN. Prevalence and characterisation of, and producers' attitudes towards, hock lesions in UK dairy cattle. Vet Rec 2011 (169): 2952–2963.Keywords: Hoof conformation, housing, pasture

Keywords: Hock lesion, housing, pasture

P 3-5 Genome Wide Association Analysis And Regional Heritability Mapping For Lameness Causing Foot Lesions And Digital Cushion Thickness In UK Holstein Dairy Cows

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Introduction

Foot lesions account for most lameness cases in dairy cattle and are usually of infectious or non-infectious classification. Low to moderate heritability estimates have been reported for most of these lesions[1]. The digital cushion is a complex structure composed mostly of connective and adipose tissue located underneath the distal phalanx and plays an important function in dampening compression of the corium tissue. In a recently published study, the heritability estimate of digital cushion thickness was 0.33 ± 0.09, whereas a statistically significant genetic correlation was estimated between digital cushion thickness and prevalence of claw horn lesions (−0.60 ± 0.29)[2]. Our objective here is to present the first results from an ongoing project aiming to detect genomic regions of interest for these traits.

Materials and Methods

The study was approved by the University of Liverpool Veterinary Research Ethics Committee. 267 Holstein cows from one herd were genotyped with a genome-wide 50K Affymetrix DNA array. Information regarding five lameness causing foot lesions (sole ulcer, sole haemorrhage, white line disease, digital dermatitis and interdigital hyperplasia) was collected by the researchers and from the farm's records. Additional phenotypes for digital cushion thickness were available for a subset of animals (~125) before calving, at calving and 60 days after calving.Three genomic analyses for each trait were performed: 1) Variance component estimation[3], 2) Genome-wide association (GWA) analysis[4], 3) Regional heritability mapping (RHM)[3] of consecutive genomic regions of 20 SNPs. In models 2 and 3, significant (one false positive in 20 genome scans) and suggestive (one false positive per genome scan) thresholds were computed using a Bonferroni correction for multiple testing. Quantitative trait loci were explored by matching significant outcomes of the above analyses to the bovine reference genome.

Results

All traits except for sole haemorrhage exhibited genomic heritabilities significantly greater than 0 (0.20-0.42). GWA analysis revealed a significant peak on BTA6 for interdigital hyperplasia. RHM identified two significant regions on BTA6 for this trait, one of which included the significant SNP from GWA; these regions accounted for 66% of the total genomic (SNP) variance and harboured or were close to a gene related to the immune system (*CLNK*), a gene related to protein-protein interactions (*WDR1*) and a two-gene cluster related to bone and skeletal development (*EVC* and *EVC2*). Furthermore, RHM resulted in additional suggestive regions identified for interdigital hyperplasia (BTA10), digital dermatitis (BTA11 and BTA27) and sole ulcer (BTA12). Digital cushion thickness at calving showed significant results, with RHM, revealing a significant region on BTA12 close to a relevant gene related to lipid and hormone metabolism (*DHRS12*) and two suggestive regions on BTA1 and BTA7. Regional variance estimates were larger than the total genetic variance, potentially indicating an oligogenic architecture for this trait.

Discussion

Interdigital hyperplasia, digital dermatitis, sole ulcer and DCT at calving may be improved based on genomic analysis results.

Acknowledgements

V. Bay is gratefully acknowledging support from the Turkish Ministry of Education. G. Oikonomou is gratefully acknowledging support from the Wellcome Trust (Wellcome Trust ISSF non clinical fellowship).

References

[1]Bicalho R, Oikonomou G. Control and prevention of lameness associated with claw lesions in dairy cows. Livestock Science 2013 (156): 96 – 105.

[2]Oikonomou G, Banos G, Machado V, Caixeta L, and Bicalho RC. Short communication: Genetic characterization of digital cushion thickness. Journal of Dairy Science 2014 (97): 532 - 536.

[3]Gray A, Stewart I, Tenesa A. Advanced Complex Trait Analysis. Bioinformatics. 2012 (28): 3134-3136.

[4]Zhou X, Stephens M. Genome-wide efficient mixed-model analysis for association studies. Nature Genetics. 2012 (44): 821 – 824.

Keywords: genomic, regional heritability mapping, foot lesions, digital cushion

P 3-6 Can Technical Parameters Characterise The Slipperiness Of The Floor?

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Introduction

Objective assessment of cow gait on different surfaces is a good and comprehensive way to evaluate the slipperiness of a floor. However, it is time-consuming to gather gait data, it requires special arrangements and the results depend on different environmental factors and individual animal variability (2, 5). Therefore, it would be beneficial if gait tests could be replaced with more standardised technical floor tests. The aim of the present study was thus to assess the slipperiness of some common solid floor designs for improving traction in cattle houses. In order to get a comprehensive evaluation of slip resistance, the floor surfaces were characterised using a number of different physical tests, along with cow gait analysis.

Materials and Methods

Dynamic and static coefficient of friction, measured by a drag test (3), skid resistance, measured by Skid Resistance Tester (SRT) according to American Society for Testing and Materials (1), and floor abrasiveness, measured by weighing the block of plaster before and after the dragging a distance of 10 m (4) were tested on: concrete flooring with a smooth finish, a grooved pattern or a tamped pattern; acid-resistant mastic asphalt and soft rubber mats (KLS, Kraiburg). Linear kinematic variables were assessed in 40 cows by trackway measurements (5) after cows passed over the floors in a straight walk (the study of animals was approved by Lund Ethical Committee on Animal Research, approval nr M 118-02). The data were then analysed with a repeated measures ANOVA using the Residual Maximum Likelihood method (JMP, Version 6.0, SAS Inst.).

Results

The concrete floors had lowest coefficients of friction and neither static nor dynamic coefficient of friction could differentiate the concrete floors with and without patterns, tamped or grooved (Fig. 1). The mastic asphalt floor had medium values of friction and the rubber mats had highest coefficients of friction (Fig. 1). Skid resistance tests showed the lowest values for the smooth concrete and mastic asphalt. The highest abrasion was measured on the asphalt flooring and least was on rubber mats, while the concrete flooring with a tamped pattern had significantly higher abrasiveness than the other concrete floors (Fig. 1). Among the gait characteristics the stride length was most informative to differentiate the floors. Cows walked with shortest strides on smooth and grooved concrete floors, average on tamped concrete and asphalt and the longest strides were on soft rubber mats (Fig. 1).

Discussion

None of the technical parameters alone was informative enough to characterise slip resistance. Low coefficient of friction did not always coincide with inferior traction. With reference to stride length, the abrasiveness, which characterises the roughness of a surface, was more informative than the coefficients of friction for the hard floors, while the effect of pattern was better detected by skid resistance measurements. Consequently several technical parameters are needed to describe objectively the slip resistance of animal house floors. Soft rubber mats gave better tracking than hard, solid floors even when their surface was grooved or tamped with a pattern.

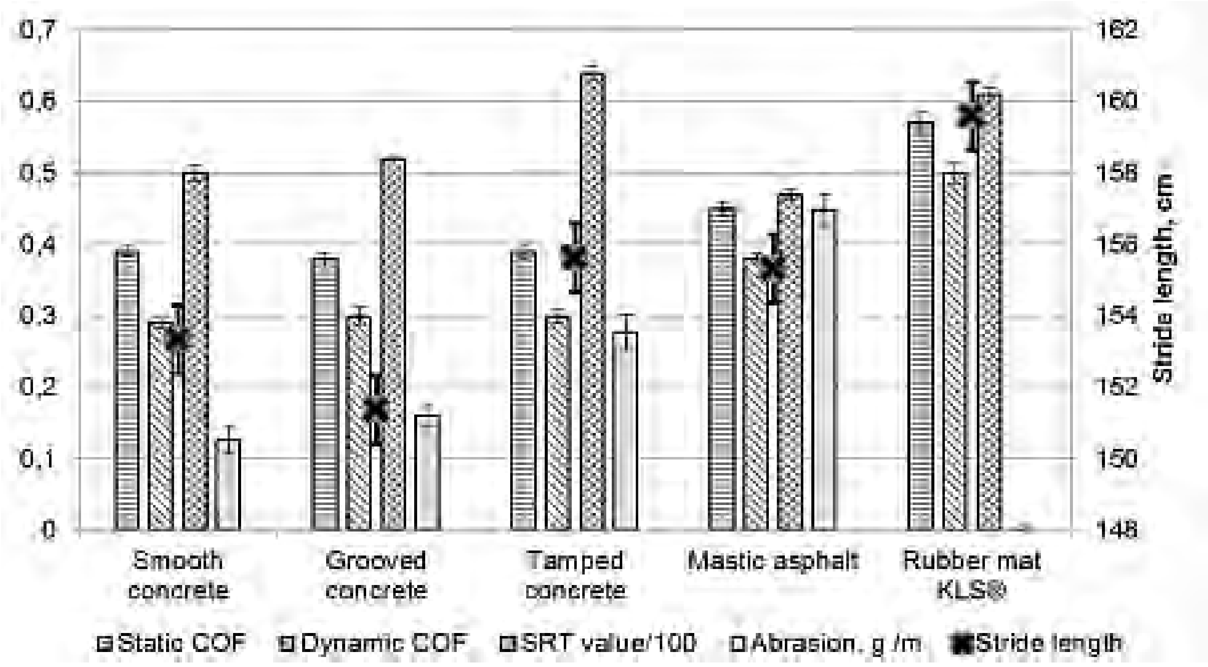

Figure 1. Technical characteristics of slipperiness and stride length on different floors

Acknowledgments

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References

1. ASTM. Standard test method for measuring surface frictional properties using the British pendulum tester. 1993. ASTM E303-93.

2. Flower FC, Sanderson DJ, Weary DM. Effects of milking on dairy cow gait. J Dairy Sci 2006 (89): 2084-2089.

3. Nilsson C. Floors in animal houses. Page in Vol. PhD., Lund, Sweden: Swedish Univ. of Agr. Dep.Farm Buildings 1988; 258.

4. Nilsson C, Jönsson R. Floors in horse stables – The design of aisle surfaces. In: European Society of Agricultural Engineers Conference. Oslo, Norway 1998; Vol. 98; 7.

5. Telezhenko E. Measurement of spatial gait parameters from footprints of dairy cows. Animal 2009 (3): 1746-1753.

Keywords: slipperiness, gait, floor, friction

4 MIXED TOPICS

15 Interdigital Hyperplasia In Holstein Cows: A Case Study Of A Farm With High Prevalence

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Introduction

Assessment of the health status of the bovine claw can be done during routine hoof trimming. In the large database of the third author, a farm was identified on which cows showed a highly elevated prevalence for interdigital hyperplasia (IH). Aim of the present study was to examine the data considering types of IH as well as influences on their occurrence.

Material and methods

The respective dairy farm has been a client for a long time such that assessment for IH on hind legs was available for 1,547 trimmings between 2003 to 2017. Observations were recorded at 22 farm visits and covered a total of 380 cows. For an analysis of the trend over years, data was edited so that only the last observation per year was kept. This yielded a total of 1,123 observations. For an analysis of incidence rate by lactations, cows were required to have had observations from first lactation onwards (n = 1,277 observations) and only the last observation per cow-lactation-number was kept. This yielded 790 observations of 316 individual cows.

Results and discussion

Table 1 displays incidence rates (definitions below table) over years. In 2017 (year not complete), 67 % of all cows show IH and 46 % are affected at both hind legs.

		Incidence-1		Left leg		Right leg		Incidence-2		Incidence-3	
	N	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
2003	63	0.17	0.38	0.13	0.34	0.13	0.34	0.08	0.27	0.25	0.59
2004	68	0.12	0.32	0.12	0.32	0.07	0.26	0.07	0.26	0.19	0.55
2005	85	0.14	0.35	0.09	0.29	0.12	0.32	0.07	0.26	0.21	0.56
2007	78	0.10	0.31	0.09	0.29	0.08	0.27	0.06	0.25	0.17	0.52
2008	79	0.13	0.33	0.11	0.32	0.06	0.25	0.05	0.22	0.18	0.50
2009	96	0.22	0.42	0.17	0.37	0.18	0.38	0.13	0.33	0.34	0.69
2010	79	0.16	0.37	0.13	0.33	0.14	0.35	0.10	0.30	0.27	0.63
2011	95	0.20	0.40	0.13	0.33	0.19	0.39	0.12	0.32	0.32	0.67
2012	77	0.31	0.47	0.16	0.37	0.23	0.43	0.08	0.27	0.39	0.63
2013	97	0.37	0.49	0.27	0.45	0.28	0.45	0.18	0.38	0.55	0.78
2014	70	0.46	0.50	0.34	0.48	0.34	0.48	0.23	0.42	0.69	0.83
2015	86	0.27	0.45	0.24	0.43	0.22	0.42	0.20	0.40	0.47	0.81
2016	104	0.51	0.50	0.38	0.49	0.41	0.49	0.29	0.46	0.80	0.86
2017	46	0.67	0.47	0.57	0.50	0.54	0.50	0.46	0.50	1.11	0.88

Incidence-1: Any hind leg affected yes/no – (1/0)
Incidence-2: Both hind legs affected yes/no – (1/0)
Incidence-3: Sum of affected hind legs
Left leg: incidence as yes/no (1/0)
Right leg: incidence as yes/no (1/0)

Analysis of incidence by lactation revealed increasing rates from 22 % to 43 % from parity 1 to 5. Clearly, IH is developing as cows are getting older and may not be seen as a problem when inspecting first parity cows only. IH appears in different manifestations, medial and lateral types can be differentiated. A number of images will illustrate the findings in the presentation.

Keywords: Hoof trimming data, interdigital hyperplasia, morphology

16 Acute Phase Response In The Outbreaks Of Interdigital Phlegmon In Dairy Herds In Finland

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Introduction

Recently, several Finnish dairy farms have suffered from the outbreaks of interdigital phlegmon (IP). With high morbidity and severe signs, these outbreaks have caused heavy economic losses (1). Acute phase proteins (APPs) are useful indicators of systemic infection and their role has been studied in various hoof diseases of cattle (2, 3). Our aim was to study APPs in the outbreaks of IP.

Materials and methods

We visited 18 free stall dairy herds with an outbreak of IP (IP herd) and 4 control herds. The criteria for an outbreak were; at least three affected cows during one week, and no previous cases of IP in the herd. The IP herds were later divided in two groups; herds with high morbidity in IP (>50%) and with moderate morbidity (9–33%) during the first month of the outbreak. We took blood samples of cows with IP, but also from cows with several other hoof lesions, like digital dermatitis (DD), interdigital dermatitis, sole ulcer or hoof abscesses, and control cows. Acute IP was diagnosed if a symmetric swelling, possible ulceration and odor appeared, and the healing process of IP defined with proliferation tissue or scar formation in the affected region. The diagnosis of DD was made according to Döpfer et al. (4). Of APPs, we analyzed serum amyloid A (SAA) and haptoglobin from the separated serum samples. SAA was measured with a commercial solid phase sandwich ELISA kit (Phase TM Range Multispecies SAA ELISA kit, Tridelta Development Ltd., Maynooth, Co. Kildare, Ireland) and haptoglobin determined by a haemoglobin-haptoglobin binding assay (Phase TM Range Haptoglobin kit, Tridelta Development Ltd., Ireland). The statistical analyses were performed by Stata IC version 14 (Stata Corporation, Texas, USA). In 2012 Finnish National Animal Experiment Board decided that our study was not an animal experiment. After their decision, Viikki Campus Research Ethics Committee of Helsinki University reviewed and approved the research protocol of this study.

Results

The control cows (n=66) had a mean SAA value of 37.46 µg/ ml with standard error (SE) of 6.21. A mean for a group of acute IP cows (n=61) was 312.58 µg/ ml (SE 37.92,), at a healing stage (n=36) 70.33 µg/ ml (SE 17.65), and in a group of other hoof diseases (n=51) 74.19 µg/ ml (15.23). The control cows had a mean value of haptoglobin 0.17 g/l (SE 0.03), acute IP group 2.20 g/l (0.25), healing IP 0.48 g/l (0.12), and other hoof diseases 0.33 g/l (0.08). Figure 1 presents the APP concentrations in various disease categories in high morbidity, moderate morbidity and control herds.

Discussion

The APP response of IP was clear and intense. In addition to SAA, also haptoglobin values were elevated in acute IP cases. Similar mean values were demonstrated in experimentally induced *E.coli* mastitis (5). Higher APP values reflecting more severe inflammation were detected in herds with high morbidity in comparison to moderate morbidity herds. The intensity of the APP response can be considered when deciding the treatment of IP.

Acknowledgements

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References
Häggman, J., Junni, R., Simojoki, H., Juga, J. and Soveri, T. The costs of interdigital phlegmon in four loose-housed finnish dairy herds. Acta Veterinaria Scandinavica 2015 (57):90

Kujala, M., Orro, T. and Soveri, T. Serum acute phase proteins as a marker of inflammation in dairy cattle with hoof diseases. Veterinary Record 2010 (166):240-241.

Tadich, N., Tejeda, C., Bastias, S., Rosenfeld, C. and Green, L. E. Nociceptive threshold, blood constituents and physiological values in 213 cows with locomotion scores ranging from normal to severely lame. The Veterinary Journal 2013 (197):401-405.

Döpfer, D., Koopmans, A., Meijer, F. A., Szakáll, I., Schukken, Y. H., Klee, W., Bosma, R. B., Cornelisse, J. L., Van Asten, A. J. A. M. and Ter Huurne, A. A. H. M. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and campylobacter faecalis. Veterinary Record 1997 (140): 620-623.

Hyvönen, P., Suojala, L., Orro, T., Haaranen, J., Simola, O., Røntved, C. and Pyörälä, S. Transgenic cows that produce recombinant human lactoferrin in milk are not protected from experimental *Escherichia coli* intramammary infection. Infection and Immunity 2006 (74): 6206-6212

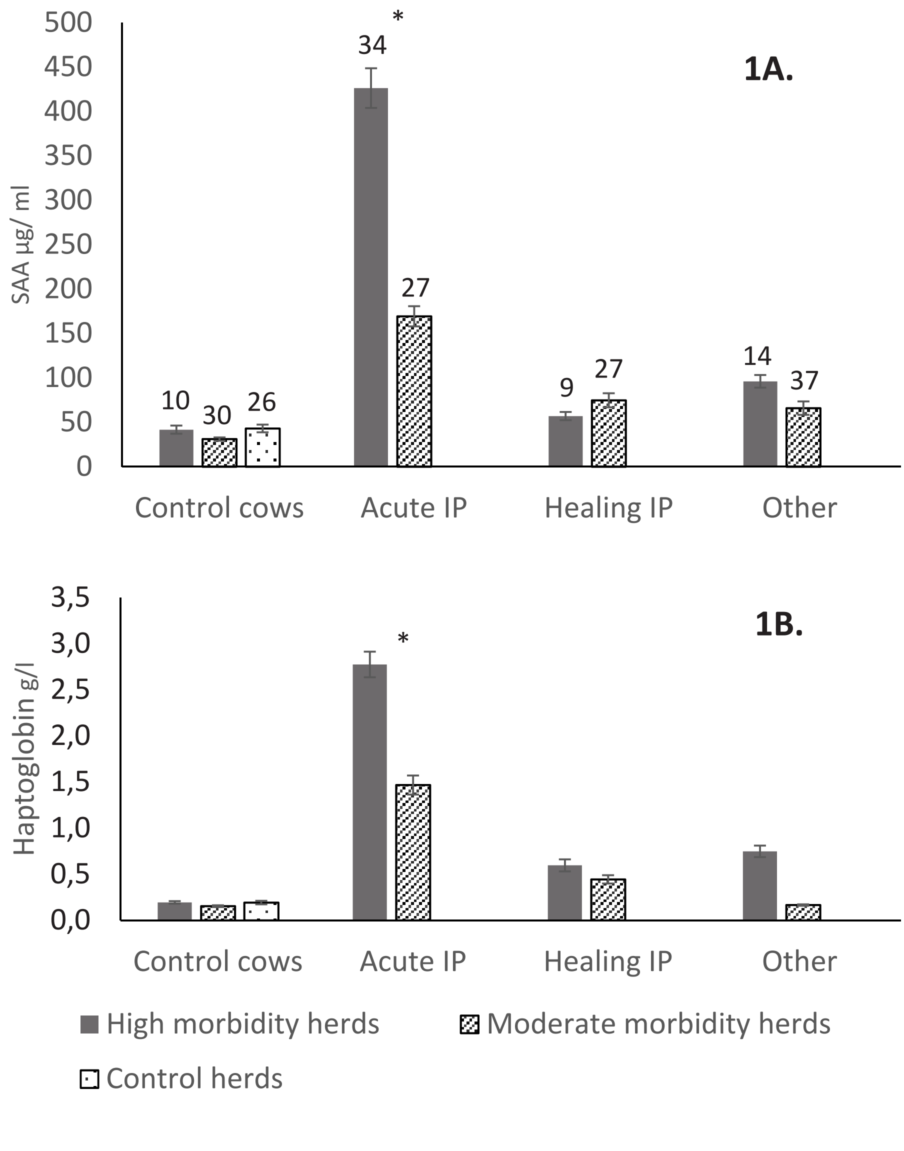

Figure 1A & B. The mean values and standard errors of SAA (A) and haptoglobin (B) in high (n=7) and moderate morbidity (11) outbreak herds, and control herds (4). The number of sampled animals in each group is presented above the columns of SAA values. T-test was performed within diseased animal groups. Statistical difference is marked with * ($p < 0.05$).

Keywords: interdigital phlegmon, outbreak, acute phase response, serum amyloid A, haptoglobin

17 Tibial Nerve Paresis In *Post Partum* German Holstein Cows - Etiology And Treatment Under Farm Conditions

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Introduction

Peripheral nerve injuries are the most frequent bovine neurological disorder. Aside claw diseases the tibial nerve paresis is the most frequent cause of lameness in milking cows after parturition. Its clinical symptoms involve a hyperflexion of the hock and a forward knuckling of the fetlock joint. The aim of the current study was to develop a diagnostic and therapeutical procedure and to verify it under farm conditions.

Materials and Methods

A study was conducted from January 2013 to Dezember 2016, involving 30 stationary patients at the clinic and 36 cases presented on farm visits. In 21 cases no treatment was applied, due to the lack of consent by the owner (14 cases), short appearance of symptoms (only during 24 h in 5 cows) and euthanasia (2 cows, due to coma hepaticum and bilateral pyelonephritis). The other 45 cows were treated as follows: after initial systemic treatment with antibiotics and steroidal antiphlogistics (IV injection of 0.4 mg/kg BW dexamethasone) the affected leg was stabilized from the coronary band to the distal part of the tarsal joint using a synthetic resin cast. The cast was removed after 28 days by splitting it laterally and medially into two parts. These parts were then reapplied as a new bandage. After two weeks a supporting bandage was applied, which was removed after another two weeks.

Results

In 12/45 cases the pressure exerted by the cast resulted in decubitus wounds, mostly occurring in severe cases of tibial nerve paresis with a high grade of hyperflexion and knuckling. By changing the treatment schedule in form of removing the cast earlier and treating for a longer time with supporting bandages the paresis was treated successfully in 11 cases. In one case the complications were too severe and the animal was culled. In all 45 cases the symptoms of a tibial nerve paresis were absent 56 days following treatment (most of them after 28 days).

Discussion

The short regeneration time in each case shows that a low-grade damage of the nerve is present. In case of severe damage of the nerve, followed by a WALLERIAN-degeneration, the regeneration would have required two months to one year, depending on the site of injury. This study presents a way to treat the tibial nerve paresis in case of a low-grade nerve damage. The etiology of tibial nerve paresis in post parturient cows is multifactorial and a more profound data collection concerning patient history and anamnesis is needed to further elucidate its cause and possible prevention strategies.

Key Words: neurological disorder, tibial nerve paresis, transition cow

18 Magnitude Of Wear In Wooden Hoof Blocks Is Associated With The Density Of The Wood

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Introduction

Hoof blocks are routinely used as an ancillary tool in the treatment of lame cows in dairy herds, however, not much attention has been paid to its characteristics. Hoof blocks are expected to provide support for the diseased claw for a certain amount of time, alleviating pain and allowing for improved rate of healing. Different materials are used in manufacturing hoof blocks. Wooden hoof blocks are used quite prevalent in the dairy industry. Different type of wood is used in manufacturing wooden hoof blocks around the world.

Materials and Methods

Methods used were approved by the Animal Ethics Committee of The University of Sydney. Wooden blocks were manufactured from three different type of wood with different densities (n = 36); soft wood (**FG**), medium wood (**BG**) and hard wood (**IB**) blocks. Blocks were applied to cows with sound locomotion to assess the magnitude of wear in three different groups (n = 12) during 28 days after application. Block thickness were measured during milking at days 7, 11, 14, 18, 21, 25 and 28. Thickness was measured at three points during milking using a digital height meter. Abaxial wall angle was also measured using a digital inclinometer. The density of wood was measured using a modified hydrostatic weighing technique. Wooden hoof blocks sourced from other countries were compared in thickness, surface area and density.

Results

The first measurement was done on 32 cows as 4 cows (11%) lost their blocks. The FG blocks were lost by day 14. Almost half of the cows in the BG and IB groups lost their blocks by day 21 and 28, respectively. In comparing the three blocks, statistically significant difference was found in the magnitude of wear at the front and abaxial point of BG and IB blocks compared to the FG group. However, at the caudal point, this significant difference was only found between the IB and the FG group. It was also shown that FG blocks had the tendency to wear at the abaxial edge compared to BG and IB blocks. Results from comparison of internationally sourced blocks will be addressed at a later stage.

Discussion

We aimed to estimate the density of wood suitable for manufacturing wooden hoof blocks. Higher density wooden hoof blocks not only wore down with a slower rate but also remained attached for a longer period. It was also demonstrated that the distribution of wear across the harder blocks was more even, maintaining a more consistent abaxial wall angle. The capacity of the wooden hoof blocks to provide support and relieve weight bearing by the diseased claw, for the proposed duration of 28 days needed for healing, seem to be influenced by the longevity, wear characteristic and design of the block. It is sufficient to say that it is inappropriate to assume the performance of different wooden blocks are the same.

Acknowledgements

The authors would like to thank Mr. Greg Johnston (Camden Cow Clogs) for providing hoof blocks and advice on wood, Associate Professor Tina Bell for her guidance of the measurement of wood density and Mr. Gavin Moore for providing the study farm and cows.

Key words: Hoof block, Wood, Density, Wear

P 4-1 Peri-Tarsitis In Youngstock And Young Dairy Cows

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Introduction

Hock lesions are generally seen, together with locomotion score, as important indicators for animal welfare in dairy cows (Barberg et al., 2007). The prevalence of hock lesions in dairy cows is generally reported as high (>50%:Kester et al., 2014). In a German study, the mean herd prevalence of hock lesions, i.e. scabs, wounds, and swellings, was estimated to be 50% also, (Brenninkmeyer et al., 2014). In literature, no specific reports about youngstock can be found on investigations of prevalence and risk factors of hock lesions. To estimate the prevalence and risk factors of hock lesions in youngstock, a survey was carried out in combination with a study on the prevalence and risk factors of hind claw disorders (Holzhauer et al., 2012).

Material and methods

The same dataset is used as is described for a two years longitudinal study on the prevalence and risk factors of claw and hock disorders in youngstock (Holzhauer et al., 2012). Randomly selection of 40 female youngstock, aged 2 months – 2 years, in 10 dairy herds. Observations of these animals were done 8 times with 3 monthly intervals (May 2008-February 2010). In the two years study period some youngstock was culled and sometimes a few animals could not be observed. In total 2731 observations were suitable for estimating the prevalence of hock lesions. Calves were predominantly housed on straw until 3 months and from 3 months until the end of the study on slatted floors with cubicles (mainly rubber mats); except 1 herd from 3 months until first calving on concrete floor with cubicles, and later also on slatted floor with cubicles; and except 1 herd from 3 months to the end of study on concrete floor with cubicles. Nearly all the concrete and slatted floors had manure scrapers. Beneath hind claw observations, also was notified the presence of hock lesions. Observations were notified as presence or absence of (peri-)tarsitis. The difference of PT for right and left side and for pasture and housing was tested statistically with the chi-squared test ($P < 0.05$).

Results

All the positive observations resulted in few to moderate swelling, so we use the term of peri-tarsitis (PT) instead of (peri-)tarsitis.

Criteria	tarsus left	tarsus right	pasture group	housing group
Number of observations	2731	2731	1384	1347
Cows with PT	11	18	12	17
% cows with PT	0,4	0,7	0,9	1,3

Table1. Peri-tarsitis in youngstock and young dairy cows

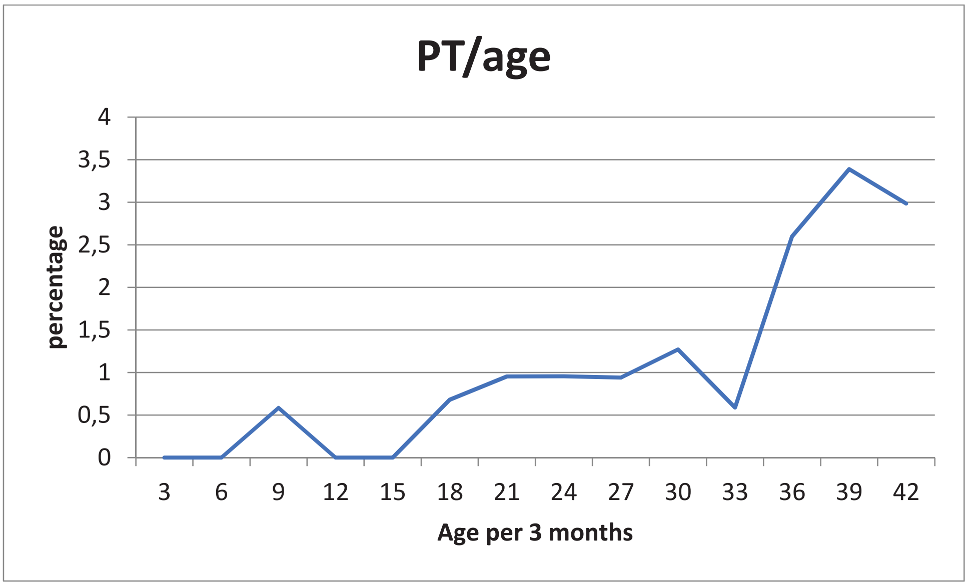

Figure1. Relation PT/age in youngstock and young dairy cows

Conclusions

Compared with data from literature, youngstock in this research group have much lower prevalence of PT as mature dairy. Year round housed young stock had no statistical higher prevalence of PT as summer grazed youngstock (p=0.3). There was no statistical difference in prevalence for PT right compared to left (p=0.2). Though a low prevalence of PT in youngstock, it is increasing when getting older.

References

Barberg AE, Salfer JA, Reneau JK. 2007. Performance and welfare of dairy cows in an alternative housing system in Minnesota. J. Dairy Sci. 90:1575-83.

Brenninkmeyer C, Dippel S, Brinkmann J, March S, Winckler C, Knierim U. 2013. Hock lesion epidemiology in cubicle housed dairy cows across two breeds, farming systems and countries. Prev. Vet. Med. 109: 236-45.

Holzhauer M Brummelman B Frankena K and Lam TJGM 2012 A longitudinal study into the effect of grazing on claw disorders in female calves and young dairy cows. Vet. J. 193: 633-638

Kester E, Holzhauer M, Frankena K. 2014 A descriptive review of the prevalence and risk factors of hock lesions in dairy cows. Vet. J. 202: 222-8.

Key words: youngstock, hock lesions.

P 4-2 A Sand Crack In A Giraffe And Its Treatment

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Introduction

Vertical fissures in the hoof or sand cracks are scarce in cattle, horses and other species and demand specialized treatment (Holzhauer, personal communication). Although reports on the clinical efficacy of these different techniques are scarce (3), some techniques to fixate these cracks are described in equine and bovine medicine (1, 4). As far as we know, this is the first report of a complete vertical hoof crack in a giraffe, including the successful fixation.

Materials and Methods

A 1.0-yr-old, female reticulated giraffe (*Giraffa camelopardalis reticulata*) at ARTIS Amsterdam Royal Zoo, The Netherlands, was severely lame in the right front leg. A complete sand crack (see Fig 1.?) was visible in the inside claw. The animal was anesthetized two times with 15 mg medetomidine and 375 mg ketamine. The crack was refreshed and inspected. There were no remarks on hoof-horn quality. On each side of the crack 3 stainless steel screws were placed. Silver wire was applied upwards in oblique direction to the opposite site. This pattern was continued downwards. Then Vettec Superfast adhesive (Vettec Hoofcare, Utrecht, The Netherlands) was applied.

Results

The fixation was worn off after 29 days. A new fixation was applied in the same way, while the inside claw was shortened more. This fixation remained until 140 days.

Discussion

The described fixation method is suitable in giraffes. Foot imbalance might be a potential cause of this sand crack, similar as described in horses (1). Training this giraffe is essential for hoof care in the future (2).

Acknowledgements

The authors would like to thank the management and personnel of the ARTIS Amsterdam Royal Zoo for their great assistance with this case report.

References

1. Booth T. Clinical aspects of the equine foot. Part 3: Hoof cracks and wall injury. 2009. UK Vet 14;1–5

2. Dadone LI, Schilz A, Friedman SG, Bredahl J, Foxworth S, Chastain B. 'Training Giraffe (*Giraffa camelopardalis reticulata*) for Front Foot Radiographs and Hoof Care', 2016. Zoo Biology 35: 228–236.

3. Pardoe CH, Wilson AM. 'In vitro mechanical properties of different equine hoof wall crack fixation techniques', 1999. Equine Veterinary Journal 31(6): 506–509.

4. Shearer JK. 'Hoof Wall Cracks in Cattle', In: VM169, one of a series of the Veterinary Medicine-Large Animal Clinical Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. 2007. http://edis.ifas.ufl.edu.

Keywords: Giraffe, complete sand crack, fixation

Fig 1. A complete sand crack was visible in the inside claw of the right front leg of a 1.0-yr-old, female reticulated giraffe (*Giraffa camelopardalis reticulata*) at ARTIS Amsterdam Royal Zoo, The Netherlands.

P 4-3 Evaluation Of The Relationship Between Hyperketonemia And Hoof Horn Lesion In Dairy Cattle

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Introduction

Lameness has a large impact on the economics of dairy production (Bicalho et al., 2008; Cramer et al., 2009) and the welfare of the cow. Factors such as body condition score (Randall et al., 2015; Green et al., 2014), the thickness of the digital cushion (Machado et al., 2011; Bicalho et al., 2009) and subclinical ketosis (Berge et al., 2014) have been identified as risk factors for lameness. These risk factors indicate that there is a likely relationship between fat mobilization and lameness. One way to measure fat mobilization in early lactation is to determine the beta-Hydroxybutyrate (BHB) status of cows (Iwersen et al., 2009).The goal of this study was to evaluate the relationship between negative energy balance as measured by BHB levels in early lactation and the development of hoof horn lesions in the first 100-150 days in milk.

Matherials and Methods

Data was collected in one freestall herd milking 1600 cows, located in Minnesota (USA). This herd participated in a hoof trimming technique study (Institutional Animal Care and Use Committee #1412-32099A) and the current project used the same cows. From February to August 2016 BHB levels in blood were determined biweekly in cows at 3-14 DIM who did not have lesions when they were trimmed 60-100 days prior to calving. The BHB measurements were determined cowside using the NovaVet BHB meter. Following BHB testing all cows were evaluated for lesions between 100-150 DIM. To determine the relationship between lesion status at the mid lactation evaluation and BHB status post calving odds ratios were calculated at different BHB cut-off points (BHB > 1.2; > 1.4; > 1.6; > 1.7 mmol/L) using R (Free Software).

Results

A total of 249 cows were enrolled in the study and 41% were in 2nd lactation and 49% in 3rd lactation or greater. Holsteins made up the majority (60.5%) of the breeds represented with the remaining 30.5% being crossbreds. Overall incidence of hyperketonemia (BHB > 1.1 mmol/L) was 16%. Incidence of hoof horn lesions (Sole Ulcer, White Line Disease, Toe Ulcer/Necrosis and Thin Sole) was 9%, with the most prevalent condition being White Line Disease (70% of horn lesions). No relationship was found between BHB levels in the 3-14 days post calving and the incidence of lesions at mid lactation trimming.

Discussion

No relationship was found between a single BHB level post calving and hoof horn lesions at mid lactation. Lack of relationship could be due to the fact that measurement has been done in very early lactation and BHB levels are not close to peak levels. Also, incidence of hyperketonemia and lesions was low in this well managed herd. There might be some seasonal influences, study has been done only during one season. Furthermore, WLD was the most common lesion in this herd and biologically, fat mobilization should affect more likely lesions such as sole ulcers. It remains a need to more fully understand the mechanism of hoof horn lesion development.

Acknowledgements

University of Minnesota, ANKA Hoof Care, Gar-Lin Dairy .

References

Berge, A.C., and G. Vertenten.. A field study to determine the prevalence, dairy herd management systems, and fresh cow clinical conditions associated with ketosis in western European dairy herds. *Journal of Dairy Science* 2014 (97):2145–2154.

Bicalho, R.C., V.S. Machado, and L.S. Caixeta. Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. *Journal of Dairy Science* 2009 (92):3175–3184.

Bicalho, R.C., L.D. Warnick, and C.L. Guard. Strategies to analyze milk losses caused by diseases with potential incidence throughout the lactation: a lameness example. *Journal of Dairy Science* 2008 (91):2653–2661.

Cramer, G., K.D. Lissemore, C.L. Guard, K.E. Leslie, and D.F. Kelton.. The association between foot lesions and culling risk in Ontario Holstein cows. *Journal of Dairy Science* 2009 (92):2572–2579.

Green, L.E., J.N. Huxley, C. Banks, and M.J. Green. Temporal associations between low body condition, lameness and milk yield in a UK dairy herd. *Preventive Veterinary Medicine* 2014 (113):63–71.

Iwersen, M., U. Falkenberg, R. Voigtsberger, D. Forderung, and W. Heuwieser. Evaluation of an electronic cowside test to detect subclinical ketosis in dairy cows. *Journal of Dairy Science* 2009 (92):2618–2624.

Machado, V.S., L.S. Caixeta, and R.C. Bicalho. Use of data collected at cessation of lactation to predict incidence of sole ulcers and white line disease during the subsequent lactation in dairy cows. *American Journal of Veterinary Research* 2011 (72):1338–1343.

McArt, J.A.A., D.V. Nydam, G.R. Oetzel, T.R. Overton, and P.A. Ospina. Elevated non-esterified fatty acids and β-hydroxybutyrate and their association with transition dairy cow performance. *Veterinary Journal* 2013 (198):560–570.

McArt, J.A.A., D.V. Nydam, and M.W. Overton. Hyperketonemia in early lactation dairy cattle: A deterministic estimate of component and total cost per case. *Journal of Dairy Sciience* 2015 (98):2043–2054.

Randall, L.V., M.J. Green, M.G.G. Chagunda, C. Mason, S.C. Archer, L.E. Green, and J.N. Huxley. Low body condition predisposes cattle to lameness: An 8-year study of one dairy herd. *Journal of Dairy Science* 2015 (98):3766–3777.

Keywords: dairy cow hoof lesions, β-Hydroxybutyrate, hyperketonemia

P 4-4 Prevalence Of *Dichelobacter Nodosus* And *Fusobacterium Necrophorum* In The Interdigital Space Of Healthy And Lame Dairy Cows

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Introduction

The bacteria *Dichelobacter nodosus* and *Fusobacterium necrophorum* cause a highly pathogenic claw disease in dairy cows – interdigital phlegmon. The presence of *D. nodosus* has been described in dairy cows with claw diseases (interdigital phlegmon and digital dermatitis) and in healthy cows (Knappe-Poindecker et al., 2013; Capion et al., 2012; Rasmussen et al., 2012; Zhou et al., 2009; Bennet et al., 2009; Osová et al., 2015, 2016). The aim of this study was to compare the prevalence of *D. nodosus* and *F. necrophorum* on the interdigital skin of healthy and lame dairy cows on one farm.

Material and methods

On a dairy farm out of a total of 314 dairy cows 20 cows were diagnosed with a lameness grade 3 – 5 according to Sprecher et al. (1997). From all 314 cows two sterile swabs were taken from the interdigital space of the right pelvic limb. They were inoculated in tubes containing Anaerobic Basal Broth (AB) and Phosphate Buffered Saline (PBS), respectively. In a next step the samples were processed in order to multiply and detect DNA of the anaerobic bacteria *D. nodosus* and *F. necrophorum*. DNA was extracted from the AB and PBS tubes with the method of freezing and boiling, and additionally from the PBS tube with a commercial kit (High Pure PCR Template Preparation Kit, ROCHE).

Results

290 out of 294 healthy cows (98.6 %) and all 20 lame cows (100 %) were positive for *D. nodosus*. Only 132 healthy cows (44.9 %) and eleven lame cows (55 %) were positive for *F. necrophorum*. The difference in prevalence between both bacteria was statistically significant in healthy cows ($p<0.0001$) as well as in lame cows ($p=0.0012$). However, there was no significant difference in prevalence of both pathogens between healthy and lame dairy cows.DNA of anaerobic bacteria was extracted using three different methods. The results are shown in table 1.

Positive (%)	**Healthy cows**		**Cows with lameness**	
	N	%	N	%
PBS *D.nodosus*		60,88[a]		50[a*]
AB *D.nodosus*		84,69[b]		80
Roche *D.nodosus*		88,44[b]		85[b*]
PBS *F.necrophorum*		2,38[d]		5[d*]
AB *F.necrophorum*		42,52[c]		55[c*]
Roche *F.necrophorum*		3,4[d]		0[d]

Table 1: Comparison of extraction methods, groups with different letters (a,b,c,d) are significantly different, $p<0.0001$, except * $p<0.05$

For *D. nodosus* the commercial kit and for *F. necrophorum* the AB method was the most sensitive method of extraction.

Discussion

Osová et al. (2015, 2016) reported a prevalence of *D. nodosus* between 64.1 and 100 %, depending on extraction method and lameness status of the cows. Bennet et al. (2009) reported 53.4 % positive samples for *F. necrophorum* in lame cows and Osová et al. (2015) of 39.1 %. These findings corroborate the results of this study. The limiting factor is that the study was performed on one farm and the results cannot be extrapolated to draw general conclusions about the prevalence of both pathogens.

Conclusion

The obtained results point out that there is no difference in prevalence of the anaerobic bacteria *D. nodosus* and *F. necrophorum* between healthy and lame dairy cows.

References

Bennett, G., Hickford, J., Zhou, H., Laporte, J., Gibbs, J. Detection of *Fusobacterium necrophorum* and *Dichelobacter nodosus* in lame cattle on dairy farms in New Zealand. Research Veterinary Sci. 2009; 87:413–415.

Capion, N., Boye, M., Ekstrom, C.T., Jensen, T.K. Infection dynamics of digital dermatitis in first-lactation holstein cows in an infected herd. J. Dairy Sci. 2012; 95:6457–6464.

Knappe-Poindecker, M., Gilhuus, M., Jensen, T.K., Klitgaard, K., Larssen, R.B., Fjeldaas, T. Interdigital dermatitis, heel horn erosion, and digital dermatitis in 14 Norwegian dairy herds. J. Dairy Sci. 2013; 96:7617–7629.

Osová A, Segurado Benito Pilipčincová I, Király J, Mudroň P. Výskyt *Dichelobacter nodosus* a *Fusobacterium necrophorum* v interdigitálnom priestore zdravých dojníc a dojníc s ochoreniami paznechtov. XI. Seminar for Postgraduate Students devoted to the memory academician BOĎA. Scientific work of PhD students. 2016 Sept. 5–6, Košice, Slovak Republic. ISBN 978-80-971428-3-4.p.67–69.

Osová, A., SeguradoBenitoPilipčincová, I., Király, J., Mudroň, P. Porovnanie metód izolácie *Dichelobacter nodosus* a *Fusobacterium necrophorum* z končatín dojníc. X. Seminar for Postgraduate Students devoted to the memory academician BOĎA. Scientific work of PhD students. 2015 Sept. 8–9, Košice, Slovak Republic. ISBN 978–80–971428–2–7.p.62–66.

Rasmussen, M., Capion, N., Klitgaard, K., Rogdo, T., Fjeldaas, T., Boye, M., et. al. Bovine digital dermatitis: Possible pathogenic consortium consisting of *Dichelobacter nodosus* and multiple *Treponema* species. Vet. Microbiology 2012; 160:151–161.

Zhou, H., Bennett, G., Hickford, J.G.H. Variation in *Fusobacterium necrophorum* strains present on the hooves of footrot infected sheep, goats and cattle. Vet. Microbiology 2009; 135:363–367.

Keywords: *Dichelobacter nodosus*; *Fusobacterium necrophorum*; laboratory diagnostics; DNA extraction; PCR

P 4-5 Therapy Of The Metacarpal And Metatarsal Fractures In Calves In Field Conditions

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Introduction

Long bone fractures are common in beef and dairy cattle. It often happensin beef cattle, where calves stay in the herd with their mother. In this case calves can be trampled by their mother or other adults of the herd. Other causesare rough handling during calving, use of excessive force or use of special tools (calf puller etc.). Fractures of the metacarpal and metatarsal bones are the most common type of fractures in cattle (50%) (1). Usually it is a simple transverse or simple oblique fracture. For fractures of the metacarpusor metatarsus external skeletal fixation (ESF) is considered as an ideal option, because of the limb anatomy where neurovascular tissue proceeds caudolateral and caudomedial, while the ESF is attached lateromedial. On metacarpus and metatarsusthere is a minimum of soft tissue which simplifies attachment.

Materials and Methods

In our study we used an external fixation with percutaneous pins and acrylic column or external fixation with percutaneous pins in combination with cast. For patients in whom both fragments were large enough that it was possible to introduce at least two pins to each fragment, percutaneous fixation with acrylic column was used. In the case of patients with short distal fragment that wasn`t possible to put two pins in, external fixation with percutaneous pins in combination with cast was used . After waking up from anesthesia, the animals are able to stand on the treated limb. ESF was usually left for 8 weeks and then removed. As cured, we consider animals that were returned to the breeding.

Results

From 2009 to 2015 we treated this way a total of 26 calves in 3 farms aged up to one week, usually immediately after birth. 22 calves were successfully recovered. The treatment failure occurred in one calf and it was taken out of breeding due to complications during the healing of the fracture. 3 calves were removed or died during treatment for other causes unrelated to fracture (respiratory syndrome, diarrhoea syndrome etc.).

Discussion

Bone fractures of limbs in calves at most farms often causes unnecessary euthanasia of animals or the elimination of breeding. Usually when calf is proceed to therapy common bandages or simple casts areused, but that does not prevent rotation of the limb or shifting fragments. Thus there is no proper healing and therefore it often end fatal. The methods described above are relatively inexpensive and fast and can be easily done in field conditions. Early therapeutic intervention allows in most cases to save the calf. Despite the other diseases (like respiratory syndrome, diarrhoea syndrome etc.) in these cases we do not expect a loss on weight gain. Cattle are excellent patients for treatment of orthopedic injuries because they spend a majority of time lying down, have a tremendous potential for bone healing, are more resistant than other animals to contralateral limb breakdown and stress laminitis, and usually do not resist having orthopedic devices on their limbs (1).

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References
1. Anderson DE, St Jean G, Management of Fractures in Field Settings, Veterinary Clinics of North America: Food Animal Practice. 2008:24 (3): 567-82.

Keywords: fracture, metacarpus, metatarsus, calf, ESF

P 4-6 Complicated Claw Lesions In German Holstein Cows Under Field Conditions In Larger Dairy Herds – Diagnosis, Surgical Treatment And Follow Up

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Introduction

In cows with common claw disorders profound septic inflammatory processes of the corium can develop and spread to neighbouring structures. In most cases radical surgical treatment is necessary (resection of the toe (RT), digital amputation (DAMP), resection of the distal interphalangeal joint (JRES), resection of the flexor tendon (RESFT)). The aim of the study is to test the practicability and acceptance in larger dairy farms.

Materials and Methods

In this retrospective study 175 German Holstein dairy cows from 13 free-stallfarms (540 ± 174 milking cows, 10,216 ± 704 kg milk yield) in Saxony/Germany and Thuringia were included. All of them had been treated by hoof trimmers or veterinarians. Cows suffered from profound, partially perforated inflammation of the pododerma of one claw. The surgical treatment occured under retrograde intravenous anesthesia (15 ml Procainhydrochlorid, Procasel 2%®, Selectavet GmbH). The wounds were treated with chlorotetracyclinehydrochloride-spray (CTC-Blauspray®, WDT) and formosulfthiazole-ointment (Socatyl® SFD, WDT) under bandage. RT (N = 120), DAMP (N = 40), JRES (N = 23), or RESFT (N = 2) were performed in the clinic (N = 80) or in the farm (N = 95). A wooden- or rubber-block was attached to the healthy partner claw. Starting ahead the surgery the animals were treated with non-steroid antiphlogistics and antibiotics for three consecutive days after surgery. The first three replacements of the bandage and wound revision were performed with a three-day range and later with a five- to seven-day range. The outcomes were classified as back to the routine milking process (A), slaughtering as active decision because of bad economical prognosis (B), slaughtering because of failure of therapy (C), culling by euthanasia (D).

Results

The cows, which treated in the clinic, were sent back to the farm 21 ± 14 days after RT, 18 ± 6 days after JRES, x + y days after RESFT or 12 ± 6 days after DAMP. The following treatments in the farm were done by the local vet or the hoof trimmer under our guidance. 151 cows went back to the routine milking process (A), 17 cows were slaughtered as active decision because of bad economical prognosis (N = 17; B), or because of failure of therapy (N = 7; C), x cows were euthanized, respectively.

Discussion

The high prevalence of severe or long lasting lameness is not only a welfare issue, but currently also one of the major causes of culling. The current study illustrates that even under field conditions cows with complicated claw disorders can have the same life expectancy as their unaffected herdmates when appropriate surgical treatment and aftercare is provided.

Key words: cattle, toe resection, digital amputation, resection of the distal interphalangeal joint, resection of the flexor tendon

5 HYGIENE

19 Seasonal Variability In Locomotion Scores And Foot Lesions On Organic Dairy Farms In The United States

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Introduction

Ideally, organic livestock production aims to use best management practices to prevent disease and to ensure the wellbeing of animals. Surprisingly the prevalence and risk of lameness is similare between organic and non organic herds and higher when cows spend more time outdoors (1) In the Upper Midwestern USA the housing and nutrition of organic cows changes throughout the year due to the pasture requirement under the National Organic Program. Hence, to fully understand the riskfactors for lameness on an orgainc farm a prospective longitudinal study is needed. The objective of this study was to describe foot health and risk factors for lameness of organic dairy cows over the course of a year.

Materials and Methods

In the Spring of 2015, a convenience sample of 10 organic dairy farms in upper midwestern USA were enrolled and followed for 6 visits, two-months apart. At the first visit, 25 sentinel cows were randomly selected blocked by parity and lactation stage. At the 2nd, 4th, and 6th visit the feet of the 25 sentinel animals were examined for foot lesions and sole thickness at the toe was measured. In addition at the 1st visit 3 animals had pedometers applied er (IceQube, Icerobotics, Scotland). The data of the 3 pedometers was averaged each month to estimate the average distances walked daily in the herd. At each visit a management survey and assessment of the environemnt was conducted and the entire lactating herd as well as all available dry cows and pre-fresh heifers were assessed for locomotion, body condition, hock and hygiene scores.

Results

In the study herd size ranged from 60-120 milking cows. Over the course of the pasture season, the number of steps increased followed by a decline in the fall and winter months. Similarly, the prevalance of lameness increased dramatically at the beginning of the pasture season and declined back to previous levels over the course of the summer. Hygiene scores improved over the course of the summer. On average, cows lost body condition over the course of the summer. The frequency of infectious foot lesions (e.g. digital dermatitis) and heel erosions decreased over the pasture. Overall, the most common lesion observed were heel horn erosions, digital dermatitis and sole hemorrhages. Most sole hemorrhages were observed during the January visit in the middle of the housing season. Sole to P3 thickness at the toe decreased on average from 11mm in May to 9 mm in September and January. Herds with well maintained pasture walk ways were less likely to observe hemorrhages.

Discussion

As expected, the foot health and locomotion scores of organic cows changed over the course of the summer. Pasture and a clean environment were beneficial against infectious foot lesions and well maintained pasture walk ways are important to prevent foot lesions. The strong increase in lameness at the beginning of pasture season may be attributable to the rapid increase in walking distances or nutritional factors.

Acknowledgements

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References

Richert RM, Cicconi KM, Gamroth MJ, Schukken YH, Stiglbauer KE and Ruegg PL. Perceptions and risk factors for lameness on organic and small conventional dairy farms. Journal of Dairy Science 2013 (96): 5018–5026.

Key Words: pasture, foot lesions, organic, sole thickness, body condition

20 Are Biosecurity Measures Associated With The Odds Of Digital Dermatitis In Dairy Herds?

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Introduction

Biosecurity is a concept that can be divided into two categories: a) external biosecurity which involves practices to protect herds against external sources of pathogens, and b) internal biosecurity comprising practices to restrain infectious agents from dissemination within a herd. In addition to gains on productivity, biosecurity may also result in improved animal welfare, better health status and reduced use of antibiotics in livestock herds (Brennan and Christley, 2012; Laanen et al., 2013). Despite its importance, the influence that biosecurity may have for controlling digital dermatitis (DD) remains unclear. The objective of this study was to evaluate the relationship between biosecurity measures and DD in dairy herds.

Materials and methods

A cross-sectional study was conducted in Danish commercial dairy herds from January 2015 until August 2016. Digital dermatitis at the hind legs was scored in all lactating cows during milking in the milking parlour after washing of the legs (Thomsen et al., 2008). A cow was scored as positive if it had any clinical manifestation of DD, based on the M-stages classification (Berry et al., 2012), in at least one hind foot; or negative if skin alterations associated with the disease were not detected. Information about biosecurity was collected through questionnaires addressed to farmers, on-farm observations, and information from the Danish cattle database. These assessment tools were designed considering potential sources of DD pathogens and included infected hosts, manure, farm staff, vehicles, equipment and facilities. Two separate logistic regression models were built with 7 external and 8 internal biosecurity measures being predictors, and herd level prevalence of DD as the outcome.

Results

A total of 8,269 cows in 39 herds were evaluated with an overall DD prevalence of 24%. Herd level prevalence ranged from 0% to 56%. External biosecurity predictors associated with higher odds of DD had odds ratios (OR) varying between 1.2 and 2.6 and included e.g. recent purchase of cattle and farm staff working at other dairy farms as well. Regarding internal biosecurity, lack of frequent manure scraping and presence of manure in waterers were examples of important predictors associated with increased OR of DD (range1.2 to 2.0).

Discussion

These findings showed that both infected cows and farm employees may contribute to the spread of DD pathogens between herds. Thus, maintaining closed herds and ensuring correct personal hygiene of employees could implicate less DD cases. Increased odds of DD were found in herds that did not adopt measures to reduce the exposure of cows to manure. Since DD Treponema is present in manure (Klitgaard et al., 2014), this was possibly a consequence of higher infection pressure for the animals. So improvements in the hygiene of dairy facilities appear to be a relevant control measure. Overall, results from this study showed that adequate internal and external biosecurity measures were associated with lower odds of DD.

Acknowledgments

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References

Berry SL, Read DH, Famula TR, Mongini A and Döpfer D 2012 Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. *The Veterinary Journal* 193: 654-658.

Brennan ML and Christley RM 2012 Biosecurity on cattle farms: a study in north-west England. *PloS one* 7: e28139.

Klitgaard K, Nielsen MW, Ingerslev HC, Boye M and Jensen TK 2014 Discovery of bovine digital dermatitis-associated Treponema spp. in the dairy herd environment by a targeted deep-sequencing approach. *Applied and Environmental Microbiology* 80: 4427-4432.

Laanen M, Persoons D, Ribbens S, de Jong E, Callens B, Strubbe M, Maes D and Dewulf J 2013 Relationship between biosecurity and production/antimicrobial treatment characteristics in pig herds. *The Veterinary Journal* 198: 508-512.

Thomsen PT, Klaas IC and Bach K 2008 Scoring of digital dermatitis during milking as an alternative to scoring in a hoof trimming chute. *Journal of Dairy Science* 91: 4679-4682.

Keywords: biosecurity, digital dermatitis, dairy cow, hoof disorder, disease control

21 An Approach To Filtering And Recycling Copper Sulfate Foot Bath Solutions To Decrease Cost And Environmental Impact

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Introduction

Whole-herd foot bathing with copper sulfate ($CuSO_4$) can aid in control of digital dermatitis (1,2,3). However, $CuSO_4$ is an environmental hazard if applied onto pasture as the majority of the copper strongly adsorbs to organic matter and clay surfaces leading to copper accumulation (4). If $CuSO_4$ foot baths could be filtered and recycled, the cost and the environmental impact of using $CuSO_4$ footbaths could be significantly reduced. This paper describes an approach to do this on a New Zealand dairy farm.

Materials and Methods

The study was undertaken on a 550-cow spring-calving dairy farm, where part of the herd was housed and an exponential increase in digital dermatitis prevalence necessitated the installation of a foot bath. Total foot bath volume was 620 L with a wall height of 20 cm for a minimum solution depth of 10 cm. The filter, constructed next to the footbath, comprised a submersible pump, a funnel made from an old fertilizer spreader bin, a filter membrane (bidim Nonwoven Geotextiles A19), and a collection tank (Fig.1). Initial foot bath volume was 550 L of 5% $CuSO_4$ (1L per cow). After all cows had walked through the footbath, the pump delivered the spent $CuSO_4$ solution to the filter. After this the remaining liquid was topped up to 550 L and $CuSO_4$ added to restore the concentration of 5% before re-use.

Figure 1: Copper sulfate filter under construction (without submersible pump attached)

Results

The filtered solution was on average still 5% $CuSO_4$ by weight (pH 4.3) before it was topped up to the required 550 L volume. Two solid residues were left at the end of this process: 1) A sandy residue that remained on the bottom of the foot bath after pumping to the filter (this contained 31 g $CuSO_4$ per kg); and 2) filtered mud which contained 70g $CuSO_4$ per kg The sandy residue was washed from the foot bath into the effluent system while the filtered mud was left to dry and spread on to races and gateways. The amount of solid residue was variable, with up to 10 kg of sandy residue and 25 kg of mud after each footbath. Using these figures as a worst case scenario ~2 kg of copper was lost into the solid residues after each footbath. As 27.5 kg of $CuSO_4$ is required to make a 5% solution for a 550 L footbath, this means that, at worst, the filtration system recovered 92.5% of the copper in the footbath, a saving on $CuSO_4$ of NZ$155 per footbath

Conclusions

This filter and recycling system was extremely effective at recovering $CuSO_4$ from the footbath, greatly reducing the costs of footbathing and markedly reducing the amount of copper that had to be applied to the farm. Further work should focus on recovery of the $CuSO_4$ from the mud to further reduce the environmental impact of footbathing with $CuSO_4$.

Acknowledgements

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References

Teixeira AGV, Machado VS, Caixeta LS, Pereira RV, Bicalho RC. Efficacy of formalin, copper sulfate, and a commercial footbath product in the control of digital dermatitis. J Dairy Sci 2010 (93): 3628–3634.

Holzhauer M, Bartels CJ, Bergsten C, van Riet MMJ, Frankena K, Lam TJGM. The effect of an acidified, ionized copper sulphate solution on digital dermatitis in dairy cows. Vet J 2012 (193): 659–663.

Speijers MHM, Finney GA, McBride J, Watson S , Logue DN, O'Connell NE. Effectiveness of different footbathing frequencies using copper sulfate in the control of digital dermatitis in dairy cows. J Dairy Sci 2012 (95): 2955–2964.

Salam D, El-Fadel M. Mobility and Availability of Copper in Agricultural Soils Irrigated from Water Treated with Copper Sulfate Algaecide. Water Air Soil Pollut 2008 (195):3–13.

Keywords: Digital dermatitis, foot bath, copper sulfate

22 PCR Detection Of Digital Dermatitis Treponemes Within Cattle Footprints And On Equipment Surfaces

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Introduction

Although widespread, little is known about the transmission of digital dermatitis (DD). It is generally accepted that exposure to slurry is a DD risk factor (Rodríguez-Lainz et al., 1996). Whilst initial attempts failed to detect DD treponemes in slurry but demonstrated presence in the ruminant GI tract (Evans et al., 2012) ; subsequent high throughput metagenomics have provided some evidence for slurry containing DD treponemes (Klitgaard et al., 2014). One study (Sullivan et al., 2014), using PCR and culture, identified DD treponemes on hoof knives, even after disinfection. This highlights surfaces involved with direct foot contact need further investigation to understand transmission routes.

Materials and Method

The area of soiled flooring beneath the foot of dairy cows (the 'foot print') of dairy cows was swabbed on rubber, concrete and metal floors, from milking parlours and foot trimming crushes, This was achieved by lifting or knocking the animal's leg, and quickly taking a swab before the foot was replaced onto the ground. Floors were cleaned by washing before each cow entered. During foot trimming, gloves and equipment were swabbed. The dry cotton swabs were transported to the laboratory on ice and tested for DD associated treponemes using DD treponeme phylogroup specific PCR assays and a *Treponema* genus PCR assay.

Results

Swabbing foot prints after cows with gross visible lesions of DD, DD treponemes were detected by PCR on 25% of rubber floors, 24% of concrete floors but only 4% of metal floors (Table 1).

floor	Rubber		Concrete		Metal	
DD status of foot	DD +	DD -	DD +	DD -	DD +	DD -
PCR +ve for DD treponemes	8/31 (25.8%)	3/41 (7.3%)	9/38 (23.7%)	1/15 (6.7%)	1/23 (4.3%)	0/29 (0%)
PCR +ve for *Treponema* genus	30/31 (96.8%)	37/41 (90.2%)	38/38 (100%)	15/15 (100%)	23/23 (100%)	29/29 (100%)
PCR + ve for DD treponemes	Hoof grinder disc	Hoof grinder handle	Hoof clippers (used)	Hoof clippers after washing	Used vinyl gloves	
	1/24 (4.2%)	1/19 (5.3%)	2/20 (10%)	0/18 (0%)	2/8 (25%)	

Table 1. PCR results from foot print swabs on differing flooring types

From foot clippers (2/20) 10% were positive for DD treponemes after trimming, both samples following DD positive cows, but all were negative following washing the clippers in water (without disinfectant). For the *Treponema* genus, 100% (20/20) of foot clippers were positive after trimming, but after washing with water all foot clippers were negative. New vinyl gloves were negative for DD treponemes prior to trimming, but 25% (2/8) were positive after trimming DD positive cows.

Discussion

The high PCR detection rate of DD treponemes on foot prints from DD positive feet and from gloves, and the lower detection rate from hoof clippers and the hoof grinder, suggest that all could be possible vectors of transmission. It would be necessary to repeat the work using culture to demonstrate the viability of the DD treponemes. There are anecdotal reports that groups of 'clean' heifers have become infected after passing through a race or handling system after known infected cows. Our data would suggest that washing floor surfaces between groups would be a sensible preventive measure thus differing from Sullivan et al (2014) who found that a brief dip in antiseptic solution without removing faeces from the hoof knife had a limited effect.

References

Evans, NJ, Timofte D, Isherwood DR, Brown JM, Williams JM, Sherlock K, Lehane MJ, Murray RD, Birtles RJ, Anthony Hart C, Carter, SD, 2012b. Host and environmental reservoirs of infection for bovine digital dermatitis treponemes. Veterinary Microbiology 156, 102-109.

Klitgaard K, Nielsen MW, Ingerslev HC, Boye M, Jensen TK. 2014. Discovery of bovine digital dermatitis-associated Treponema spp. in the dairy herd environment by a targeted deep-sequencing approach. Applied and Environmental Microbiology 80, 4427-32.

Rodríguez-Lainz A, Hird DW, Carpenter TE, Read DH, 1996. Case-control study of papillomatous digital dermatitis in Southern California dairy farms. Preventive Veterinary Medicine 28, 117-131.

Sullivan L.E, Blowey RW, Carter SD, Duncan JS, Grove-White DH, Page P, Iveson T, Angell JW, Evans NJ, 2014. Presence of digital dermatitis treponemes on cattle and sheep hoof trimming equipment. The Veterinary Record 175, 201.

Key words: DD, footprint, transmission

23 Mmmooogle Accutrim: A New Technology In Claw Health Monitoring And Prevention

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Introduction

Lameness is one of the most important endemic diseases of dairy cattle and cause large economic losses to the dairy industry. These losses are mainly due to the effect of lameness on milk production, fertility and culling performance of dairy cows. Several studies worldwide show that lameness reduces milk yield (Green et al., 2002), has a substantial negative impact on reproductive parameters (Barkema et al., 1994) and leads to an increased involuntary culling (Olechnowicz et al., 2011). Although many risk factors for different claw diseases have been identified, multiple studies have documented a deteriorating claw health in dairy cows, despite the effort of the scientific and dairy industry. On-farm evaluation and monitoring of claw health is often challenging. First, good recording of claw health often fails due to a lacking incentive for the dairy farmer to start recording claw diseases. Second, claw disease nomenclature is ambiguous and confusion, causing comparison between claw trimmers and herds a difficult process. And finally, combining claw health records with existing herd management records requires data scientists capable of combining statistical and technical skills.

Materials and methods

The amount of data created on a dairy farm exponentially grew over the last decade to 100 megabytes each day (herd management software, milk meters, accelerometers and other sensors). *MmmooOgle* is a new, innovative Industry 4.0 platform for the dairy industry, whereby the data from different data sources as well as new Internet of Things devices are integrated, analyzed and visualized in a simple but not simplistic way. The platform can ingest both batch (eg. milk recording) as well as continuous data streams (often referred to as streaming data, eg temperature loggers, data capture applications, accelerometers). The data is both stored and analyzed for herd-specific risk factor analysis or predictive modelling. The output of both models can subsequently be visualized, pushed towards the farmers and used for decision making in real-time. The entire platform uses multi-tenant and secure Big Data technologies to create a nearly real-time experience focused on decision support in livestock.

Results

We propose the integration of the *Accutrim* Hoof Health App (*SaveCows*, Wisconsin). The approach first focused on alleviating technical hurdles in the process of capturing the actual hoof trims during regular and therapeutic hoof trim visits in a standardized way. Hence a mobile application fed with on-farm animal identification (avoiding double data entry) was mapped towards the MmmooOgle platform. Mobile usage is continuously monitored to increase the user experience at the moment of trimming increasing the quality of recorded events. As such, the possibility for trimmers to store pictures at cow level was created to check hoof health cure over time, or have off-site second opinion about animals. Within the platform standardized analysis of claw lesions combined with production and reproduction performance of trimmed vs non-trimmed, cured vs non-cured animals can be monitored in order to evaluate trimming techniques or preventive measures. As a last step, anonymized data can be fed in real-time to researchers to allow real-time data science.

Discussion

The proposed integration illustrates the need and possibilities for data integration in the dairy industry, more specifically hoof health. The approach is often referred to as industry 4.0 and can be applied or combined with other subdomains of the dairy industry. It aligns with the broader goal of knowledge discovery for researchers as well as knowledge dissemination between stakeholders active in hoof health and dairymen.

References

Green LE, Hedges VJ, Schukken YH, Blowey RW and Packington AJ 2002 The impact of clinical lameness on the milk yield of dairy cows. In: Journal of Dairy Science, Volume 85, Issue 9, September 2002, Pages 2250-2256

Barkema HW, Westrik JD, van Keulen KAS, Schukken YH and Brand A. 1994 The effects of lameness on reproductive performance, milk production and culling in Dutch dairy farms. In: Preventive Veterinary Medicine, Volume 20, Issue 4, September 1994, Pages 249-259.

Olechnowicz J an Jaskowski JM. 2011 Reasons for culling, culling due to lameness, and economic losses in dairy cows (Review). In: Medycyna Wet. 2011, 67 (9).

Key words: Big data, technology, prevention, Accutrim, MmmooOgle

P 5-1 Assessment Of The Footbaths Contamination By Dairy Cattle Manures Under Fields Conditions.

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Introduction

Foot infectious diseases such as digital dermatitis and interdigital phlegmon (foot rot) are important conditions associated to lameness in ruminants. Among the strategies for the control of foot infectious diseases, footbaths represent a useful alternative to treat concomitantly an important numbers of animals in a given time. However, the active compounds used in footbaths can be challenged against different numbers of cow passages and therefore, to different volume losses and levels of manure contamination which could alter their presumed bactericidal activity. The objective of this study was to explore under field conditions the variations in the measures of residual volume, temperature, pH, microbial densities and organic matter (OM) concentration in footbaths challenged to a different number of cows which walk through them.

Materials and Methods

The study was carried out in 6 dairy cattle farms from western France. The hygienic status of the farms was determined by the overall feet cleanliness score of the herd. A footbath filled with water was placed at the usual location of each farm. Footbath samples were taken after 0, 50, 100, 150 and 200 cow passages to analyze the evolution of the microbial densities and the OM concentration. The number and moment of cow defecations were recorded until complete 200 cow passages. During the sampling, the ambient and internal temperature, the pH and the approximate residual volume of the footbath were recorded.

Results

The results indicate that the microbial densities and the OM concentration increased mainly as the number of passages of animals rose, and in a minor degree, with the number of defecations in the footbath. This increase was independent of the hygienic status of the farms, indicating that the increasing number of cow passages influenced the OM concentration in footbaths and not the cleanliness of the feet. On average 6% of cows defecated in footbaths. Only slight variations on the temperature and the pH measures across the different numbers of cow passages were recorded. However, the volume decreased drastically in the order of 40 to 50% after 200 cow passages.

Discussion

The OM concentration after 150 and 200 cow passages reaches the maximal concentrations in which the bactericidal efficacies of footbath products are tested, indicating the relevance of this renewal rates. Nevertheless, the renewal rates must be mainly adapted according to the footbath remaining volume, provided that the entire foot should be cover by the footbath solution.

Keywords: Footbath, manures, organic matter, contamination

P 5-2 Effects Of A Pre-Wash Footbath And Footbath Capacity Loss Observations

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Introduction

Solid matter contamination of chemical foot baths is an important consideration in the footbathing process as it is thought to reduce effectiveness of active ingredients used in foot bath preparations. The use of a pre-wash footbath has divided opinion within the lameness research community. Some researchers have suggested pre wash foot baths will reduce contamination within chemical footbaths (1,2,3). However others have suggested the opposite to be the case.

Methodology

5 farms in Northern Ireland, United Kingdom, were employed for the study. Overall foot bath contamination was measured by taking 40 mL samples from chemical foot baths and measuring the solid matter content at the bottom of the bottle (mL). Capacity loss was measured by chemical foot bath volume (length x width cm x depth(cm)/1000 = volume L) before commencement of milking minus volume after milking completed, divided by number of cow passes.

Results

Dry matter contamination ranged from 5% to 19% in chemical foot baths with no pre-wash foot bath setup, compared to 1.25% dry matter contamination observed within the pre-wash foot bath setup. Other foot bath observations showed average capacity loss from cow kick out to range from 235 mL to 1220 mL per cow.

Discussion

This study concluded that a pre-wash foot bath can reduce the contamination levels in the chemical foot bath. It also indicates that kick out rate should be considered when estimating foot bath capacity and depth requirements. Further larger sample size studies would be required to confirm this.

References

Manning A.D, Mahendran SA, Hurst BS, Blackmore TL, Bell NJ. Effect of a prewash on footbath contamination: a randomised control trial. Veterinary Record 2017. 180: online

Greenough PR. Bovine Laminitis and Lameness. Philadelphia, USA: Saunders Elsevier Ltd; 2007

Watson C. Lameness in Cattle. Marlborough, UK: The Crowood Press Ltd; 2007

Keywords: Pre wash, Foot bath, Contamination, Lameness

P 5-3 5 Point Plan For Control Of Digital Dermatitis

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Introduction

Digital dermatitis (DD) is the major infectious cause of lameness in dairy cows with herd prevalences as high as 90% (1,2). As DD is a multifactorial disease, control strategies based on one solution may fail to control the disease (3). There is a need for a structured DD control plan that considers all the risk factors.

Materials and Methods

Early 2016, seven European hoof experts assembled on the invitation of DeLaval to discuss hoof health management and develop a 5 Point Plan For Control Of Digital Dermatitis, in analogy to the 5 point plan for mastitis control (4). The plan aims to reduce the prevalence of DD on dairy farms by implementing management practices in 5 major focus areas.

Results

The plan involves young stock, heifers, lactating and dry cows.

1. External biosecurity to keep DD out

Keeping a closed farm should be preferred. Respecting a quarantine period for newly bought cattle can reduce the risk of introduction of DD-pathogens into the herd. Hoof trimmers and veterinarians should disinfect their equipment and preferably use farm-specific equipment, clothing and boots.

2. Internal biosecurity to minimize infection pressure

Managing the environmental hygiene and cow comfort in the barn will reduce the prevalence of DD. Avoid movement of animals, manure, equipment and personnel between groups of animals. Ideally, separate infected cows from the herd and treat them with dedicated tools.

3. Early identification, recording and treatment of clinical hoof disease cases

Hooves and gait should be checked regularly to identify lame cows. Infected cows should be treated immediately and followed up on. All treatments should be documented. Regular functional hoof trimming is essential to maintain the herd's hoof health. Cows with chronic lesions, being a source of infection, should be culled.

4. Frequent foot disinfection to prevent new cases

Hoof disinfection by hoof bathing or spraying will have a larger impact when it is done frequently and on cleaned hooves. Hoof baths should allow for at least two dunks of the rear feet. The hoof bath solution should cover the foot up to the dew claws and should be refreshed according to label recommendations to avoid manure accumulating in it. Hoof bath disinfectants should have a proven effect, come from approved manufacturers and be non-hazardous.

5. Define and monitor targets

Establishing key performance indicators, standard operating procedures and regular trainings will help the farm personnel focus on the hoof health of the herd. When KPI are not met, hoof management practices should be reviewed and adjusted if necessary.

Discussion

This Plan provides a set of 5 principles which, if followed, can help to reduce DD prevalence. It should be combined with herd specific information on the main factors contributing to DD on farm to formulate tailored practical recommendations. Results after implementation of the Plan may take time. Success should be evaluated over at least 12 months to take into account seasonal influences on the prevalence of DD. Frequent follow-up is advised to evaluate changes in the situation and adapt recommendations if needed.

References

1. Somers, J.G., Frankena, K., Noordhuizen-Stassen, E.N., Metz, J.H., 2003. Prevalence of claw disorders in Dutch dairy cows exposed to several floor systems. J. Dairy Sci. 86, 2082–2093.

2. Cramer, G., Lissemore, K.D., Guard, C.L., Leslie, K.E., Kelton, D.F., 2008. Herd- and cow-level prevalence of foot lesions in Ontario dairy cattle. J. Dairy Sci. 91, 3888–3895.

3. Nuss, K., 2006. Footbaths: the solution to digital dermatitis? Vet. J. 171, 11–13.

4. National Institiute for Reserach in Dairying, United Kingdom, 1960’s

A detailed version of the plan and supporting materials are available at:
http://www.delavalcorporate.com/five-point-plan-digital-dermatitis

6 HOOF DISORDERS IN BEEF CATTLE

24 Sole Haemorrhages In Danish Bull Calves: Prevalence And Risk Factors

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Introduction

Sole haemorrhages may have negative effects on animal welfare and cause financial losses. Previous studies have found relatively high prevalences of sole haemorrhages among dairy heifers and cows (e.g. Frankena et al 1992, Capion et al 2009). Bull calves intended for slaughter at an age of approximately one year are typically not hoof trimmed routinely. As sole haemorrhages are normally diagnosed during hoof trimming, the prevalence of sole haemorrhages in such calves is largely unknown. Graunke at al. (2011) studied sole haemorrhages in 80 bull calves from one experimental herd, but to our knowledge, the present study is the first to evaluate the prevalence of sole haemorrhages and associated risk factors in a larger number of calves from many different herds.

Materials and Methods

A total of 730 Holstein bull calves from 33 Danish herds were hoof trimmed shortly before slaughter and the presence of sole haemorrhages was recorded. Mean daily weight gain (g/day), presence of liver abscesses at slaughter (yes or no) and floor type (slatted concrete floor with cubicles or deep litter straw) was recorded for each calf. Two logistic regression models were used to evaluate the association between the outcome variables sole haemorrhages and severe sole haemorrhages, respectively, and the explanatory variables daily weight gain, liver abscesses and flooring.

Results

Of the 730 calves, 545 (74.7%) had sole haemorrhages (mild or severe) on at least one foot and 119 (16.3%) had severe sole haemorrhages. Median daily weight gain was 1137 g/day. At the time of slaughter, 82 calves (11.2%) had liver abscesses. Slightly less than half of the calves (47.4%) were housed on deep litter and 52.6% were housed on slatted floors. Calves housed on slatted concrete floors had significantly higher odds of having sole haemorrhages (odds ratio 2.69, $p<0.0001$) and severe sole haemorrhages (odds ratio 2.07, $p=0.0006$) compared to calves housed on deep litter. The odds of having severe sole haemorrhages increased with increasing daily weight gain (odds ratio 1.28 for an increase in daily weight gain of 100 g, $p=0.008$). No associations between liver abscesses and sole haemorrhages were found.

Discussion

Almost 75% of the calves had sole haemorrhages and 16% had severe sole haemorrhages. Further research is needed to clarify to what degree such a high prevalence of sole haemorrhages among bull calves constitutes a problem in terms of animal welfare and economic losses. Previous studies have demonstrated an increase in prevalence of sole haemorrhages with increasing age among dairy heifers (Frankena et al 1992, Holzhauer et al 2012). As the calves in the present study were examined close to slaughter (median 20 days before slaughter) the prevalence may be seen as a 'worst case scenario' in relation to sole haemorrhages among bull calves. The lower prevalence of sole haemorrhages in animals housed on soft surfaces is in agreement with a number of previous studies (Frankena et al 1992, Somers et al 2003, Graunke et al 2011). Providing soft surfaces for walking and standing may help decrease problems with sole haemorrhages.

References

Capion N, Thamsborg SM and Enevoldsen C 2009 Prevalence and severity of foot lesions in Danish Holstein heifers through first lactation. The Veterinary Journal 182: 50-58.

Frankena K, van Keulen KAS, Noordhuizen JP, Noordhuizen-Stassen EN, Gundelach J, de Jong D-J and Saedt I 1992 A cross-sectional study into prevalence and risk indicators of digital haemorrhages in female dairy calves. Preventive Veterinary Medicine 14: 1-12.

Graunke KL, Telezhenko E, Hessle A, Bergsten C and Loberg JM 2011 Does rubber flooring improve welfare and production in growing bulls in fully slatted floor pens? Animal Welfare 20: 173-183.

Holzhauer M, Brummelman B, Frankena K and Lam, TJGM 2012 A longitudinal study into the effect of grazing on claw disorders in female calves and young dairy cows. The Veterinary Journal 193: 633-638.

Somers JGCJ, Frankena K, Noordhuizen-Stassen EN and Metz JHM 2003 Prevalence of claw disorders in Dutch dairy cows exposed to several floor systems. Journal of Dairy Science 86: 2082-2093.

Keywords: Bull calf, Flooring, Sole haemorrhage, Weight gain

25 Evaluation Of Clinical Stages Of Digital Dermatitis In Beef Cattle Through Histological Examination And Determination Of Risk Factors For Spirochetal Skin Invasion

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Introduction

Bovine digital dermatitis (DD) is a contagious and multi-factorial disease that leads to painful, ulcerative lesions of the skin near the heel-horn border of the foot (Read & Walker 1998). Bovine DD has mainly been described as a disease of dairy cattle. With regards to beef cattle, there are very few published reports in literature (Evans, et al. 2016). The aim of this study was to evaluate DD lesions in beef cattle to determine the extent of disease and spirochetal involvement in different clinical stages. The understanding of DD in terms of the relationship between the clinical stages and histological states and extent of microbial involvement may be key to controlling the disease within a herd and this understanding could provide insight into the effectiveness of control measures.

Methods

One hundred and forty four biopsies from various clinical M-stages (Berry, et al. 2012, Dopfer, et al. 1997) of DD lesions in beef cattle were submitted for histological analysis. Biopsies were taken at the end of the feedlot finishing period from the feet of 120 different beef steers, with 24 steers having biopsies taken from two different feet, within 1 to 3 hours after slaughter. Hematoxylin and Eosin (H&E)-, Giemsa-, and Steiner-stained histologic micro sections of the skin biopsies were prepared. Biopsies were classified according to histopathologic guidelines established by Berry et al. (2010) with slight modifications. Results describe the prominence of spirochetes and non-spirochetal organisms and their location within the skin samples using a semi-quantitative system described by Gomez et al. (2012). Also stage, state, and extent of DD within each sample was associated with the histological findings. A logistic regression approach was used to determine risk factors associated with the invasion of spirochetes into the deeper layers of the skin.

Results

Histologic diagnosis of disease was made for each biopsy and only 4 out of 144 biopsies submitted were classified as normal (3 M0 and 1 M4 with hyperkeratosis), the rest were classified as having signs of DD. The majority of active disease states were seen in M2 lesions, M0 lesions had the highest majority of healed states, and M4 hyperkeratotic (M4H) lesions accounted for about half of the incompletely healed states (Table 1). The majority of chronic proliferative lesions (M4P) were in the active state of disease (89%). Steiner silver stain detected invasive spirochetes in the stratum spinosum and papillary dermis in 94% of M2 lesions, 63% of M4.1 lesions, 29% of M4H lesions, and 89% of M4P lesions. Upon dark field microscopic evaluation spirochetes were seen in 66% of biopsies processed. Statistical modeling showed that lesion type, presence of other microorganisms, and steer type potentially increased the probability for invasion by spirochetes into the stratum spinosum and papillary dermis.

Discussion

This is the first report about systematic histology of DD per M-stage in beef cattle, with particular attention paid to chronic lesions. The evaluation of DD lesions scored as clinically normal (M0) after revealed spirochetes when evaluated histologically. This hints at a discrepancy between clinical appearance and potential reservoir formation. Particular attention should be aided to the reduction of chronic lesion formation, because those represent reservoirs of infection with spirochetes that are considered to be associated with the etiology of DD.

Acknowledgements
Thanks to the Zinpro Corporation for their generous funding support. Thanks to Dr. Deryck Read for his histological evaluations of the biopsies. Thanks to Aurora Packing Plant (Aurora, IL) for their cooperation with biopsy sampling.

Table 1. Histological states of disease of by M-stage

	M0 *(n=21)*	**M2** *(n=26)*	**M2 with proliferation** *(n=37)*	**M4.1** *(n=16)*	**M4 with hyperkeratosis** *(n=35)*	**M4 with proliferation** *(n=9)*
Active, %	4.76	84.62	89.19	43.75	22.86	88.89
Healed, %	47.62	0	0	6.25	5.71	0
Incompletely Healed, %	33.33	15.38	8.11	43.75	68.57	11.11
NA, %	14.29	0	2.70	6.25	2.86	0.00

References

Berry SL, Read DH, Famula TR, Mongini A, and Dopfer D 2012 Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. *Veterinary Journal* 193: 654-658.

Berry SL, Read DH, Walker RL, and Famula TR 2010 Clinical, histologic, and bacteriologic findings in dairy cows with digital dermatitis (footwarts) one month after topical treatment with lincomycin hydrochloride or oxytetracycline hydrochloride. *J Am Vet Med Assoc* 237: 555-560.

Dopfer D, Koopmans A, Meijer FA, Szakall I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, vanAsten A, and terHuurne A 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. *Veterinary Record* 140: 620-623.

Evans NJ, Murray RD, and Carter SD 2016 Bovine digital dermatitis: Current concepts from laboratory to farm. *Vet J* 211: 3-13.

Gomez A, Cook NB, Bernardoni ND, Rieman J, Dusick AF, Hartshorn R, Socha MT, Read DH, and Dopfer D 2012 An experimental infection model to induce digital dermatitis infection in cattle. *Journal of Dairy Science* 95: 1821-1830.

Read DH, and Walker RL 1998 Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. *J. Vet. Diagn. Invest.* 10: 67-76.

Keywords: Digital dermatitis, histology, beef cattle, M-stages, chronicity

26 Outbreaks Of Digital Dermatitis In Beef Fattening Units: Clinical Findings And Control

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Introduction

Digital dermatitis (DD) is a well-known cause of lameness in dairy cattle. The disease has also been recently reported in beef cattle but its prevalence was rather low (1, 2). Several measures are usually recommended to control DD, including early detection and prompt individual topical treatment, regular footbathing, improvement of foot hygiene and regular hoof trimming (3). These measures might be difficult to implement in feedlots. This report presents two outbreaks of DD in beef fattening units, with emphasis on clinical findings, treatment and prevention.

Materials and Methods

In September 2014 and July 2016, two French cattle fattening units with high prevalence of lameness associated with poor weight gain were presented to our faculty for further investigation. The farms reared Charolais bulls, housed indoor on concrete with a deep litter bedding system (2.5 to 4 m^2/animal; 350 and 400 places). History was outlined and, as feet inspection in a trimming chute was not feasible, the feet of the most severely lame bulls were inspected at slaughterhouse and radiographed. After clinical diagnosis, the main factors contributing to DD were checked to implement measures adapted to each situation.

Results

Both farmers detected weight losses and reluctance to move after 5 months of fattening (500 - 600 kg). Up to 50% of bulls were affected in each pen. The signs did not improve despite 3 days of oxytetracyclin parenteral treatment. Observation of the feet at slaughterhouse revealed typical DD lesions with circumscribed ulcerative to granulomatous lesions at the skin-horn junction, between the heels or, more frequently, at the dorsal coronary band (Figure 1). Radiographs demonstrated osteopenia of the 3rd phalanx in one bull. Control was achieved by 1) cleansing, disinfection and depopulation between affected and new batches; 2) applying drying agents to litter; 3) deep cleaning the containment corridors after each use; 4) passing through a lime footbath at arrival (Saniblanc®). In addition, in farm 2 stocking density was reduced, locomotion was scored at arrival and 3 times every 3 weeks to improve early detection, frequency of cleaning of the quarantine was increased and severely affected bulls were treated with a single injection of tulathromycin (2.5 mg/kg, SC). No new cases of DD have been detected since now.

Discussion

This report confirms that DD is present in young beef cattle and might create outbreak with major economic losses in beef fattening units that combine multiple risk factors such as mixing of animals of different origins, high stocking density, poor foot hygiene, and late lameness detection. In contrast to dairy cattle, DD lesions were often found at the dorsal coronary band, impairing normal growth of the hoof horn capsule, as observed in contagious ovine digital dermatitis (4). Detection of DD was usually late when cattle were reluctant to move. Individual treatment required long acting parenteral antibiotics as topical treatment were impossible to apply. Control was mostly achieved by implementing strict external and internal biosecurity measures and applying drying agents in the litter. Deep sequencing analyses are ongoing to determine if bacteria and *Treponema* species are similar to those observed in DD lesion in dairy cattle.

Acknowledgments
The authors would like to thanks the farmers involved in this work, and Dr Marie Lamandé (hospital assistant, Oniris, Nantes) for her help in feet examination.

References

1. Brown CC, Kilgo PD and Jacobsen KL. Prevalence of papillomatous digital dermatitis among culled adult cattle in the southeastern United States. American Journal of Veterinary Research 2000 (61): 928–930.

2. Sullivan LE, Carter SD, Blowey R, Duncan JS, Grove-White D and Evans NJ. Digital dermatitis in beef cattle. The Veterinary Record 2013 (173): 582.

3. Evans NJ, Murray RD and Carter SD. Bovine digital dermatitis: current concepts from laboratory to farm. The Veterinary Journal 2016 (211): 3–13.

4. Angell JW, Blundell R, Grove-White DH and Duncan JS. Clinical and radiographic features of contagious ovine digital dermatitis and a novel lesion grading system. The Veterinary Record 2015 (176): 544.

Key-words: digital dermatitis; beef cattle; control

Figure 1. Digital dermatitis lesion in the rear feet of a young Charolais beef bull

27 Occurrence And Economic Impact Of Beef Cattle Lameness In Canadian Feedlots

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Introduction

Lameness is the second most common diagnosis in feedlots. Feeder cattle are diagnosed with both infectious and non-infectious causes of lameness (1). The economic impact of lameness results from reduced feed intakes, altered ambulation, and lower body condition, resulting in increased costs including treatments, increased days on feed, premature culling, and death (2-3). The objective of this study was to estimate the economic impact of lame cattle per lameness diagnosis, cattle type and season using average Canadian slaughter prices.

Materials and Methods

The study consisted of a retrospective producer-collected dataset from 2005 – 2015 presenting data from 28 southern Alberta feedlots. The dataset contained health records on footrot, footrot fat (in finishing cattle), injury, lame with no swelling, and joint infections. Records also included animal type upon arrival, arrival and treatment weight, average daily gain (ADG), and cost of treatment. Animal categories included season of arrival (fall or winter), gender (steer or heifer) and age (calves or yearlings), respectively. Time at diagnosis was categorized as spring, summer, fall, and winter. A decision tree model was developed using the dataset, expert opinion, and literature to estimate the economic impact of finishing cattle diagnosed and treated in the six lameness categories.

Results

The main lameness diagnosis was footrot, 76% (n = 23,442) of all observations (n = 28,788). Fall placed calves were most commonly affected, with fall placed steer calves representing 19.5% (n = 6,049) of all affected animals, and spring as the most common season when lameness was identified with 47% (n = 14,658) of all observations. The highest treatment cost was identified for footrot diagnosed closer to the slaughter turn out ($14.49/treatment). Footrot and footrot fat had the highest ADG (2.51 and 3.46 lb/d, respectively) compared to cattle diagnosed with injuries 1.92 lb/d, lame with no swelling 1.42 lb/d, or joint infections 1.16 lb/d on average; resulting in higher economic impact due to longer days on feed to reach slaughter weight. Based on average slaughter prices for healthy cattle net return was $690. The average net return for footrot was $569, for footrot fat $695, injury $260, however, joint infections and lame with no swelling had negative returns of $-287 and $-701, respectively. The net-benefit returns for successfully treated footrot cases of fall placed calves (steers vs heifers) ($725 and $374) compared to winter placed calves ($576 and $457), were lower than yearlings ($793 and $866). Where net-benefit returns for animals affected in fall was higher compared to winter ($655 vs $419).

Discussion

With knowledge on economic impact of a lameness diagnosis per cattle type and season, more adequately responding to these circumstances can prevent new cases to occur as the economic impact on ADG warrants additional labor and management resources allocated towards early detection and treatment and lameness prevention and control.

Acknowledgements

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References

Stokka, G. L., K. Lechtenberg, T. Edwards, S. MacGregor, K. Voss, D. Griffin, DM Grotelueschen, RA Smith, LJ Perino. Lameness in Feedlot Cattle. Vet Clin North Am: Food Anim Pract 2001 (17): 189-207

Tibbetts, G. K., T. M. Devin, D. Griffin, J. E. Keen, and G. P. Rupp. Effects of a Single Foot Rot Incident on Weight Performance of Feedlot Steers. Prof Animal Sci 2006. (22): 450 - 453.

Veriviunt, J. J., and P. R. Greenough. Predisposing Factors of Laminitis in Cattle. Br Vet J 1994 (150): 151 - 164.

Table 1: Number of feedlot cattle affected by lameness: treatment frequency, arrival weight (median), weight at treatment (median), Average Daily Gain (median) and treatment costs (mean).

Lameness Diagnoses	Treatment	Total number of observations (n=28,788)	Arrival Weight (median lb BW)	Weight at date of treatment (median lb BW)	ADG at treatment (median lb/d)	Net benefit return after successful treatment (mean CAD)
Footrot	1	21,290	652	1085	2.95	$ 569
	2	1,989	668	1110	2.81	
	3	163	660	1100	2.51	
Footrot Fat	1	147	700	1304	3.46	$ 695
Injury	1	893	620	780	1.92	$ 260
Joint Infection	1	4,697	575	650	1.42	$ -287
Lame No	1	1,761	569	614	1.16	$ -701

Keywords: beef cattle, lameness diagnosis, feedlot, economics

28 Characterization Of The Fecal Microbiome From EHEC Positive And Digital Dermatitis Negative Beef Cattle

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Introduction

Digital dermatitis (DD) causes painful ulcerative lesions on the feet of cattle that lead to economic losses (Döpfer et al. 1997, Evans et al. 2016). Cattle can additionally carry and introduce the zoonotic foodborne pathogen enterohemorrhagic *Escherichia coli* serotype O157:H7 (EHEC O157) into the human food supply (Chopyk et al. 2016). Infection with EHEC O157 does not commonly cause clinical disease in cattle, but can cause mild to potentially life-threatening human illness (Lim et al. 2010). The mechanisms behind a cow's ability to shed EHEC O157 are not well-understood. However, transmission of this infection is impacted by diseases, such as DD, which cause cattle to be lame and thus change their contact structure (Kulow et al. 2012). Preliminary data has shown that EHEC O157 positive and DD negative infection status in beef cattle is associated with gut microbiome differences. Our objective was to obtain a better understanding of the fecal microbiome characteristics in EHEC+/DD- beef cattle to quantify associations between EHEC+/DD- infection status and production variables.

Materials and Methods

Beef cattle fecal samples were collected during a field trial comparing inorganic and organic trace mineral supplements. DNA was isolated from 20 fecal samples and sequenced. Raw sequence data were cleaned using mothur, a statistical software, and then aligned to the SILVA reference database to produce taxonomic assignments. Mothur outputs were exported into R for further analysis.

Results

In this study, the organic trace mineral supplement was associated with protection against DD infection. The EHEC+/DD- cattle clustered together, suggesting similarities with microbiomes, metadata, or both. The nutritional supplement's effect on treponeme abundance is associated with EHEC infection status. Additionally, Bayesian regression analysis with informative priors can be used to support the data's effect on estimated regression coefficients.

Discussion

The OTM supplement appears to be protective against DD infection, which a possible mechanism for which is that the OTM supplement causes the skin epithelium to be stronger and thus more resistant to colonization by the microbes involved in DD infection (Gomez et al. 2015). There is likely a three-way association between EHEC infection status, DD infection status, and OTM supplementation. These findings will better our understanding of how to prevent the spread of EHEC O157 and DD among cattle. This can potentially reduce food supply contamination with EHEC O157 and thus human illness caused by this pathogen.

References

Chopyk J, Moore RM, DiSpirito Z, Stromberg ZR, Lewis GL, Renter DG, Cernicchiaro N, Moxley RA and Wommack KE 2016 Presence of pathogenic Escherichia coli is correlated with bacterial community diversity and composition on pre-harvest cattle hides. *Microbiome* 4

Döpfer D, Huurne AAHM ter, Cornelisse JL, Asten AJAM van, Koopmans A, Meijer FA, Schukken YH, Szakáll I, Klee W and Bosma RB 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. *Veterinary Record* 140: 620–623.

Evans NJ, Murray RD and Carter SD 2016 Bovine digital dermatitis: Current concepts from laboratory to farm. *The Veterinary Journal* 211: 3–13.

Gomez A, Cook NB, Socha MT and Döpfer D 2015 First-lactation performance in cows affected by digital dermatitis during the rearing period. *Journal of Dairy Science* 98: 4487–4498.

Kulow MJ, Gonzales TK, Pertzborn KM, Dahm J, Miller BA, Park D, Gautam R, Kaspar CW, Ivanek R and Döpfer D 2012 Differences in Colonization and Shedding Patterns after Oral Challenge of Cattle with Three Escherichia coli O157:H7 Strains. *Applied and Environmental Microbiology* 78: 8045–8055.

Lim JY, Yoon JW and Hovde CJ 2010 A Brief Overview of Escherichia coli O157:H7 and Its Plasmid O157. *Journal of microbiology and biotechnology* 20: 5–14.

Keywords: fecal microbiome, digital dermatitis, *Escherichia coli* O157:H7

P 6-1 Case Report: Lameness In Three Limousin Bulls And Its Impact In Copulate Attempts

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Introduction

Lameness is one of the most common problem in cattle (1) and it is widely known about its impact on reproductive and productive parameters in cows (2), but there is minimal information about its impact on the same parameters in bulls.

Materials and Methods

A herd of Limousin cattle in Almacelles Cataluña, Spain. Three Bulls presented recurrent lameness and reduce copulate attempts. A veterinarian executed the clinical examination of the three bulls on November 26th of 2016 and determined the injuries and Locomotion Score (LS).

Results

Bull ID*	LS	Left Front Limb		Right Front Limb		Left Rear Limb		Right Rear Limb		Copulate attempts
Hoof	/5	Lateral	Medial	Medial	Lateral	Lateral	Medial	Medial	Lateral	
Bull #1	5	SH**	SH	SH	SH	WLD ***	SH	HS	WLD	No
Bull #2	4	SH	SH	SH	SH	WLD	SH	HS	WLD	No
Bull #3	3	SH	SH	SH	WLD	SH	SH	HS	HS	No

*Real ID were not registered due to confidenciality commitment. **SH refers to Sole Hemorrhage ***WLD refers to White Line Disease

The treatment included rubber blocks, bandages and analgesics. The veterinarian recommended to incorporate a proper nutrition management to reduce lameness.

On December 30th of 2016 the bulls presented the next results:

Bull ID*	LS	Copulate Attempts
	/5	
Bull #1	1	Yes
Bull #2	1	Yes
Bull #3	3	No

Bull #3 had a hock inflammation.

Discussion

Lameness affects animal welfare (3), reproductive, productive (2) and economy (4) parameters in cattle. Lameness is related to reduce copulate attempts in this report. It is recommended to execute research methodologies to estimate the real impact of lameness in reproductive parameters in bulls.

References

Flor E , Tadich N. Claudicaciones en vacas de rebaños lecheros grandes y pequeños del sur de Chile. Arch. med. vet. [online]. 2008, vol.40, n.2, pp.125-134.

Morris MJ, Kaneko K, Uppal SK, Walker SL, Jones DN, Routly JE, Smith RF, Dobson H. 2013. Effects of high somatic cell counts in milk on reproductive hormones and oestrus behaviour in dairy cows with special reference to those with concurrent lameness. Animal Reproduction Science. Volume 141, Issues 1–2, September 2013, Pages 20–25

Millman ST. 2013. Behavioral Responses of Cattle to Pain and Implications for Diagnosis, Management, and Animal Welfare. Veterinary Clinics of North America: Food Animal Practice. Volume 29, Issue 1, March 2013, Pages 47–58

W. Refaaia, b, M. Van Aerta, A.M. Abd El-Aalb, A.E. Beheryb, G. Opsomer. 2013. Infectious diseases causing lameness in cattle with a main emphasis on digital dermatitis (Mortellaro disease). Livestock Science. Volume 156, Issues 1–3, September 2013, Pages 53–63}

Key words: locomotion score, reproduction, copulate, Bulls

P 6-2 Case Report: A High Rate Of Toe Ulcers In A Group Of Jersey Bulls

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Introduction

Lameness in bulls, particularly in systems where natural mating is used, is a common problem that could have a significant effect on herd reproductive performance [1]. This abstract describes a significant problem with toe ulcers in bulls being used in a dairy herd in south-east Australia

Materials and Methods

The affected herd was a pasture based, 500-cow, predominantly Jersey herd in south west Victoria. This herd calved in autumn (April to June) with bull mating starting in late July after 5 weeks of AI. Nineteen Jersey bulls were run with the herd in groups of six and rotated every 3-4 days. Prior to their use in the herd, bulls were kept on pasture. During mating they were fed a diet of pasture plus silage fed on the concrete feedpad. Their average daily walking distance was 4-6 km.Fifteen out of a total of nineteen bulls were presented due to clinical lameness. Data was recorded on lesion type and lesion site over two visits on 17/8/2015 and 21/8/2015. All bulls were restrained in a mobile tipping crush allowing examination of all feet. Distribution of findings: Of the fifteen bulls examined, lesions were found in a total of 26 feet. The results are as summarised in Table 1:

No of feet	Lesion	Fore/Hind	Claw
2	Interdigital necrobacillosis		
13	White line disease Zone 1	Hind	Medial
6	White line disease Zone 1	Hind	Lateral
3	White line disease Zone 1	Fore	Medial
2	White line disease Zone 1	Fore	Lateral

Table 1: Cause and site of lameness-related lesions in 15 lame Jersey bulls

Discussion

Lameness in this herd was due to claw horn disease rather than joint injury or claw overgrowth. There are very limited data on the cause of lameness in bulls used for mating, but it is highly likely that it was the change from pasture only to prolonged walking and contact with concrete (bulls will mount cows in oestrus either at pasture, on the collecting yard and on the feedpad) that precipitated the lameness. Over wear of the toe is a precipitating factor in the development of WLD at the zone 1/zone 5 junction [2]; this will be exacerbated by sudden extended contact with concrete [3] and by the natural slowing down in hoof growth during winter [4]. However, similar situations are likely to apply on, at least, some of the farms studied by Hancock et al (2016) [1], but this study provided no analysis of claw horn lesions post natural mating. The reduced mobility of a large proportion of the bulls is likely to have significantly reduced herd reproductive performance. However, the extent of that reduction is unclear. Further research is required, under Australian conditions, to determine the detrimental effects of lameness on herd reproductive performance.

Acknowledgements

Many thanks to Richard and Linda Laven, Massey University, for their assistance in the development of this case report.

References

1. Hancock, A.S., Younis, P.J., Beggs, D.S., Mansell, P.D., Stevenson, M.A., Pyman M.F. An assessment of dairy herd bulls in southern Australia: 1. Management practices and bull breeding soundness evaluations, J. Dairy Sci, 2016 (99): 9983-9997

2. Greenough, P.R. Disorders of the Claw Capsule Associated with Laminitis. In Bovine Laminitis and Lameness. Philadelphia, Pennsylvania, USA, Saunders Elsevier, 2007; 84-106

3. Vermunt, J.J., Greenough, P.R. Structural characteristics of the bovine claw: horn growth and wear, horn hardness and claw conformation, Br. Vet. J 1995 (151): 157-180.

4. Tranter W.P., Morris ,R.S (1991) A case study of lameness on three dairy herds, NZ Vet J 1991 (39): 88-96.

Keywords: Bulls, fertility, toe ulcer

P 6-3 Activity Of Beef Cattle Affected By Digital Dermatitis Compared To Healthy Cattle

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Introduction

Digital dermatitis (DD) in cattle is the major causes of lameness, production and welfare losses that compromise claw health under intensive cattle husbandry systems, both dairy and beef. Given the fact the DD is associated with painful ulcerative lesions and lameness, it is to be expected that cattle affected by DD will have different activity patterns compared to healthy cattle. This project investigates this hypothesis using HOBO activity meters attached to beef cattle in a feed yard.

Materials and Methods

Ito, et al. (2009) showed that the output data obtained by attaching an electronic data logger to the leg of a cow for several days could accurately estimate the lying behavior of dairy cattle. We chose to use the protocol published by the University of British Columbia Animal Welfare Program for data loggers to obtain lying and standing behavior of feedlot steers. For this study, HOBO Pendant® G Acceleration Data Logger accelerometers (Onset Computer Corporation, Bourne, MA USA) were attached to right hind legs of 38 steers for ten consecutive days. Twenty-one steers had active DD lesions >2cm in diameter and matched with 17 healthy control steers were for bodyweight. Data about standing and laying behavior were extracted using SAS 9.2.1 (code modified from UBC Animal Welfare Program) and analyzed using R version 3.2.1 and logistic regression to quantify associations between lesions and behavior.

Results

Significant increases of laying and standing time averaged over ten days were found together with significantly reduced numbers of laying and standing bouts and reduced Average Daily Weight Gain (ADG) in cases compared to controls, when corrected for time.

Discussion

It was concluded from the results that DD affected steers would not change position if they could avoid it by standing for longer periods of time and laying down for longer periods of time. The consequences for ADG are probably the reflection of reduced feed intakes in the cases compared to controls. The findings should increase the awareness of beef producers to prevention and control of DD in beef cattle, because it is currently underreported and true economic losses such as added feed costs go unnoticed.

Acknowledgements

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References

K. Ito K Weary D M von Keyserlingk Lying behavior: assessing within- and between-herd variation in free-stall-housed dairy cows. Journal of Dairy Science, 2009, Vol.92(9), p.4412-4420.

Keywords: digital dermatitis, activity, beef cattle

7 ULTRASOUND, RADIOGRAPHY

29 Detection Sensitivity Of Bovine Hoof Structures Using Ultrasonography

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Introduction

We investigate causes of detection insensitivity of the sole structures clarified from 1) different types of ultrasonographic probes, 2) variety of sole lesions (diagnosed by computed tomographic (CT), and 3) hardness of the sole horns in applications of ultrasonography to the bovine claws.

Materials and Methods

Specimens comprised 150 pairs of hind limbs obtained from lactating Holstein cows from a slaughterhouse. Two types of ultrasonographic device were used; Device #1 was an ultrasonographic machine (HI VISION Preirus; Hitachi-Aloka Medical). Ultrasonographic probes were a linear, 6.5-MHz type (probe A), and a convex 5.0-MHz type (probe B); Device #2 was a portable ultrasonographic machine (HS-101V; Honda Electronics). Ultrasonographic probe was a linear 5.0-MHz type (probe C). CT images were obtained using a slip-ring scanner (Pronto SE, Hitachi) or a 16-section multidetector scanner (ECLOS; Hitachi) (Tsuka et al., 2012, 2014). Sole structures were observed at three points; Point sole 1 (S1), located on virtual lines from the most apical margin of the distal phalanx to the sole surface; Point sole 2 (S2), as a region perpendicular to the deepest concavity of the ventral surface of the distal phalanx; and Point sole 3 (S3), as a region perpendicular to the tuberculum flexorium (Kofler et al., 1999). Hardness of sole horns (SH; units) was measured by applications of a durometer (ESD model; Elastron) to weight-bearing surface within point S2 in 80 pairs of hind limbs. Statistical tests; (1) Detection sensitivities (DS) of sole structures were compared among three probes at each point S1, S2, and S3 with chi-square test.; (2) The logistic regression coefficient was used to investigate influences of sole lesions (thin soles, heel erosions, white line separations, double soles, and sole ulcers) associated with the invisible situations of sole structures on ultrasonography, with odds ratios (ORs); and (3) DS was statistically compared among three groups of SH <40 units (SH40: n=110), 40-<50 units (SH40-50: n=162), and ≥50 units (SH50: n=48) with chi-square test.

Results

(1) The sole structures were visible with uses of probe A for 77.9, 65.9, and 60.8 % of the claws at points S1, S2, and S3, respectively. The DSs were lower than those with uses of probe B (92.3, 91.2, and 88.3 %), and those with uses of probe C (96.5, 95.1, and 92.9 %) at points S1, S2, and S3, respectively. (2) Significantly (P<0.001) higher ORs were found in claws with sole ulcers (DS: 46.7%, OR: 20.10 at point S3), and double soles (DSs: 57.1-60.7%, ORs: 11.38-14.46 at all points). Significantly (P<0.001) lower ORs were found in claws with thin soles (DS: 99.5%, ORs: 0.10 and 0.09 at points S1 and S2). (3) Using probe B, the DS of 77.1% in the SH50 group was significantly (P<0.05) lower than those of 93.7% in the SH40 group and 91.4% in the SH40-49 group.

Discussion

Factors for detection insensitivity of the sole structures on ultrasonographic images were 1) higher frequency of the probe, 2) presences of double soles and sole ulcers, and 3) sole hardness of ≥50 units.

References

Kofler J, Kübber P, Henninger W. Ultrasonographic imaging and thickness measurement of the sole horn and the underlying soft tissue layer in bovine claws. Vet J 1999;157:322-331.

Tsuka T, Ooshita K, Sugiyama A, Osaki T, Okamoto Y, Minami S, Imagawa T. Quantitative evaluation of bone development of the distal phalanx of the cow hind limb using computed tomography. J Dairy Sci 2012;95:127-138.

Tsuka T, Murahata Y, Azuma K, Osaki T, Ito N, Okamoto Y, Imagawa T. Quantitative evaluation of the relationship between dorsal wall length, sole thickness, and rotation of the distal phalanx in the bovine claw using computed tomography. J Dairy Sci 2014;97:6271-6285.

30 Comparison Of Computed Tomography Versus Radiography For The Evaluation Of The Distal Phalanx In Cows Diagnosed With Complicated Toe Necrosis

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Introduction

Toe necrosis is still a poorly understood and difficult to treat condition in cattle. Treponema species associated with digital dermatitis have been accounted for the development of a diffuse osteomyelitis of the pedal bone (1). This might induce irreversible changes that cannot be appreciated based on inspection of the external claw lesions (2). Radiography has been shown a valuable tool in the diagnosis of necrosis of the apex of the pedal bone (3,4,5). In this study a comparison is made between radiography and computed tomography (CT) of claws affected with toe necrosis.

Materials and methods

Affected claws (n = 4) were collected from 4 Holstein Friesian cows (mean age 1617 $\pm$ 445 days) diagnosed with chronic toe necrosis in one claw each. All animals have received intensive local treatment for the last 3 months. Latero-medial radiographic projections of diseased claws were obtained and an additional CT study conducted using a 4-slices helical CT scanner. Periosteal reactions at the extensor process, sole and flexor tuberosity were graded on both radiographs and sagittal CT images using the following grading system: none – minor – moderate – extensive. The characteristics of the tip of the pedal bone were recorded (normal - pointy – rounded – blunt – irregular). Finally, the overall shape of the claw was evaluated and compared between the two imaging techniques.

Results

Despite their treatment, all animals still showed a degree of lameness ranging from 2.5 to 5 (6). All 4 claws still showed non-healing lesions at the toe. Based on the diagnostic imaging of the different claws, two were classified as severely attained by toe necrosis whereas the other two were more mildly diseased. In the severe cases, radiography tended to underestimate the severity of the pedal bone lesions in comparison with CT, whereas in the mild cases, similar results were obtained between radiography and CT. Periosteal changes at the extensor process and sole were seen in all affected claws and appeared extensive in the more severe cases. Periosteal changes at the flexor tuberosity were observed in 3/4 affected claws. All pedal bones were markedly shorter and showed a divergent toe shape on both CT and radiography.

Discussion

In all cases, the affected pedal bone was abnormally shaped compared to normal claws illustrated by both CT and radiography. This shows the diffuse character of the disease in these cases. CT was superior compared to radiography in advanced cases for the assessment of the severity of pedal bone lesions. Severity of several abnormalities identified on CT were underestimated due to superposition using radiography. Although underestimating the severity in advanced cases, radiography was a valuable tool to visualise important bony changes associated with chronic toe necrosis. These irreversible changes most likely accounted for the persistent lameness observed in all animals. The latero-medial projection used on cadaver specimens is difficult to obtain in an in vivo setting. In practice, an oblique lateral projection using an interdigital plate would be more preferable to obtain a comparable diagnostic image of the pedal bone.

References

Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown JM, Murray R, Paton RJ, Carter SD. Association between bovine digital dermatitis treponemes and a range of non-healing bovine hoof disorders. Veterinary Record 2011 (168): 214.

Gyan LA, Paetsch CD, Jelinski MD, Allen AL. The lesions of toe tip necrosis in southern Alberta feedlot cattle provide insight into the pathogenesis of the disease. The Canadian Veterinary Journal 2015 (56): 1134-1139.

Kofler J. Clinical Study of Toe Ulcer and Necrosis of the Apex of the Distal Phalanx in 53 cattle. The Veterinary Journal 1999 (157): 139-147.

Bargai U, Pharr JW, Morgan JP. Bovine Radiology, Ed. Ames, Iowa State University Press 1989; 5-44.

Blowey R, Burgess J, Inman B, Evans N. Bone density changes in bovine toe necrosis. Veterinary Record 2013 (172): 164.

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 1997 (47): 1179-1187.

Keywords: Toe tip necrosis, Computed tomography, Radiography

31 Is The Bovine Pedal Bone Sinking Around Calving?

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Introduction

Softening of connective tissue of the claw suspensory apparatus around calving as described by Tarlton, et al. (2002) may lead to sinking of the bovine pedal bone resulting in compression of the digital cushion. The objective of this study was to describe changes in the thickness of the soft tissue on weight bearing claws in the weeks around calving.

Materials and methods

Thirty-five Holstein heifers were followed in a Danish dairy herd. Each heifer underwent an ultrasonographic examination of the hind claws four times,twice before calving and twice after calving, with a one-week interval. The ultrasonographic examination was performed through the sole horn as described in other studies (Bicalho, et al. 2009, Kofler, et al. 1999, van Amstel, et al. 2004) but on weight bearing claws, while the heifers were standing in a tub with a 10 mm. thick polyethylene bottom. The claws were covered with water to improve the image quality. At each examination, the body condition score (BCS) of the heifers was recorded. The thickness of the soft tissue in the sole, defined as the distance between inner margin of the sole horn and the pedal bone, was measured on the ultrasonographic images at the apex of the claw and at the typical sole ulcer site.

Results

We made 1096 ultrasonographic examinations.

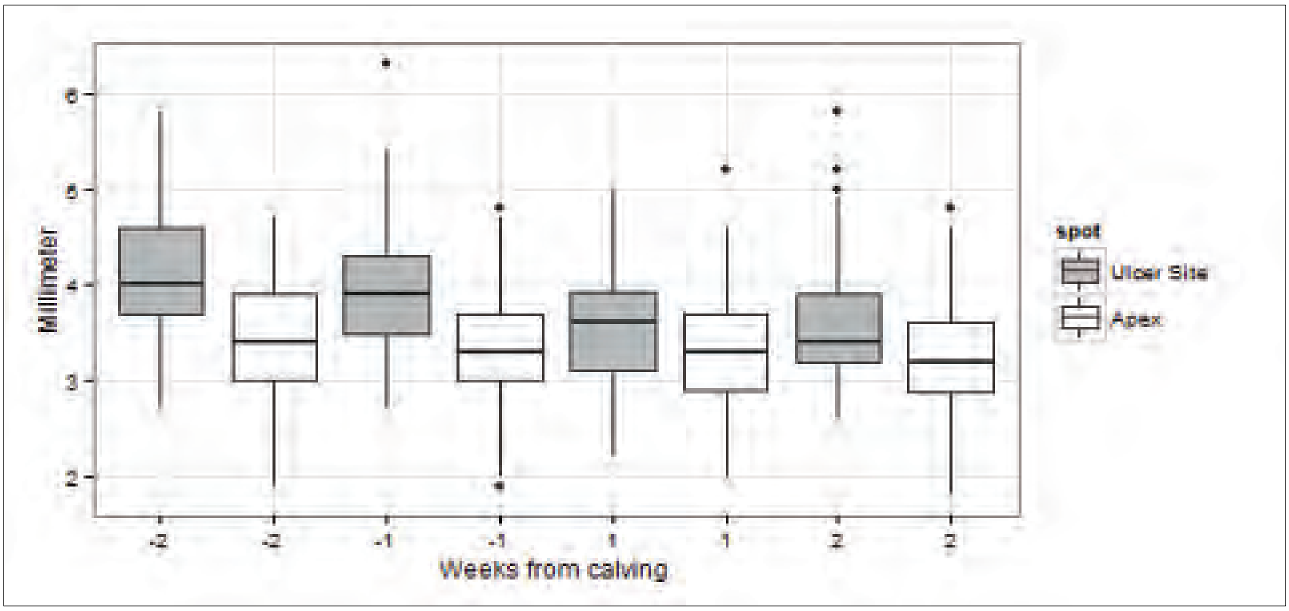

Figure 1. Thickness of the soft tissue in millimeter at the sole ulcer site (grey boxes) and at the apex of the claw (white boxes) in the weeks around calving. “-2” and “-1” is week two and one before calving respectively. “1” and “2” is the first and second week after calving. The mean thickness of the soft tissues at the typical sole ulcer site was reduced with 0.6 millimeters from the first to the last examination (Figure 1). This was a 15 % reduction of the thickness, in approximately four weeks. The correlation between “days from calving” and “thickness of the soft tissue” was 0.31 (Pearson’s, $p<0.001$). At the apex of the claw only small changes was observed. We did not observe any significantly loss in BCS in the four-week period we followed the heifers’.

Discussion

The decrease in soft tissue thickness in the weeks post-partum could be the result of actual sinking of the pedal bone inside the claw capsule. This may lead to increased pressure on the dermis of the sole horn. However, we do not know if the decrease in thickness entirely was a consequence of calving. Changes in environment, feeding and handling of the heifers might also contribute to the decrease in the thickness and development horn related lesions as described by other authors (Bergsten, et al. 2015, Webster 2001) In future studies, multiparous cows and animals from more than a single farm should be included and the number of known risk factors related to claw horn lesions should be limited. A longer study period post calving to reveal a possible increase in thickness would be of interest.

Acknowledgements

Thanks to Helle Holstein for providing heifers.

References

Bergsten C, Telezhenko E, and Ventorp M 2015 Influence of Soft or Hard Floors before and after First Calving on Dairy Heifer Locomotion, Claw and Leg Health. *Animals* 5: 0378.

Bicalho RC, Machado VS, and Caixeta LS 2009 Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. *Journal of dairy science* 92: 3175-3184.

Kofler J, Kubber P, and Henninger W 1999 Ultrasonographic imaging and thickness measurement of the sole horn and the underlying soft tissue layer in bovine claws. *Veterinary Journal* 157: 322-331.

Tarlton JF, Holah DE, Evans KM, Jones S, Pearson GR, and Webster AJF 2002 Biomechanical and Histopathological Changes in the Support Structures of Bovine Hooves around the Time of First Calving. *The Veterinary Journal* 163: 196-204.

van Amstel SR, Palin FL, and Shearer JK 2004 Measurement of the thickness of the corium and subcutaneous tissue of the hind claws of dairy cattle by ultrasound. *Vet Rec* 155: 630-633.

Webster AJF 2001 Effects of housing and two forage diets on the development of claw horn lesions in dairy cows at first calving and in first lactation. *Veterinary Journal* 162: 56-65.

Keywords: Ultrasound, Calving, Claw suspensory apparatus

P 7-1 Ultrasound Examination Through The Sole Horn On A Weight-Bearing Claw: Pilot In-Vitro Study

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Introduction

A decrease of the soft tissue thickness in the claw increases the pressure on the corium from the pedal bone and may lead to injuries and claw horn lesions (Ossent & Lischer 1998, Tarlton, et al. 2002). Ultrasonography has been described as a useful method to exam the soft tissue inside the claw capsule (Kofler, et al. 1999, Laven, et al. 2012, Toholj, et al. 2013, van Amstel, et al. 2004), but performing ultrasonography directly through the sole horn on raised claws or on legs of slaughtered cattle. The aim of this study was to develop a method that made it possible to measure the thickness of the soft tissue inside the bovine claw using ultrasonography on a weight-bearing leg of live cattle.

Materials and methods

We designed a tub made of polyethylene with the following dimensions: width: 750 mm; length: 400 mm; height: 50 mm; thickness of the bottom: 10 mm (RIAS, Roskilde, Denmark). We checked if the tub was able to carry the weight of a cow.

Fifty-two hind feet from Holstein cows were collected from a slaughterhouse. After trimming the claws the sole of each claw underwent an ultrasonographic examination at two points as descripted by Laven et al. (2012). Examination was done with a linear-transducer from GE (GE i739L-RS) at 6 MHz connected to GE Loqic e (GE Healthcare, USA) portable scanner. Afterwards the examinations were repeated on the same claws, while the claws were placed in water with the sole horn in the bottom of the custom made polyethylene tub. The ultrasonografic examination was made from below through the bottom of the tub.

After scanning we measured the distance between the internal margin of the sole horn and the pedal bone by using the measuring software on the ultrasonographical machine.

Results

The 10 mm. polyethylene could carry the weight from the hindlegs of a 700 kg heavy Holstein cow

The correlation between the thickness of the soft tissue measured with the two different methods was 0.91 (Pearson's correlation coefficient, Figure 1).

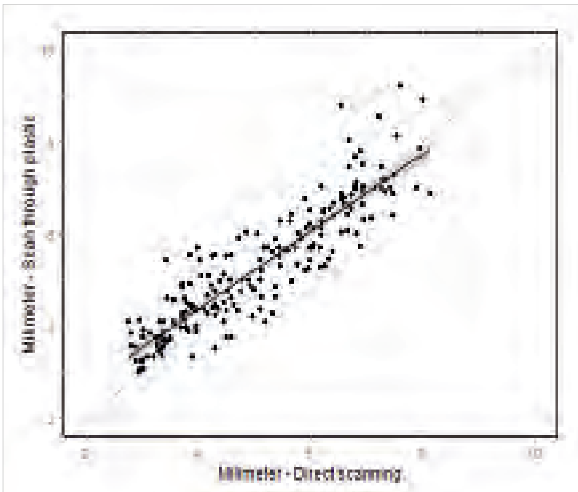

Figure 1: The correlation between the thickness of the soft tissue in millimeter, measured on ultrasonographic images from scannings made directly through the sole horn (x-axis) and scannings made through 10 mm. polyethylen and the sole horn (y-axis). The grey line represents a 100% correlation and the black line shows the correlation between the two methods.

Discussion

The bottom of the tub could carry the weight of a 700 kg cow. It was possible to scan through the sole horn and a plastic plate, even though the image quality was not as good as from scans made directly through the sole horn, it was still possible to identify the essential structures: outside and inside margin of the sole horn and the pedal bone. The measurements made on sonographic images preformed directly through the sole horn and through the polyethylene plate respectively had an acceptable correlation.

Acknowledgements

Thanks to Mogens Nielsen Kreaturslagteri A/S for providing slaughter house legs.

References

Kofler J, Kubber P, and Henninger W 1999 Ultrasonographic imaging and thickness measurement of the sole horn and the underlying soft tissue layer in bovine claws. *Veterinary Journal* 157: 322-331.

Laven LJ, Laven RA, Parkinson TJ, Lopez-Villalobos N, and Margerison JK 2012 An evaluation of the changes in distance from the external sole surface to the distal phalanx in heifers in their first lactation. *Veterinary Journal* 193: 639-643.

Laven LJ, Margerison JK, and Laven RA 2012 Validation of a portable ultrasound machine for estimating sole thickness in dairy cattle in New Zealand. *New Zealand veterinary journal* 60: 123-128.

Ossent P, and Lischer C 1998 Bovine laminitis: the lesions and their pathogenesis. *In Practice* 20: 415-427.

Tarlton JF, Holah DE, Evans KM, Jones S, Pearson GR, and Webster AJF 2002 Biomechanical and Histopathological Changes in the Support Structures of Bovine Hooves around the Time of First Calving. *The Veterinary Journal* 163: 196-204.

Toholj B, Cincovic M, Stevancevic M, Spasojevic J, Ivetic V, and Potkonjak A 2013 Evaluation of ultrasonography for measuring solar soft tissue thickness as a predictor of sole ulcer formation in Holstein-Friesian dairy cows. *The Veterinary Journal* 199: 290-294.

van Amstel SR, Palin FL, and Shearer JK 2004 Measurement of the thickness of the corium and subcutaneous tissue of the hind claws of dairy cattle by ultrasound. *The Veterinary Record* 155: 630-633.

Keywords: Ultrasound, Weight bearing claw, Claw suspensory apparatus

P 7-2 The Accuracy Of Ultrasonography And Radiography For Identifying The Position Of The Distal Phalanx Within The Hoof.

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Introduction

Laminitis/pedal osteitis is a sporadic but significant problem in groups of young calves in New Zealand. Clinical picture includes lameness, claw pain, hoof haemorrhage, conformational defects [1]. Some calves respond to anti-inflammatories and claw trimming, but others do not despite similar presentation. Differences in distal phalanx (P3) position within the claw may be responsible for this disparity. The ability to identify sinking/rotation of P3 in live calves could be a useful prognostic indicator. This pilot study used healthy claws to assess whether P3 position within the claw could be established using ultrasound or digital radiography.

Materials and Methods

The front left and right hind feet of 14 calves (6-12 weeks old) were collected after slaughter identified and chilled (3-5°C). After cleaning, measurements were obtained from all claws at four sites using ultrasound, radiography and electronic callipers (following freezing and sectioning).

Measurements made (figure 1):

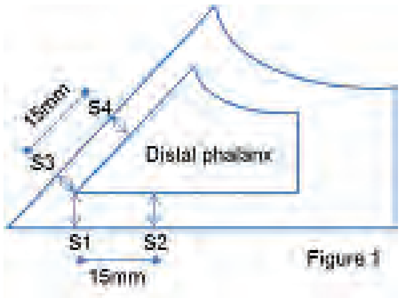

Figure 1

S1: Sole surface to P3 tip

S2: Sole surface to ventral P3, 15mm from S1

S3: Dorsal wall surface to P3 tip

S4: Dorsal wall surface to P3, 15mm proximal to S3

Agreement between radiographic or ultrasound and calliper measurement were assessed using Lin's concordance correlation coefficient (CCC) (calculated using variance component analysis [2]) and limits-of-agreement (LOA) analysis [3]. Within each method, the results for S1 were compared to S2 and those for S3 with S4.

Results

Agreement analysis results are summarised in Table 1.

Estimation method	Agreement method	Sole sites		Dorsal wall sites	
		S1	S2	S3	S4
Ultrasound	CCC	0.77	0.85	0.53	0.44
	LOA (mm)	-2.44 to 1.94	-3.80 to 3.89	-2.15 to 2.18	-2.41 to 2.44
Radiography	CCC	0.35	0.5	0.32	0.25
	LOA (mm)	-1.38 to 8.66	-2.11 to 7.53	-1.23 to 3.76	-1.06 to 4.75

Table 1 Agreement between radiographic and ultrasound measurements and measurements made with electronic callipers.

For ultrasound and radiography, concordance was significantly lower for dorsal wall than for sole measurements. However, concordance was higher for ultrasound than radiographic estimates at all four sites. The limits-of-agreement for radiographic estimates were significantly worse than ultrasound for sole but similar for dorsal wall measurements. Calliper and ultrasound values obtained for S1 were less than those for S2; however, for radiographic estimates S1 values were greater than S2 values. Calliper and ultrasound values obtained for S3 and S4 were not significantly different; however, for radiographic estimates S3 values were smaller than S4 values.

Discussion

Ultrasound measures were readily obtained and the agreement demonstrated between ultrasound and calliper assessment of distal phalanx position within the hoof supports the use of ultrasonography in live calves. In contrast radiographic estimation proved inaccurate and less transferable to field conditions. The significant difference between results at S1 and S2, and the lack of difference between S3 and S4, suggest that taken together these measurements could aid the identification of sinking or rotation of the distal phalanx in affected calves and thereby contribute to prognosis.

Acknowledgements

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References

Laven LJ, Laven R, Carr R, Stevenson M, Cohen E, Tulley W. Laminitis and pedal osteitis complex in dairy replacements. Proceedings of the XVIII World Buiatrics Congress. 2014; 191.

Carrasco, JL, Jover L., Estimating the generalized concordance correlation coefficient through variance components. Biometrics, 2003 (59): 849-858.

Bland JM, Altman DG. Agreement Between Methods of Measurement with Multiple Observations Per Individual, Journal of Biopharmaceutical Statistics, 2007 (17): 571-582.

Keywords: Ultrasound radiography comparison, P3 position

P 7-3 Doppler Sonographic Evaluation Of Digital Hemodynamic Indexes In Cattle

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Introduction

Doppler ultrasound (DUS) is a useful tool for quantifying blood flow. In the last decade, the amount of research that uses DUS in veterinary medicine has been increasing, mainly in the animal reproduction (1). As we know, lameness is considered one of the most serious economic and welfare issue in dairy production (2). In recent years, some studies have associated the presence of claw injures with the increase in the local temperature, being a consequence of an increased blood flow caused by the inflammatory process (3,4). Therefore, our study aimed to evaluate the feasibility of DUS in order to assess the blood flow and obtain the hemodynamic indexes of the hind limbs in cattle.

Materials and Methods

The procedures were performed in accordance with the ethical standards and animal care utilization (protocol 8384270117). Ten young healthy steers, aged between 16 and 22 months, free of hooves and leg problems were selected for the study. Due to the epidemiological importance, only one of the hind limbs was randomly evaluate. The animals were kept in standing position and the DUS examination were performed using a Sonosite M-turbo (Fujifilm – Sonosite Inc. USA) ultrasound system with a 5–8 MHz micro-convex transducer. The hair between the fetlock and coronary band was clipped to assess the digital common dorsal artery (DCDA), the main blood supply to the hind claw (5). The DCDA ultrasound images were obtained between the first phalanx joint and the metatarsus-phalangeal joint. The examination began with the transducer's surface oriented lengthwise to the artery, the depth was set to 2.5 cm, and the artery diameter was measured. Then, the Doppler sample volume was adjusted to 3 mm in size and positioned centrally within the artery with the insonation angle between the ultrasound beam and the blood flow adjusted to 60° in order to minimize error (6). The quality of the spectral waveforms was evaluated with respect to visual clarity and a clearly audible signal sound (7). Two-dimensional images were obtained of the arterial diameter and of the automatic contour of five consecutive spectral waveforms. Measurement of DCDA diameters was calculated from systolic images. Velocities (Vmax and Vmean) and the resistivity index were calculated by the ultrasound software. The arterial cross-sectional area (CSA = πr^2) and blood flow volume were calculated (8). All Doppler examination were carried out using the same equipment and the professional to avoid possible causes of variation (9).

Results

The results are shown in Table 1.

Table 1 – Hemodynamic indexes of the DCDA from left and right hind limbs

Left digital artery	Mean	Median	S.D.	CV	Min	Max
Diameter (cm)	0.32	0.32	0.05	14.63	0.26	0.38
Area (cm²)	0.07	0.055	0.03	44.14	0.03	0.11
Vmax (cm/s)	40.43	38.55	7.9	19.73	29.70	55.6
Vmean (cm/s)	15.04	14.45	2.6	17.30	10.98	18.76
Resistivity index	0.70	0.73	0.09	13.70	0.54	0.81
Blood Flow (L/h)	3.54	3.55	1.59	44.96	1.53	5.89
Right digital artery	**Mean**	**Median**	**S.D.**	**CV**	**Min**	**Max**
Diameter (cm)	0.33	0.32	0.03	9.83	0.29	0.39
Area (cm²)	0.08	0.08	0.02	19.54	0.06	0.11
Vmax (cm/s)	41.26	41.9	9.24	22.39	28.60	51.80
Vmean (cm/s)	15.05	13.65	3.97	26.46	10.79	22.06
Resistivity index	0.76	0.78	0.10	13.66	0.52	0.87
Blood Flow (L/h)	4.20	3.94	0.88	21.09	3.34	5.56

S.D.: standard deviation; CV: coefficient of variation

Discussion

According to our results the study has proven the feasibility of DUS to assess the DCDA blood flow and to evaluate hemodynamic indexes in standing cattle. In horses, some studies demonstrate the viability of DUS in both femoral and palmar digital artery (7,10), however, to the best of our knowledge, this is the first report of the use of DUS in the bovine digital artery. Further studies should be performed to address the relationship between blood flow and the occurrence of lameness.

References

1. Oliveira BMM, Arruda RP, Thomé HE, Filho MM, Oliveira GC, Guimaraes CF, Silva LA, Nichi M, Celeghini ECC. Artificial insemination causes uterine hemodynamic alterations in suckled beef cows subjected to an ovulation synchronization program. Livestock Science 2014 (167): 449-454.

2. Whay HR, Main DCJ, Green LE, Webster AJF. Assessment of the welfare of dairy cattle using animal-based measurements: direct observations and investigation of farm records. Veterinary Record 2003 (153): 197-202.

3. Alsaaod M, Büscher W. Detection of hoof lesions using digital infrared thermography in dairy cows. Journal of Dairy Science 2012 (95): 735-742.

4. Oikonomou G, Trojacanec P, Ganda EK, Bicalho MLS, Bicalho RC. Association of digital cushion thickness with sole temperature measured with the use of infrared thermography. Journal of Dairy Science 2014(97): 4208-4215.

5. Vermunt JJ, Leach DH. A macroscopic study of the vascular system of the bovine hind limb claw. New Zealand Veterinary Journal 1992 (40): 139-145.

6, Ginther OJ. Principles of B-mode and Doppler Ultrasonography. In: Ultrasonic Imaging and Animal Reproduction: Color – Doppler Ultrasonography, Book 4. Ginther OJ. ed. Wisconsin, USA: Equiservices Publishing 2007, 25-38.

7. Raisis AL, Young LE, Meire H, Walsh K, Taylor PM, Lekeux P. Repeatability of Doppler ultrasound measurements of hindlimbs blood flow in halothane anaesthetized horses. Equine Veterinary Journal 2000 (32): 239-246.

8. Starke A, Schmidt S, Haudum A, Scholbach T, Wohlsein P, Beyerbach M, Rehage J. Evaluation of portal blood flow using transcutaneous and intraoperative Doppler ultrasonography in dairy cows with fatty liver. Journal of Dairy Science 2011 (94): 2964-2971.

9. Gill RW. Measurement of blood flow by ultrasound: accuracy and sources of error. Ultrasound in Medicine and Biology 1985 (11): 625–641.

10. Hoffmann K, Wood AKW, Griffiths KA, Evans DL, Gill RW, Kirby AC. Doppler sonographic measurements of arterial blood flow and their repeatability in the equine foot during weight bering and non-weight bearing. Research in Veterinary Science 2001 (70): 199-203.

Keywords: Blood flow, Doppler ultrasound, Digital artery, Hemodynamic

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8 PAIN

32 The Practical Use of Blocks to alleviate pain and improve recovery in lame cows.

Reader, J.D.1, Burnell, M.C.1, Frecknall, D.1 and Huxley, J.N.2

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Introduction

The Dutch 5 step foot trimming method has become well established as the recognized method of trimming dairy cow's feet across the world. Modifications have been suggested but generally they still use the general principles outlined by Toussaint Raven (1985).

Materials and Methods

The first three steps of this method tend to describe the method for a preventative trim and steps four and five tend to only be required where lesions are present on the foot. Toussaint Raven described in step four the need to remove weight from an affected lesion. He describes that this may require a block. Potterton et al (2012) summarized all the peer reviewed literature involved in the treatment and prevention of lameness for the previous 10 years. This highlighted an absence of evidence based research relating to the effective treatment of claw horn lesions. The University of Nottingham in partnership with AHDB – Dairy (formerly Dairy Co) highlighted the need for further research in this area.

Results

Thomas et al (2015) demonstrated that there was a definite benefit from the addition of a block to the non-diseased claw and this effect was enhanced further when a non-steroidal was also used.
Percentage sound after 5 weeks (MS Score 0) – Thomas et al (2015)

- •Trim Only 24.4%
- •Trim and Block 35.9%
- •Trim and NSAID 28.6%
- •Trim and Block and NSAID 56.1%

Toussaint Raven in his original book describes applying a block using a rubber block and nails. Technology has moved on considerably since then with the availability of many different glues and block materials.

Discussion

This poster attempts to try to summarise some of the commonly used blocks as well as the commonly used glues available on the market. Some of the properties of these glues have been researched as part of a 3rd year research project at the University of Nottingham looking at block retention times while another project looked at some of the factors influencing the choice of blocks by vets and foot trimmers. The poster also introduces some other novel concepts in block application including 'double blocking' and some other success factors to maximise success following block application. The poster is intended as a practical discussion point at the conference with some examples of blocks on show. We hope that this will stimulate a discussion of how block retention and raid resolution of lameness can be achieved in different operators' hands. The authors do not pretend that the blocks discussed in the poster are an exhaustive list of those readily available in the UK but hope that they are able to stimulate meaningful discussion.

Acknowledgements

The authors would like to acknowledge the help of the Vet Tech team at Synergy Farm Health and the students at the University of Nottingham who carried out the block studies.

References

1. S.L. Potterton, N.J. Bell, H.R. Whay, E.A. Berry, O.C.D. Atkinson, R.S. Dean, D.C.J. Main, J.N. Huxley: A descriptive review of the peer and non-peer reviewed literature on the treatment and prevention of foot lameness in cattle. 2000. The Veterinary Journal, Volume 193, Issue 3, 2012: 612-616.

2. H. J. Thomas,*1, G. G. Miguel-Pacheco,* N. J. Bollard,* S. C. Archer,* N. J. Bell, † C. Mason, ‡ O. J. R. Maxwell,*, J. G. Remnant,* P. Sleeman,* H. R. Whay, § and J. N. Huxley*: Evaluation of treatments for claw horn lesions in dairy cows in a randomized controlled trial. Journal of Dairy Science Vol. 98 No. 7, 2015

3. E. Toussaint Raven.: Cattle Footcare and Claw Trimming. Aloys Lurvink, eds. 1985

Key Words: Lameness – Blocks - 5 Step Foot trimming – Non steroidal - Cows

33 The Presence Of Hoof Lesions Affects Lying And Standing Duration Around Trimming

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Introduction

With increasing herd size, time to observe and monitor individual cows decreases and hence, also proper lameness management may be impaired. Thus, there is a need for tools to support farmers in detecting lame cows in need for treatment. Pedometers are already available in many commercial dairy herds and the relationship between lying time and lameness has been investigated already by several researchers [1,2,3]. In contrast, much less information is available on the relationship between lying time and hoof lesions being the main cause of lameness in cows.

Materials and methods

The behaviour of approximately 400 cows from four Danish commercial dairy herds was measured in 2008 and 2009 using IceTag-sensors (IceRobotics). The relationship between the accelerometer data and lameness has already been analysed [2], as well as the change in daily lying time, motion index and step frequency throughout lactation [4]. In addition, data from hoof trimming was collected three times/year in each herd by two scientists with a veterinarian background. Hoof lesions were scored as suggested by Manske et al. [5], including the type, location and severity of lesions. For the purpose of this abstract, the cows have been grouped according to lesion type and severity at the time of trimming:

Score 1: No lesions or only heel horn erosion

Score 2: Mild lesions that are not deemed necessary to alert the farmer or treat immediately

Score 3: Severe lesions that a farmer should be alerted for and that require treatment other than the regular hoof trimming; these include sole ulcers, interdigital phlegmone, severe white line disease and severe digital dermatitis

Results

In these preliminary results, the lying, standing and walking time of cows in the week before trimming was not significantly influenced by score groups and thus the severity of the grouped lesions. However, looking at individual cow data in the weeks around trimming within a group of lesions, a significant ($p<0.05$) increase in lying time and decrease in standing time was found between the week before trimming and the weeks after trimming for cows with mild or severe lesions. This effect lasted up to 6 and 11 weeks for cows with mild and severe lesions, resp.

Discussion

High variability between and within cows in all of the three lesions groups is most likely the reason that no differences between the groups are found in the week before trimming. However, differences were found between the week before and the weeks after trimming within a lesions group, indicating an effect of either the lesion itself or the trimming on the behaviour. In future work, the effect of different types of lesions on the cows' behaviour will be investigated.

Acknowledgements
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References

1. Ito, K., von Keyserlingk, M.A.G., LeBlanc, S.J., and Weary, D.M. (2010). *Lying behavior as an indicator of lameness in dairy cows*. Journal of Dairy Science 93, 3553-3560.

2. Thorup, V.M., Munksgaard, L., Robert, P.E., Erhard, H.W., Thomsen, P.T., and Friggens, N.C. (2015). *Lameness detection via leg-mounted accelerometers on dairy cows on four commercial farms*. Animal 9, 1704-1712.

3. Solano, L., Barkema, H.W., Pajor, E.A., Mason, S., LeBlanc, S.J., Nash, C.G.R., Haley, D.B., Pellerin, D., Rushen, J., and de Passillé, A.M. (2016). *Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns.* Journal of Dairy Science 99: 2086-2101.

4. Maselyne, J., Pastell, M., Thomsen, P.T., Thorup, V.M., Hänninen, L., Vangeyte, J., Van Nuffel, A., Munksgaard, L. (2017). *Daily lying time, motion index and step frequency in dairy cows change throughout lactation.* Research in Veterinary Science 110: 1-3.

5. Manske, T., Hultgren, J., and Bergsten, C. (2002). *Topical treatment of digital dermatitis associated with severe heel-horn erosion in a Swedish dairy herd.* Preventive Veterinary Medicine 53, 215-231.

Keywords: hoof lesions, lying duration, standing duration, dairy cows

34 Evolution Of Locomotion Score During Lactation In Grazing Dairy Cows

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Introduction

The objectives of the present study were to assess the evolution of locomotion scores (LS) from parturition to 200 DIM and the odds in favor of becoming severely lame (LS-4 and 5) depending on the previous LS in grazing dairy cows.

Materials and Methods

A prospective observational cohort study was conducted in one commercial dairy farm in Argentina (35°37’ S, 61°22’ W) from January to July 2015. The LS was evaluated in dairy cows every 14 days with a 5-point scale (3). Data records (n: 6702) from 955 dairy cows were included in the study. A mixed multinomial logistic regression model was used to test the effect of previous LS (2 vs. 3) on the likelihood of getting higher LS (worse), the same LS or lower LS (better) at every visit. A mixed logistic regression model was run to test the effect of previous LS (1 vs. 2 vs. 3) on the odds for becoming severely lame (LS-4 and 5) by 200 DIM.

Results

Cows with a previous LS-2 kept the same LS 45.4% of times, got worse 37.8% of times, and got better 16.8% of times; whereas cows with a preceding LS-3 kept the same LS 56.5% of times, got worse 15.6% of times, and got better 27.9% of times. Previous LS had an effect on the evolution of LS (P = 0.001) where cows with LS-2 had higher risk for getting worse than cows with LS-3 (OR = 4.504, 95%CI = 3.817 – 5.319). Previous LS also had an effect on the risk for becoming lame (P = 0.001) with cows having a LS-2 showing greater odds for becoming lame than cows with LS-1 (OR = 1.224, 95%CI = 0.907 – 1.652), and cows having a LS-3 showing a much greater odds for becoming lame than cows with LS-1 (OR = 1.653, 95%CI = 1.216 – 2.246).

Discussion and Conclusions

About 50% of the cows kept the same LS 14 days later; in the other half that changed their LS, the likelihood of getting worse was higher in cows with LS-2 than in cows with LS-3. Conversely, the likelihood of getting better was lower in cows with LS-2 than in cows with LS-3. Finally, the risk for becoming severely lame (LS-4 and 5) has greater odds in moderately lame cows (LS-2 and 3, OR= 1.22 and 1.65, respectively) than in healthy cows (LS-1).

References

Whay, H. R., Waterman, A. E. & Webster, A.J.F. Associations between locomotion, claw lesions and nociceptive threshold in dairy heifers during the peripartum period. The Veterinary Journal 1997; 154,155-61.

Leach, K.A.; Tisdall, D.A.; Bell, N.J.; Main, D.C.J.; Green, L.E. The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. The Veterinary Journal 2012; 193,626–32.

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 1997; 47(6):1179–87.

SAS University Edition. 2014. SAS Institute Inc., Cary, NC, USA.

35 Clinical Efficacy Of A Single Intravenous Regional Limb Perfusion (Ivrlp) With Marbofloxacin *Versus* Ceftiofur Sodium To Treat Acute Interdigital Phlegmon In Dairy Cows: Preliminary Data

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Introduction

Antimicrobial IVRLP is a well-established technique for the treatment of deep structures and orthopaedic infections of large animals distal limbs (1, 2, 3). The aim of the present study was to compare the clinical efficacy of a single IVRLP with marbofloxacin versus ceftiofur sodium to treat naturally occurring acute Interdigital Phlegmon (IP) in dairy cows.

Material and Methods

The study had a randomised parallel-group design. A total of 40 lactating Friesian cows clinically diagnosed with acute IP, based on case history and physical exam, presenting a 3-4/5 locomotion score (4) were enrolled in the study. Immediately after detection of the case, animals were randomly assigned to one of two treatment groups and received a single IVRLP with antimicrobial drug (group M: 0.67 mg/kg of marbofloxacin, 1/3 of the daily systemic dose, Marbocyl 10%®, Vétoquinol; group C: 500 mg/animal, Excenel®, Zoetis) diluted to 40 ml using sterile water for injections. A manual pneumatic tourniquet (7 x 35 cm cuff at 300-400 mmHg; VBM® Germany) was applied over the proximal portion of the principal metacarpus/metatarsus. Then, a 19 gauge butterfly needle was introduced into the dorsal common digital III vein in a proximal-to-distal direction and antimicrobial solution was manually infused by a slow bolus injection over 60–90 seconds. The tourniquet was released 30 minutes after the injection. Clinical data for severity of lameness, digital swelling, lesions and temporary decreased in milk yield were assessed at baseline and at 5, 10 and 15 days post-IVRLP. A positive outcome after treatment was defined as digital swelling disappearance, locomotion score reduction at least 2 points/5 and daily milk production returning to previous level. The Fisher exact test was used to compare the treatment success rates.

Results

Subjects included in the study were aged between 3–8 years; group M: 18 pelvic (7 right and 11 left) and 2 thoracic (2 right) limbs were affected; group C: 18 pelvic (11 right and 7 left) and 2 thoracic (1 right and 1 left) limbs were affected. In both groups 14/20 animals had a baseline locomotion score of 4/5 while 16/30 cows 3/5. Seventeen out of 20 (85%) lactating dairy cows showed a positive outcome by the fifteenth days after a single IVRLP in both groups with no statistical difference ($P>0,5$).

Discussion and Conclusions

Early and aggressive antimicrobial systemic treatment is recommended for acute IP. Numerous antimicrobial drugs have been suggested to successfully treat this condition but ceftiofur is recognized as the standard treatment for IF in lactating dairy cows (no or minimal milk discard time). Antimicrobial drug concentrations achieved by systemic administration are often non therapeutic in highly septic environment as is the phlegmon. To our knowledge a randomized, prospective clinical trial of IP treated with IVRLP have not been published. The primary limitation to the current study is the relatively small sample size. In this preliminary trial the treatment success rate after a single IVRL procedure in the marbofloxacin group was not significantly different from ceftiofur positive control group.

References

1) Stanek C, Fessl l, Awad-Masalmeh M. Penicillin and ampicillin levels in pathologically altered tissue following regional intravenous administration of antibiotics in cattle legs. *Berl Munch Tierarztl Wochenschr* 1984 (97): 162-166

2) Rubio-Martínez lM, Cruz AM. Antimicrobial regional limb perfusion in horses. *J Am Vet Med Assoc* 2006 (28): 706-712

3) Varasano V, Mortellaro CM, Argentieri V, Celani G, Petrizzi L. Clinical efficacy of a single intravenous regional limb perfusion (IVRLP) with marbofloxacin for treating acute interdigital phlegmon in thirty dairy cows. In: 18th International Symposium and 10th Conference on Lameness in Ruminants. Valdivia, Chile 2015; 81

4) Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. *Theriogenology* 1997 (47): 1178–87

key words: interdigital phlegmon, intravenous regional limb perfusion, antimicrobial

P 8-1 Metatarsal Exostoses – Another Potential Cause Of Chronic Lameness

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Introduction
There have been previous gross post mortem reports of size variations (Blowey and Inman 2012) and of exostoses on the pedal bone, the latter associated with chronic long term changes in mobility (Blowey 2012a) and it has been suggested that these could arise from both trauma and infection (Blowey 2012b). Others have followed up this work using CT scanning (Newsome et al., 2016). This abstract describes the development of similar exostoses on the caudal aspect of the metatarsal bone, and discusses their relevance in terms of lameness.

Materials and Method
Bovine hind limbs distal to the tarsal joint were randomly selected from adult cows of unknown age, breed and lameness history, but with pronounced chronic gross claw lesions, were obtained from an abattoir. The limbs were boiled for 8 hours, gently lifted out of the water (to prevent disintegration), and cooled to facilitate easy removal of soft tissues and a detailed examination of the bones beneath. Metatarsal bones from six claws with gross lesions were compared to bones from claws with no lesions.

Results
Exostoses on the metatarsal bone were seen only in cows with extensive pedal exostoses. The exostoses, 2 – 5mm in height, were confined to the plantar mid shaft region, especially on the lateral mid, with no exostoses on the dorsal aspect (Figure One). Exostoses were rare near to the fetlock articulation.

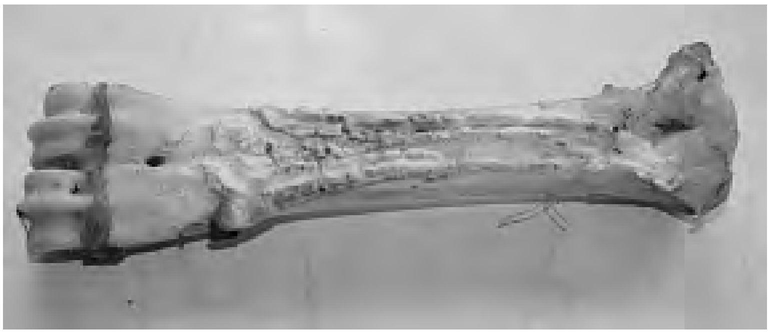

Figure One. Exostoses on the plantar mid shaft region of the metatarsal. Note the absence of exostoses proximal to the fetlock articulation (left), where the tendons are enclosed within the tendon sheath.

Discussion
As exostoses were seen only in cows with chronic pedal lesions we hypothesise that they result from infection tracking up the flexor tendon sheath. From their insertion on the flexor tuberosity, the flexor tendons are encased within tendon sheaths from the pedal joint (P2 to P3), passing over the plantar aspect of the fetlock (metatarsal – phalangeal joint) with the sheaths ending just proximal to the fetlock joint (Konig and Liebich 2004). As the unsheathed tendon will be moving over and in direct contact with the exostoses on the plantar metatarsal mid shaft during locomotion, we hypothesise that this could cause pain and is therefore a potential welfare issue. Any treatment that might reduce the development of metatarsal exostoses, for example NSAID's, should be administered to cows with inflammatory conditions of the foot such as infected sole ulcers. The

higher prevalence of exostoses on the lateral plantar mid shaft presumably reflects the greater frequency of infection of the lateral compared to medial digit, although the lateral and medial flexor tendons are joined at the proximal metatarsal region. We hypothesise that the absence of exostoses on the cranial aspect of the metatarsal is due to ascending infection of the extensor tendon being less common. We are unaware of previous reports of metatarsal exostoses.

Acknowledgements
Sharon Cooksey, who drew our attention to the anatomy of the tendon sheaths

References

Blowey RW, Inman B (2012) Is there a case for reassessing hoof trimming protocols? Veterinary Record 171 pages 592 + 593

Blowey RW (2012a) A potential cause of non-healing hoof lesions in dairy cows Veterinary Record 170:26-27

Blowey RW (2012b) ‘Bovine bunions’: an additional hypothesis for the pathogenesis of sole ulcers. Vet Rec 171, pages 130 + 131

Konig HE, Liebich HG (2004) in Veterinary Anatomy of Domestic Animals, published by Schattauer, pages 190 - 193

Newsome R, Green MJ, Bell, NJ, Chagunda MG, Mason CS, Rutland CS, Sturrock CJ, Whay HR, Huxley JN, 2016. Linking bone development on the caudal aspect of the distal phalanx with lameness during life. J Dairy Sci 99, 4512-4525.

Key words – metatarsal, exostoses, tendons

P 8-2 NSAID Reduces Lameness Score Without Affecting Lying Behaviour Of Lame Dairy Cows

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Introduction

Foot lesions in dairy cows resulting in clinical lameness are often associated with pain (2) and altered lying behaviour compared to non-lame cows (6). Use of non-steroidal anti-inflammatory drugs (NSAIDs) have shown minor effect on degree of lameness (3, 1) and no modification of lying behaviour (1), However, these studies did not control for type of foot lesions. We investigated effects of a 4-day NSAID treatment (ketoprofen) on lameness score and lying behavior in cows with lameness related to horn-related (HR) lesions and digital dermatitis (DD).

Material and methods

Ethical approval was given by the Danish Animal Experiments Inspectorate, license no. 2012-15-2934-00117. Lactating Danish Holsteins with unilaterally lameness score (LS)≥4 (5-point scale) on hind limb and either HR (n=23) or DD (n=25) on the same limb and 27 non-lame controls (LS≤2, no visible foot lesion) from two commercial herds were included. Within groups cows were randomly allocated to treatment (ketoprofen (Dinalgen®, 150 mg/ml, Scanvet, Fredensborg, Denmark, 3 mg/kg i.m) or placebo (sterile saline, 1ml/50 kg i.m.)) for four consecutive days. One observer scored lameness prior to first treatment and 1½-4 hours after last treatment. Average daily lying time, number of daily lying bouts and average lying bout duration were calculated based on limb mounted accelerometers (IceQube™, IceRobotic Ltd., Edinburgh, Scotland) at treatment days -2, -1, 2 and 3. The within cow difference between measures prior to and during treatment was used to investigate effect of treatment. Analyses were performed in R version 3.0.0 (R Development Core Team, 2013) using Wilcoxon rank sum test for lameness scores and linear models for lying behaviour.

Results

Ketoprofen reduced lameness for HR and DD cows, and when pooled this effect was statistically significant ($p<0.01$; Figure 1). Before treatment HR cows had longer total lying time than DD and control cows (838 min (SE: 45, $p<0.01$), 663 min, (SE: 42), and 664 (SE: 43), respectively); HR and DD cows had fewer lying bouts than controls (7.6 (SE: 0.9, $p<0.05$), 7.3 (SE: 0.9, $p<0.01$), and 10.1 (SE: 0.8), respectively) and HR and DD had longer lying bouts than controls (128 min (SE: 8, $p<0.001$), 106 (SE: 7, $p<0.001$), and 69 (SE: 7), respectively). No effects of ketoprofen were found on total lying time ($p>0.2$), lying bouts ($p>0.3$) or lying bout duration ($p>0.7$).

Discussion

Lameness was reduced by 4-day treatment with ketoprofen, suggesting a degree of pain relief. However, neither within nor across lesion types, the reduced lameness score was followed by a modification in lying behaviour. At present the mechanisms underlying this difference are not understood. This study included naturally occurring foot lesions of unknown duration. One aspect of the lack of effect on lying behaviour might be the timing of treatment in relation to the disease course, as treatment late in the course may have limited effects (4, 5). Further studies are needed in order to be able to alleviate pain from hoof lesions.

Acknowledgements
We would like to thank the dairy farmers for their involvement and Scanvet who unconditionally provided the Dinalgen®.

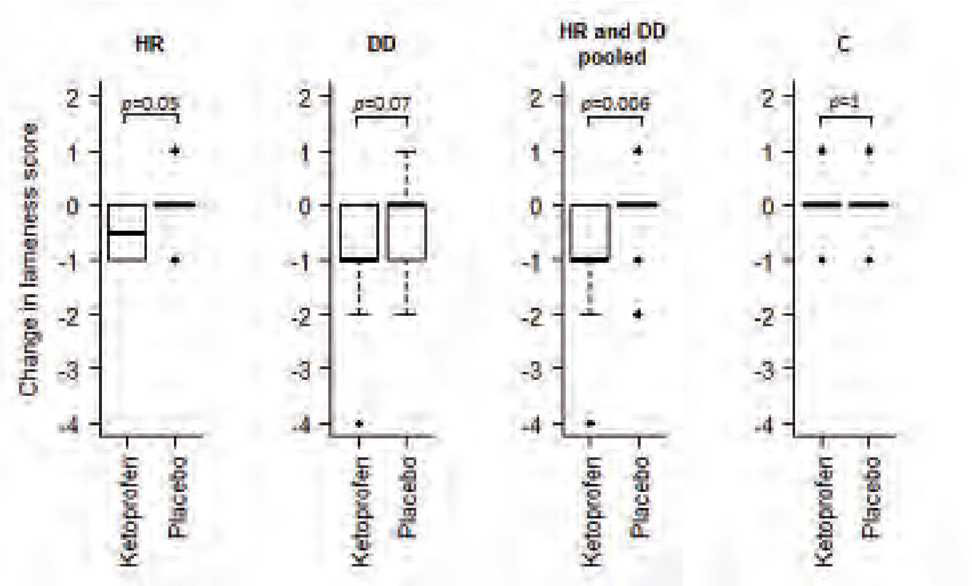

Figure 1. Boxplots of the within cow difference in lameness score between prior to first and 1½-4 h after fourth treatment (24 h intervals). *p*-values for differences between treatment groups are indicated for each comparison. The boxes show quartiles, the solid bar within boxes is the median. Observations exceeding 1.5 times the interquartile range are shown as outliers (black squares).

References

1. Chapinal N, de Passillé AM, Rushen J, Wagner S. Automated methods for detecting lameness and measuring analgesia in dairy cattle. J Dairy Sci 2010 (93): 2007–2013.

2. Dyer RM, Neerchal NK, Tasch U, Wu Y, Dyer P, Rajkondawar PG. Objective determination of claw pain and its relationship to limb locomotion score in dairy cattle. J Dairy Sci 2007 (90): 4592–4602.

3. Flower FC, Sedlbauer M, Carter E, von Keyserlingk MAG, Sanderson DJ, Weary DM. Analgesics improve the gait of lame dairy cattle. J Dairy Sci 2008 (91): 3010–3014.

4. Thomas HJ, Miguel-Pacheco GG, Bollard NJ, Archer SC, Bell NJ, Mason C, Maxwell OJR, Remnant JG, Sleeman P, Whay HR, Huxley JN. Evaluation of treatments for claw horn lesions in dairy cows in a randomized controlled trial. J Dairy Sci 2015 (98): 1–10.

5. Thomas HJ, Remnant JG, Bollard NJ, Burrows A, Whay HR, Bell NJ, Mason C, Huxley JN. Recovery of chronically lame dairy cows following treatment for claw horn lesions: a randomised controlled trial. Vet Rec 2016 (178): 116-121.

6. Thomsen PT, Munksgaard L, Sørensen JT. Locomotion scores and lying behaviour are indicators of hoof lesions in dairy cows. Vet J 2012 (193): 644–647.

Keywords: pain, ketoprofen, lying behavior

P 8-3 Flunixin Transdermal Reduces Pain In Cattle Lameness

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Introduction

Flunixin is an anti-inflammatory drug with anti-pyretic and analgesic activities. This molecule is commonly used for the relief of pain and control of inflammation and pyrexia associated with diseases of different origin. A transdermal formulation of flunixin, registered as adjunct therapy in the treatment of BRD and mastitis, has recently come to market. It is the first NSAID registered as a pour-on, making treatment more convenient for both the animal and the farmer. The study assessed the field effectiveness of flunixin transdermal for the control of pain associated with lameness in cattle.

Materials and Methods

The pain was assessed by scoring lameness (Shearer et al, 2013) and lesions. To be enrolled in the study, animals had to show lameness only in one limb (caused by interdigital dermatitis, phlegmona interdigitalis or dermatitis digitalis), a lameness score ≥ 3 and lesions score ≥ 1. A total of 65 animals, from 2 to 9 years, were enrolled, dosed, and statistically analyzed. At day 0, each animal was treated once either with the test product, Flunixin Transdermal (Finadyne® Transdermal, 3.3 mg/kg flunixin; MSD Animal Health), or with a negative control product (red dye in saline solution allowing for masking in the study), both administered once along the dorsal midline. All study animals received also cefquinome (Cobactan® 2.5%, MSD Animal Health) administered intramuscularly, on days 0, 1 and 2. All animals were observed for clinical signs and scored at 6 hours after treatment and daily thereafter up to day 3. On day 0 at 6±1 hours, an animal was designated a treatment success when its lameness score had decreased at least by 1 score compared to enrollment (day 0 pre-treatment). The dosing site was evaluated and any adverse effects were recorded.

Results

The success rates at 6 hours after treatment were 66.67% (20/30) in the Flunixin Transdermal group and 28.57% (10/35) in the Negative Control group. Lameness scores were significantly lower in the Flunixin Transdermal group than in the Negative Control group at 6 hours (p=0.0023), day 1 (p=0.0016), day 2 (p= 0.0151) and day 3 (p=0.0027). Lesions scores were significantly lower in the Flunixin Transdermal group than in the Negative Control group at day 1 (p=0.0268), day 2 (p= 0.0463) and day 3 (p=0.0101). No adverse reactions including dosing site reactions were observed throughout the study.

Discussion

Although lameness prevention is the first priority, when its occurs the associated pain needs to be controlled, not only to facilitate the animals' return into production, but also from an animal welfare aspect. The results obtained in the study showed that flunixin transdermal had a significant positive effect to control pain. Finadyne® Trandermal is now registered for pain and lameness in several countries in Europe. Finadyne® Transdermal 50 mg/ml pour-on solution has strong analgesic properties, and make it a very convenient and suitable pain control therapy to be used in cases of lameness in cattle.

References

Shearer JK 2013 Assessment and Management of Pain Associated with Lameness in Cattle. *Veterinary Clinics of North America: Food Animal Practice 29:* 135-156

Key words: Flunixin / Anti-Inflammatory / Pain / Efficacy

P 8-4 Investigation To Local Complications After The Retrograde Intravenous Regional Anesthesia Of The Toe In Dairy Cattle

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Introduction

The retrograde intravenous regional anesthesia (RIVA) is a common technique used on the distal bovine limb during surgical interventions. Several clinics have reported a series of complications concerning this technique. Therefore, the aim of the current study was to investigate possible complications during this procedure under field conditions.

Materials and Methods

A trial was conducted including 44 German Holstein cows (age 4.8 ± 1.5 (mean ± standard deviation) years, body mass 610 ± 73 kg, milk yield 43 ± 10 kg/day), housed in a freestall barn. The cows exhibited either superficial to perforating lesions of the pododerma on one hind limb (N = 33) or were healthy (N = 11). After the shaving, cleaning, defatting and disinfection of the injection area a RIVA was performed on one hind limb (plantar common digital vein IV, N = 37; dorsal common digital vein III, N = 7) of each animal (in case of the diseased animals, the affected limb was chosen). In all cases the tourniquet was applied during 25 min and after the intervention a bandage below the dewclaws was applied. The injection area was evaluated clinically and with ultrasonography one, four, six and 24 days after the RIVA.

Results

In some cases, one day after the injection superficial skin irritations (N = 3) and an increase of the skin thickness without (N = 2) and with acute inflammation signs (N = 1) in the injection area was observed. Concurrently an edema of the hypoderm was observed in seven animals during the ultrasonographical examination. Four of these animals were also considered clinical conspicuous (skin irritation N = 1; increased skin thickness N = 3). Overall, nine cows with alterations in the injection area were observed, of which six initially exhibited a pododermatitis and three were considered healthy. In all of these animals the injection was performed in the plantar common digital vein IV. Hematoma or thromboses were not diagnosed. All superficial skin irritations recovered within three days, and the increased skin thickness in the injection area not later than six days, after their first appearance.

Discussion

The skin irritations can most likely be attributed to the shaving of the injection area and inability to fully cover this area with a bandage. The edema of the hypoderm could be a sign of a local dermatitis or a partial paravenous application of the local anesthetics. However, no negative effect of these complications was observed on the healing of the claw horn lesions. The local complications were mild and recovered without any further therapy. We therefore consider the RIVA as an excellent and save anesthesia for the veterinarian practice on farm.

Key words: regional anesthesia, RIVA, limb, cattle

9 TOE NECROSIS

36 Toe Necrosis In French Dairy Cattle: A Case Series

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Introduction

In recent years, an increase of the apparent prevalence of toe necrosis was reported by hoof trimmers and practitioners in France. Nevertheless, the rationale of this increase is questionable due to (i) the absence of clear consensus on the description of the lesion and (ii) the unknown precise etiology of this condition. The aim of this study was to describe precisely (i) different cases of suspected toe necrosis and (ii) associated individual factors.

Materials and Methods

Thirty affected farms were recruited during the winter 2015-2016 in western France. Due to the low apparent prevalence of toe necrosis (<1% in France) (4), cases were pre-recruited by trimmers. In each recruited farm, a sample of cows was scored for body condition, hind and forelimbs cleanliness, horn growth, posture and locomotion (5 levels (6)). Next, an exhaustive hoof trimming was performed on selected animals suspected to be affected by toe necrosis (history of lesion) and lame cows selected by farmers and trimmers. Each necrosis lesion was described in details and all claw lesions were recorded. For recording a score system for claw lesions was used, inspired by Bareille et al. (3). A severity score (1-3) is assigned to each lesion except for ulcer, “cerise” and toe necrosis that are always severe. Once all visits were completed, reported cases of toe necrosis were classified as “confirmed”, “excluded” or “doubtful” based on consensus of 4 experts using pictures of lesions. Pattern of necrosis lesions was established with a multiple correspondence analysis coupled with ascending hierarchical classification (AHC). Correlations between lesions were identified by partial least squares regression.

Results

Finally, 27 farms were visited, 370 cows were trimmed (hindfeet and forefeet for 330 of them) and 88 suspected lesions of toe necrosis were reported. After experts meeting, 38 lesions were confirmed as toe necrosis (in 20 farms), 37 lesions as doubtful and 13 were excluded. Among the 38 lesions, 26 affected hindlimbs and 12 affected forelimbs. The first cluster of AHC mainly described confirmed lesions, as galleries digging the horn in the depth of the foot with pus, affected pododerm and a honeycomb horn. The second cluster, including more doubtful cases, included galleries, a granular pododerm, painful and a pungent odor. Third and fourth clusters, mainly represented by excluded cases, excluded previous criteria except affected pododerm. Studied herds and affected animals were severely affected by lameness (locomotion score ≥4 for 18 to 61% of cows per herd in the study sample and for 77% of affected cows). All farms were affected by digital dermatitis but none of the feet affected by toe necrosis showed this lesion. A positive correlation was observed between toe necrosis and the presence of axial or vertical fissure.

Discussion

Harmonization of the description of toe necrosis is crucial on the field. The recent ICAR consensus on toe necrosis, based on the affection of the third phalanx (5) is not fully adapted for on farm diagnosis. Based on our findings, the presence of galleries digging the horn in the depth of the foot together with affected pododerm could be used as indicators of toe necrosis. Presence of pus, painful and pungent odor improve the suspicion. Correlation with axial fissure is also reported by Atkinson (1, 2) but we didn’t observed an association with digital dermatitis lesion in dorsal face.

Acknowledgements

We thank all partners, trimmers and breeders for their participation in this study, Jean Prodhomme who was one of the initiators of the study, GDS (Bretagne and Pays de la Loire) and Livestock Institute for funding.

References

Atkinson O. Non-healing hoof lesions in dairy cows. Veterinary Record 2011 (169): 561–562.

Atkinson O and Wright T. Bone density changes in bovine toe necrosis. The Veterinary Record 2013 (172): 297–298.

Bareille N., Roussel P.. Reconnaissance des lésions des onglons et des maladies en cause. In : Guide d’intervention pour la maîtrise des boiteries en troupeaux de vaches laitières, 2e version. 2014; 20-28..

Blériot G., Thomas G. Projet PARABOV (2011-2012) Bilan de la collecte. Collection Résultats Institut de l'Elevage 2013 ; 11.

ICAR. ICAR claw health atlas. ICAR Technical Series 2015.

Sprecher.DJ, Hostetler DE., Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 1997 (47):1178-1187.

Keywords: Toe necrosis, identification, description

Figure 1: A confirmed case of toe necrosis.

37 Investigation Of Bovine Claws Infected With Toe Tip Necrosis Syndrome Using Biomechanical Testing

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Introduction:

Lameness in Feedlot cattle is a major concern to the beef industry, associated with both animal welfare and economic loss. Toe Tip Necrosis Syndrome (TTNS) is a disease that causes lameness in feedlot cattle by infecting the P3 pedal bone and adjacent soft tissue (Gyan et al. 2015). TTNS has been characterized by inflammation, necrotic bone and break down of the white line–the region in which the claw horn meets the sole of the hoof (Collis et al. 2004). It is unclear though whether white line breakdown occurs pre- or post-TTNS onset. Some have theorized that white line breakdown serves as an initiatory step for infection. Paetsch (2014) postulated that the white line is weakened due to mechanical abrasion or fatigue failure, leading to separation and foreign material entering the claw and subsequent infection. Marked separation needed for foreign material entry is not readily apparent upon visual examination of diseased claws. Though, under physiologic loading, separation may be more predominant, supporting Paetsch's premise. The objective of this ex vivo study was to evaluate white line separation in TTNS diseased claws under physiologic loading to evaluate the merit of this potential initiatory cause of TTNS. We hypothesized that white line separation increases with increasing load.

Materials and Methods:

Bovine claw ex-vivo specimens were collected from Canadian feedlots for testing (n=14). Three specimens were excluded (confirmed not to have TTNS by the participating veterinarian MJ). Specimens were fixated in dental cement in a manner such that normal alignment and function of the claw were maintained (Eichhorn et al. 2015). A material testing system (MTS Bionix) was used to incrementally load the bovine claw against an acrylic loading platform to a maximum load of 6kN (Figure 1A) (Franck et al. 2007; Hinterhofer et al. 2007). During testing, a camera (PtGrey Chameleon 5MP camera) located on the underside of the loading platform imaged white line separation (Figure 1B). Testing was stopped if the claw was too damaged to continue. Images were imported into a commerical image processing software package (Analyze 10) and the separated region was segemented using region growing with manual correction via a tablet and stylus (WACOM) (Figure 1C). Segmented regions were imported into Matlab to calculate area of the separated region. We used repeated measures ANOVA to assess the association between load and separation area. Significance was set at $p<0.05$. Measurement precision error was assessed by segmenting each image 3 times with error characterized using root mean square coefficients of variation.

Results:

No specimens were tested past 4kN loading based on stopping criteria. Data linking applied load and measured area for each specimen is indicated in Figure 1D. Statistical analysis indicated an association between load and area: Pillai's Trace value of .972(P=0.012) and a Wilk's Lambda of 0.028(P=0.012). Precision error was 7.8%.

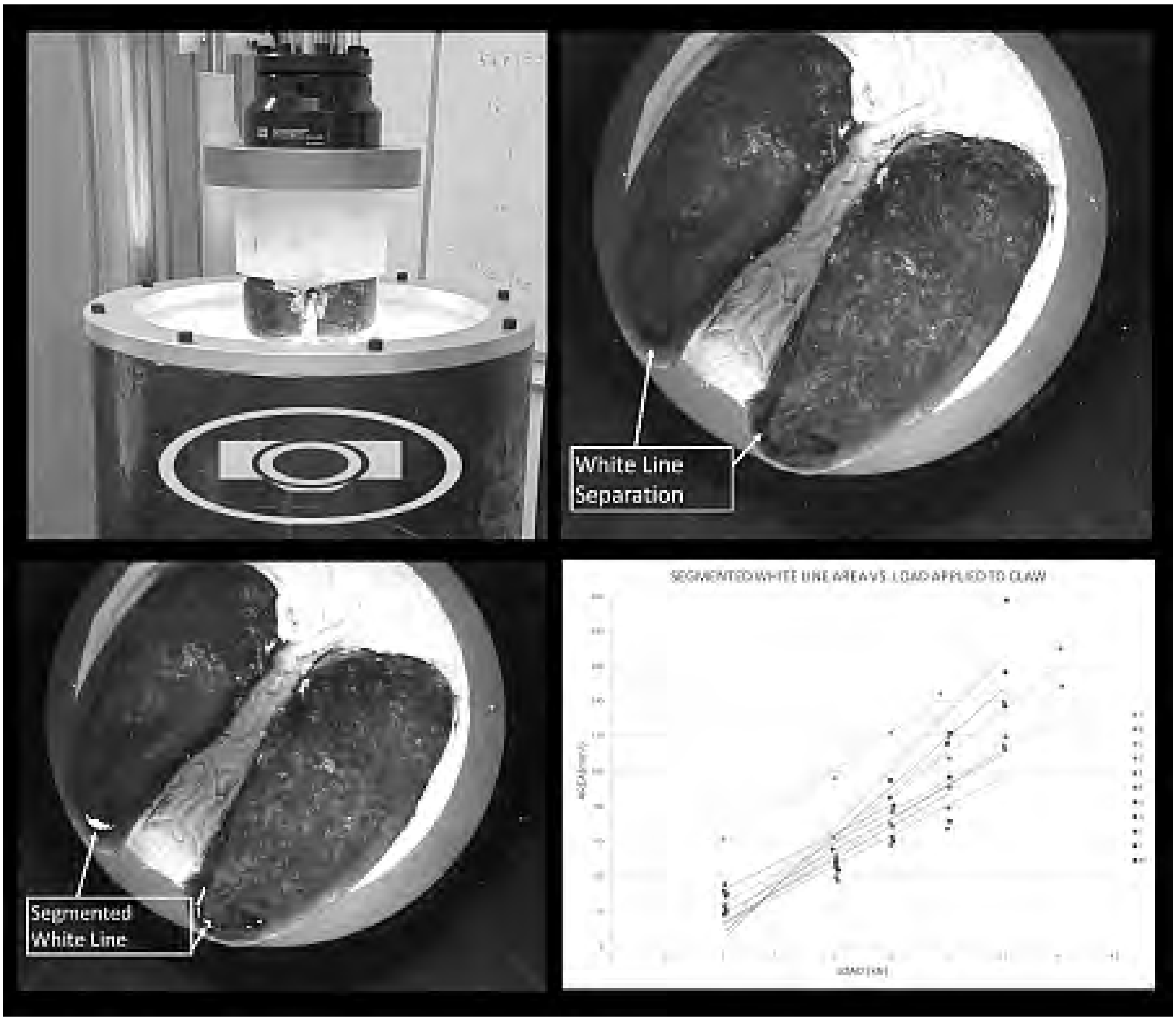

Figure 1. Upper Left Corner Figure1A: Image of the testing apparatus, claw is loaded on acrylic plate while camera takes an image of the underside. Upper Right Corner Figure 1B: Image of the underside of the claw. Showing white line separation. Bottom Left Corner Figure 1C: Image showing the white line segmented. Bottom Right Corner Figure 1D: Plot of the segmented white line area vs. the load applied to the claw.

Discussion

This research indicates a positive relationship between loading and the amount of separation in the white line. These results support the hypothesis that the white line is a potential pathway for infection and TTNS. Findings indicate that extreme loading levels (found when animals are agitated) could increase potential for TTNS. Future research with healthy claws and three-dimensional imaging is needed to better understand TTNS pathways and causality.

References

[1] Collis V. et. al. 2004 Testing White line strength in the Dairy Cow. J.Dairy Sci. 87:2874-2880.

[2] Eichhorn D. Sacher A. Jelinski M. Johnston J.D.2015 Investigation of Toe Tip Necrosis Syndrome using Biomechanical testing and High-Resolution Imaging. 16th Annual Alberta Biomedical Engineering Conference. Banff Alberta. Nov 6-8.

[3] Franck A, Verhegghe B, De Belie N. 2007 The effect of concrete floor roughness on bovine claws using finite element analysis. J Dairy Sci 91:182-192.

[4] Gluer C, Blake G, Lu Y, Blunt A, Jergas M, and Genant K. 1995 Accurate Assessment of Precision Errors: How to measure the Reproducibility of bone densitometry techniques. Osteoporosis International. 5(4):262-270.

[5] Gyan L, Paetsch C, Jelinski M, and Allan A. 2015 The lesions of toe tip necrosis in southern Alberta feedlot cattle provide insight into the pathogenesis of the disease. Can. Vet Journal 56: 1134-1139.

[6] Hinterhofer C, Ferguson J, Apprich V, Haider H, and Stanek C. 2007 A finite element model of the bovine law under static load for evaluation of different flooring conditions. New Zealand Veterinary Journal, 53:3, 165-170.

[7] Paetsch C. 2014 Epidemiology of Toe Tip Necrosis Syndrome in Western Canadian Feedlot Cattle. University of Saskatchewan. Master's Thesis.

Key Words: Claw, Necrosis, TTNS, Feedlot

38 Surgical Treatment Techniques And Outcome In 30 Cattle With Toe Necrosis (Apical Pedal Bone Infection)

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Introduction

Toe necrosis indicates an infection of the apex of the pedal bone in cattle which develops as a complication of thin soles, white line disease and toe ulcers (*Nuss et al., 1990; Kofler, 1999; Kofler et al., 1999; Gyan et al. 2015; Egger-Danner et al. 2015; Jelinski et al., 2016*). In addition, due to the high herd prevalence of endemic Digital Dermatitis infection in many countries today, several authors reported a secondary infection of toe lesions with DD-associated *Treponema spp*. within the last decade (*Evans et al., 2011; Kofler et al., 2015; Sykora et al., 2015*).

Material and Methods

In the present study case records of 30 cattle with apical pedal bone necrosis, hospitalized at the University Clinic of Ruminants in Vienna between 2006 and 2016, were evaluated retrospectively regarding their age, breed, and sex, the localization of toe necrosis, the applied surgical treatment method and the final outcome.

Results

In total, in 30 cattle (22 cows, four bulls, two heifers, two calves) of various breeds a mild to severe toe necrosis (pedal bone necrosis) was diagnosed in 33 claws. Nineteen of those (57.6 %) were located on lateral rear claws. The mean age of all cattle was 58.3 months, 50 % of the dairy cows were within the first 61 days in milk. In three cattle in two and more claws a severe toe necrosis or other severe deep digital infections were diagnosed. In three claws of three different cattle a Digital Dermatitis-associated toe necrosis was diagnosed. These lesions were associated with the characteristic pungent smell of Digital Dermatitis lesions. In 27 (84.4 %) patients a surgical treatment of the apical pedal bone necrosis was performed using different methods: the resection using a chisel, hammer and a curette (n: 16; in 4 out of those the affected claw had to be amputated two to four weeks later *in toto*), the resection using a Forstner drill (n: 3), the resection of the apex of the claw and the pedal bone using a disc equipped with seven steel knives mounted on an angle grinder (n: 7), and the amputation of the affected claw *in toto* (n: 1). All treated cattle had a good final outcome. The mean postsurgical life span of all 27 treated cattle was 26.6 months, and 28.5 months respectively for those 22 cattle that underwent only a resection of the tip of the pedal bone.

Discussion

These results on the surgical treatment of apical pedal bone necrosis showed a 90 % success rate when including also those cases with claw amputation, and of 81.5 %, respectively, when applying methods for claw conservation such as resection or amputation of the tip of the pedal bone. Similar promising results were reported by other authors in the past (*Nuss et al. 1990; Müller 1991; Kofler 1999*). These findings lead to the clear recommendation to apply these simple surgical techniques even in bovine field practice.

References

Egger-Danner C, Nielsen P, Fiedler A et al. 2015 ICAR Claw Health Atlas. Editors: ICAR Working Group on Functional Traits (ICAR WGFT) and International Claw Health Experts. www.icar.org/Documents/ICAR_Claw_Health_Atlas.pdf ; accessed December 20, 2016.

Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown JM, Murray R, Paton RJ, Carter SD 2011 Association between bovine digital dermatitis treponemes and a range of "non-healing" bovine hoof disorders. *Vet. Rec., 168:* 214-217.

Gyan LA Paetsch CD, Jelinski MD, Allen AL 2015 The lesions of toe tip necrosis in southern Alberta feedlot cattle provide insight into the pathogenesis of the disease. *Can. Vet. J., 56*: 1134–1139.

Jelinski MD, Fenton K, Perrett T, Paetsch CD 2016 Epidemiology of toe tip necrosis syndrome (TNNS) involving North American feedlot cattle. *Can. Vet. J., 57:* 829-834.

Kofler J 1999 Clinical study of toe ulcer and necrosis of the apex of the distal phalanx in 53 cattle. *Vet. J.*, 157:139-147.

Kofler J, Alton K, Licka T 1999 Necrosis of the apex of the distal phalanx in cattle - postmortem, histological and bacteriological findings. *Wien. Tierärztl. Mschr. 86*: 192-200.

Kofler J, Glonegger-Reichert J, Dietrich J Sykora S, Tichy A, Brandt S 2015 A simple surgical treatment for Digital Dermatitis-associated white line lesions and sole ulcers. *Vet. J., 204:* 229-231.

Müller K 1991 Resection of the toe tip in cattle. *Prakt. Tierarzt, 12:* 1112-1113.

Nuss K, Köstlin RG, Böhmer H, Weaver M 1990 The significance of corium infection - ungulocoriitis septica – at the toe of the bovine claw. *Tieraerztl Prax., 18*: 567-75.

Sykora S, Kofler J, Glonegger-Reichert J, Dietrich J, Brandt S 2015 Treponema DNA in 'non-healing' versus common bovine sole ulcers and white line disease. *Vet. J., 205:* 417–420.

Key Words: Toe ulcer, apical pedal bone necrosis, surgical treatment, amputation of apex of pedal bone, cattle

39 What to do? – bandging sole ulcers or not?

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Introduction

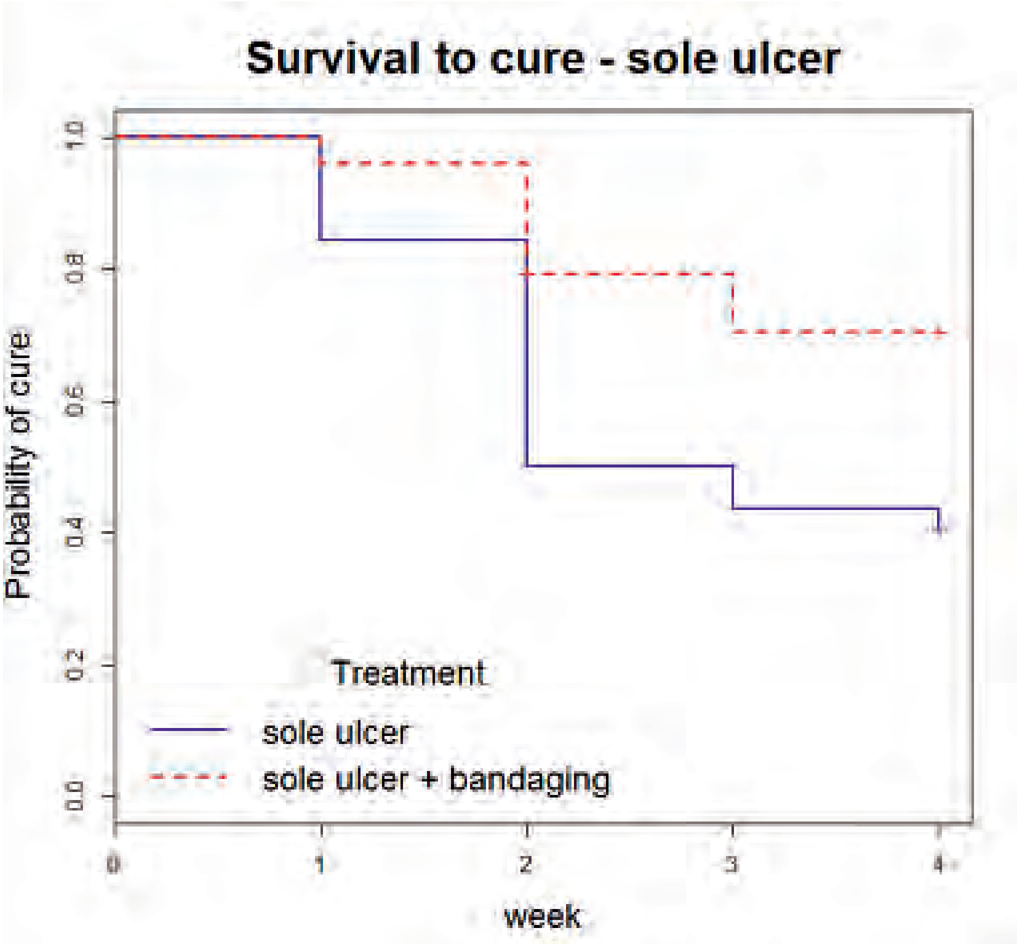
Sole ulcer is the most frequent non-infectious claw disease in dairy cattle worldwide where dairy cows are kept on hard or concrete flooring. Treatment consists in functional hoof trimming and elevation of the sound claw with a block to relieve weight bearing on the affected claw. Very few studies have compared the effectiveness of bandaging to non-bandaging. Therefore, this study will examine the effectiveness of bandaging in the healing of sole ulcers in dairy cows. Specifically, this study has evaluated the effect of bandaging on wound size and locomotion among cows randomized into bandaged or non-bandaged groups after receiving an iodine ointment.

Materials and Methods

This randomized clinical trial included (n=56) Holstein Friesian dairy cows, diagnosed with uncomplicated sole ulcer upon the first examination (week 0). Cows, ranging from 1st to 6th lactation, were housed in a stable fitted with cubicles and with concrete flooring. All hoofs were cleaned and trimmed by a professional hoof trimmer or a veterinarian. Afterwards a wooden block was applied on the sound claw. 5 g of an iodine ointment was applied on each ulcer. Cows were then randomly assigned into either a non-bandaged (n=24, 43%) or bandaged group (n=32, 57%). The bandaging process was standardized and applied by the same veterinarian for all groups. The process of wound healing was evaluated and scored weekly (weeks 0, 1, 2, 3, 4) according to a visual inspection scheme described by Guhl 2009. Photographs of lesions were taken with a digital camera and a special software package (Jalomed®) were used to track lesion size across observations. The healthy formed corium was judged as full recovery. Locomotion was also evaluated and scored weekly following initial treatment according to Sprecher et al., (1997) locomotion scheme. If an ulcer was not considered healed, the whole procedure was repeated until the end of week 4.

Results

In total 18 of 32 sole ulcers (56%) treated with a wooden block, an iodine ointment and without a bandage were healed at week 4 compared to 8 of 24 ulcers (33%) treated with a wooden block, an iodine ointment and with a bandage. Survival Analysis indicated that healing was significantly higher for non-bandaged than bandaged ulcers ($Z = -2.163$, $p = 0.0305$, 95 % CI: 0.161 to 0.914). A Wilcoxon Rank Sums Test indicated that bandaging had no effect on locomotion ($W = 6372.5$, $p = 0.9633$, 95% CI: -2.77e-05 to 4.048e-05). However, wound size was significantly larger for cows with locomotion score between 3 and 5 than for cows with lower score ($W = 4483.5$, p-value < 0.001, 95 % CI: -0.57 to -0.18).



Discussion

Results suggest that bandaging has a negative effect on the healing process of sole ulcers. Healing of sole ulcers might only require hoof trimming and a wooden block. Prolonged exposure to treatment through bandaging may only be appropriate for infectious claw diseases.

References

GUHL, E. (2009). Effects of rubber flooring and solid concrete floors on claw horn quality, horn growth and wear, net growth, lameness and claw health in free-stall housed dairy cattle. Effects of rubber flooring and solid concrete floors on claw horn quality, horn growth and wear, net growth, lameness and claw health in free-stall housed dairy cattle. Berlin: Free University of Berlin, Dissertation

SPRECHER, D. J., HOSTETLER, D. E., & KANEENE, J. B. (1997). A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, 47(6), 1179-1187.

Key words: sole ulcer, bandaging, healing process, wound size, iodine ointment

40 Treating Claw Horn Lesions – An Approach To The Evidence Base

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Introduction

Four years ago, during the Bristol meeting, one presentation was titled "Searching for the evidence base: What do we know about treating claw horn lesions?"(1). The message of this presentation was that a lot is known but only few articles are published about treatments of horn lesions. Furthermore, there is a lack of approved methods of treating lame cows so that in fact there exists no real evidence base. As a practitioner and teacher who treats claw horn lesions and teaches how to do this, I was shocked. At this point, I decided to develop a compendium about how to treat common claw lesions at the upcoming Munich meeting.

Materials and Methods

In 2015 and 2016, we treated 80 cases (66 animals) of sole ulcers, white line abscesses, bulb ulcers and toe ulcers. The treatment always followed the same procedure: detecting lameness, functional claw trimming, cutting out the lesion, blocking and bandaging. For blocking we used "easybloc" plastic shoes (Demotec®). The lesions were covered with three-layer-bandages – we sprayed "blue-spray" containing chlorine tetracycline directly on the lesion, followed by a small cotton layer, cushioning material and a breathable waterproof elastic tape. Necessary checks followed between four to six days after the first treatment and then were exercised once per week until complete regeneration of the affected claw. Bandages were renewed until thin new horn was built and the lesion did not hurt any more. End of treatment was defined by removing of the block. Generally, the blocks were removed three weeks after taking away the bandage. So the newbuilt horn could reach enough thickness to be charged again. To give an impression of recovery and to keep records on the healing process, we took photos at every check. All animals were kept in freestalls at our livestock center and examined and treated on farm in Rosensteiner® trimming boxes.

Results

Strictly following our treatment procedure we could cure all 80 cases of lameness. After the treatment, full horn quality and loading capacity was restored. All lame cows could be sent back into the freestall after the first treatment and walked on the blocked claws without lameness symptoms. As shown in Fig. 1, the mean time under bandage was less than 3 weeks and the mean time of recovery – defined as taking away the block – was after less than 6 weeks.

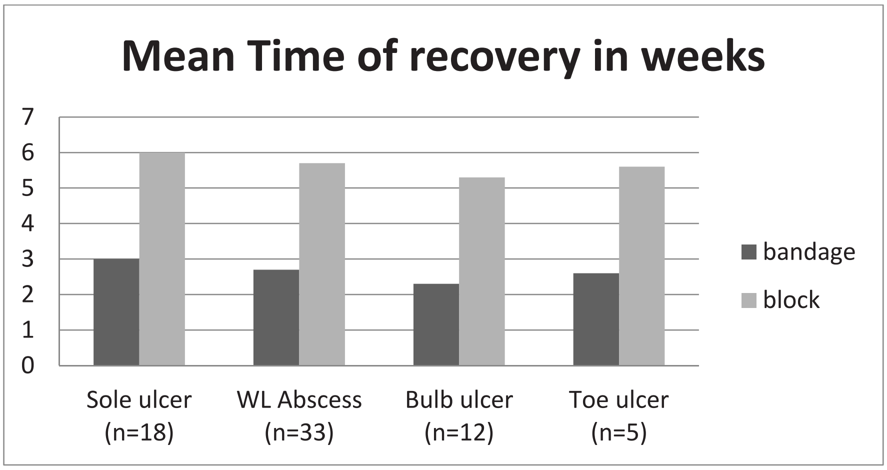

Figure 1: Mean Time of recovery depending on the kind of lesion.

Discussion

Even if lameness is very common in our dairy herds, it is possible to address this problem immediately and to reach full recovery within a few weeks. In our study we treated 80 cases of lameness caused by sole ulcers, white line abscesses, toe and bulb ulcers. All lame animals were detected by our herdsmen and examined the same day. Sticking to a rigid timetable of checks and thus controling the healing process at least once per week, it was possible to recover all animals with small investments of time and material. Once detected, when following the rules it is not necessary to use antibiotics in the most common cases. Thus, the loss of milk is very small and the animals in recovery “work as usual”. Additionally this kind of treating horn lesions is in line with the official demand to bring down the amount of antibiotics in veterinary medicine. In practice, very often claw trimmers and veterinarians do not have the possibility to look after their “patients” after a first treatment. Thus, the rate of recovery is low and a lot of animals are culled. We think, the investment of time to check bandages and blocks on treated cows is a simple way to assured success in treating lame cows.

Acknowledgements

I want to thank my whole team of herdsmen and veterinarians at our facility for having a wonderful eye on our cows and giving me a lot of hints to detect early lameness.

References

1. Huxley JN et al. Searching for the evidence base: What do we know about treating claw horn lesions. In 17th International Symposium and 9th International Conference on Lameness in Ruminants. Bristol, England, 2013; 28-29.

Keywords: Treating claw horn lesions, Three layer bandage, Recovery

P 9-1 Toe Necrosis Study From The Analysis Of Data Base Of Feet Disorders Recording

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Introduction

Toe necrosis is a disorder in expansion in the foot disorders recording of Bretagne Conseil Elevage Ouest (BCEL Ouest). It is characterized by a necrotic tissue of characteristic odor forming deep galleries reaching the pododerm or even the bone part, usually in toe. Some hypothesis are said with infectious or non-infectious origins with a link with digital dermatitis (Atkinson 2011,Paetsch 2014).

Materials and Methods

The BCEL Ouest's hoof-trimmers records the foot disorders since 2014, with the standard recording in France and the software Activ'Parage®. In this study we use a database with data from mars 2014 to december 2015. This database has 634 dairy farms and 62021 feet, on 25429 cows. The dairy farms are classified in three groups. The A group is the dairy farms without toe's necrosis (418 farms). The B group is dairy farms with 1 to 4 events of toe's necrosis (193 farms). The C group is dairy farms with more than 4 toe's necrosis events (23 farms). The links between toe's necrosis and others feet disorders have been studied. Khi² tests and Cramer's V test have been used to classified the strength of links between toe's necrosis and others feet disorders.

Results

Toe's necrosis incidence: 507 events of toe's necrosis have been recorded on 489 cows in 216 different dairy farms; it's a mean of 2,3 events by farm . All this cows are present in 34 % of the 634 dairies farms, and represent 2 % of all the cows of the database. The events number are in expansion since 3 years : 0,4 % of the cows at the beginning of 2014, and 0,8 % at the end of 2015. Foot disorders association: At the farm scale, we can see its infectious feet disorders origin appears in first digital dermatitis, heel horn erosion and interdigital hyperplasia. For each one, the prevalence is more important for the B group and C group, with toe's necrosis presence. For digital dermatitis, the prevalence is 12,1 % for the A group, and 23,7 % and 26,6 %, for the B and C group respectively. At the foot scale, the feet disorders more associated at the toe's necrosis presence are non-infectious disorders origin (double sole, horn fissure, sole ulcer).

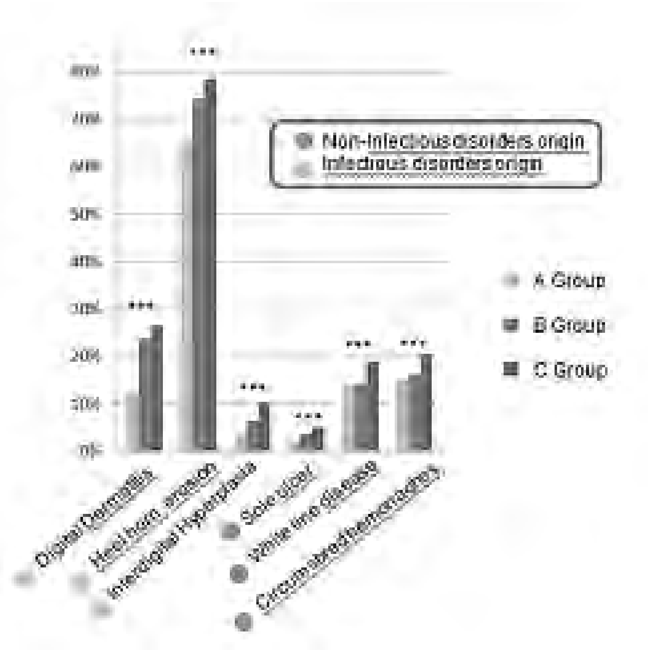

Figure 1 : Prevalence of each feet disorders in the 3 groups (A : no toe’s necrosis ; B : 1 to 4 events ; C : more than 4 events), by decreasing sequence of strength link with toe’s necrosis.(example : the link betwenn digital dermatitis and toe’s necrosis is the stronger)

Discussion and Conclusion

This study permit to investigate the toe’s necrosis aspects: incidence in dairy farms in west of France. In first, the infectious situation of a farm is a risk factor of apparition of the toe’s necrosis. In second, the non-infectious disorders on the feet with toe’s necrosis make the hypothesis that these disorders are an opening for eventual germ. We can’t conclude about a direct link between digital dermatitis and toe’s necrosis because this study doesn’t permit to study the germs of all the toe’s necrosis events.

References

Atkinson, 2011, Non-healing hoof lesions in dairy cows, Vet. Rec., 562.

Paetsch, 2014, Epidemiology of toe tip necrosis syndrome in Western Canadian feedlot cattle, Thesis for the degree in Master of Science, University of Saskathewan, 97.

Keywords : toe’s necrosis, risks factors, infectious, digital dermatitis.

10 DETECTION

41 Automatically Measured Performance And Behavior Parameters As Indicators Of Lameness In Dairy Cattle

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Introduction

Dairy farmers often underestimate the amount of lame animals in their herds (Whay et al. 2002, Šárová et al. 2011). This misperception can lead to substantial delays in detecting hoof diseases which increase suffering of the animal from the pain caused by the lesion, the duration of the recovery period and treatment costs as well as the economic loss due to impaired performance of the animal (Souza et al. 2006, Ozswari et al. 2007, Green 2009, Alawneh et al. 2012, Leach et al. 2012). The aim of this study was to analyze different performance and behavior parameters that can be measured by automatic sensors to find links between them and lameness in dairy cattle. The findings should then be integrated in a system that can help detect lameness cases earlier.

Animals, Material and Method

The study herd consisted of 60 Simmental cows that were housed in a free stall barn. During the study period from April 2014 to May 2015 cows were milked with an automatic milking system which measured milk yield as well as live weight, with an integrated scale, at every visit. The cows were fed through automatic weighing troughs in order to gather data regarding feed intake, feeding duration and number of visits to the troughs. Additionally, cows were equipped with pedometers measuring overall activity, lying time and number of lying bouts. The sensor data were calculated to daily averages or absolute values per day depending on the measure. Lameness status of every individual was scored weekly and treatments of hoof diseases were conducted and documented by a veterinarian. The data were fitted in a 10-fold-cross-validated regularized logistic regression model (Elastic Net) with lameness as outcome including relevant interaction terms. The parameters from the ten models fitted on the ten calibration sets were averaged to result in one final model which was then applied to the whole data set. An ROC (Receiver Operator Characteristics)-curve analysis was made to enumerate the predictive quality of the method.

Results

The ROC-curve of the final model had an AUC (area under the curve) of 0.92 (95% CI (confidence interval): 0.88-0.95). Table 2 shows the contingency table of this model when the threshold separating lame and non-lame cow days with the highest accuracy (Youden Index) was applied. Only 6 of the 33 lame cow days were misclassified as non-lame yielding in a sensitivity of 0.82 (95 % CI: 0.69-0.93). The corresponding specificity was 0.87 (95 % CI: 0.7576-1.00).

Table 2 Contingency table of the model with averaged estimates of the parameters.

	True outcome		
Model outcome	Lame	Non-lame	Total
Lame	27	139	166
Non-lame	6	919	925
Total	33	1058	1091

The most prominent parameters of the final model were feeding time (day-night-ratio), lying time (day-night-ratio) as well as the interaction terms milk yield*feed intake and milk yield*lying time. Milk yield as a single parameter did not affect the probability of being lame significantly.

Discussion

The combined analysis of performance parameters such as feed intake and milk yield and behavior parameters such as lying and feeding behavior can be a useful approach to automatically detect lameness in cows. Interdependencies between these performance and behavior traits seem to have a great effect on the accuracy of a lameness detection model. The findings of this study are to be evaluated in a larger number of animals and a more practically oriented environment, meaning non-research farms.

References

Alawneh JI, Laven RA and Stevenson MA 2012 Interval between detection of lameness by locomotion scoring and treatment for lameness: a survival analysis. *Veterinary journal (London, England : 1997)* 193: 622–5.

Green L 2009 Lameness in dairy cows; Piecing together the evidence base and looking forward. In University of Bristol TDG and U of N (ed.) pp. 1–7

Leach KA, Tisdall DA, Bell NJ, Main DCJ and Green LE 2012 The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. *The Veterinary Journal* 193: 626–632.

Ozswari L, Barna R and Visnyei L 2007 Economic Losses Due to Bovine Foot Diseases in Large-Scale Holstein-Friesian Dairy Herds. *Magyar Allatorvosok Lapja* 129: 23–28.

Šárová R, Stehulová I, Kratinová. P., Firla P and Spinka M 2011 Farm managers underestimate lameness prevalence in Czech dairy herds. *Animal Welfare*: 201–204.

Souza RC, Ferreira PM, Molina LR, Carvalho AV and Facury-Filho EJ 2006 Economic Losses Caused by Sequels of Lameness in Free-Stall Housed Dairy Cows. *Arquivo Brasilero de Medicina Veterinaria e Zootecnica* 58: 982–987.

Whay HR, Main DCJ, Green L. E. and Webster A. J. F. 2002 Farmer perception of lameness prevalence. *Proceedings of the 12th International Symposium on Lameness in Ruminants*: 355–358.

Key words: regularization methods, automatic lameness detection, behavior, milk yield, feed intake

42 Analysis Of Lameness Induced Changes In Dairy Cow Behaviour And Suitability Of Ethological Parameters For Early Lameness Detection

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Introduction

Lameness is one of the most prevalent diseases affecting the welfare of cows in modern dairy production (Juarez et al 2003). Diagnosis at an early stage results in a reduction of medications, faster recovery, and a shortened period of suffering for the cow (Whay et al 2003). Previous research has reported clear differences in the behaviour, i.e. lying behaviour and locomotor activity, of severely lame cows in comparison to non-lame cows (Thorup et al 2015; Solano et al 2016). However, effects of moderate lameness on cow behaviour have rarely been investigated so far. The aim of this study was to identify behavioural changes in moderately lame cows and to assess their suitability for an automatic on-farm system for early lameness detection.

Materials and Methods

The study was conducted on 17 Swiss dairy farms. On each farm, cow behaviour was measured continuously in two periods (A, B) of 48 h each with an interval of 6 - 10 weeks in between. In each herd, a sample of 5 - 8 "non-lame" and 5 - 8 "moderately lame" cows was selected based on visual lameness scoring (Sprecher et al 1997). In total, 79 moderately lame and 141 non-lame cows were examined in period A as well as 52 moderately lame and 142 non-lame cows in period B. In between the two periods, the cows underwent therapeutic claw trimming. Lying behaviour and locomotor activity (measured by means of accelerometers attached to the left hindleg), frequency of visits to the brush and the concentrate feeder, and the milking order position was compared between moderately lame and non-lame cows. Ethical approval for the study was obtained from the Veterinary Office of the Canton Zurich in Switzerland (ZH061/15, Approval No. 26475).

Results

Moderately lame cows had a longer total lying duration per 24 h (x_1^2=12.2; p=0.0005) and a longer average lying bout duration (x_1^2=22.2; p<0.0001) than non-lame cows. However, the number of lying bouts was lower in moderately lame compared to non-lame cows (x_1^2=4.79; p=0.0286). Locomotor activity was lower in moderately lame than non-lame cows (x_1^2=17.79; p<0.0001). Moreover, moderately lame cows visited the brush (x_1^2=4.46; p=0.0346) and the concentrate feeder less often than non-lame cows (x_1^2=11.46; p=0.0007). Finally, moderately lame cows were further back in the milking order compared to non-lame cows (x_1^2=11.36; p=0.0008).

Discussion

Non-lame and moderately lame cows differed significantly in all behavioural parameters investigated in this study. Consequently, these parameters have, in principle, the potential for being incorporated in an automatic on-farm system for early lameness detection. However, further analyses are necessary to assess the sensitivity of single parameters for lameness detection and to create algorithms considering several parameters in combination.

Acknowledgements

We are thankful to all the farmers and their families for their generous support of our project, to our colleagues who provided expertise that greatly assisted the research. The project was funded by Swiss Federal Food Safety and Veterinary Office FSVO (Project No. 2.14.05).

References

Juarez ST, Robinson PH, DePeters EJ and Price EO 2003 Impact of lameness on behavior and productivity of lactating Holstein cows. Applied Animal Behaviour Science 83: 1-14

Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Nash CGR, Haley DB, Pellerin D, Rushen J, de Passillé AM, Vasseur E and Orsel K 2016 Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. Journal of Dairy Science 99: 2086-2101

Sprecher DJ, Hostetler DE and Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47: 1179-1187

Thorup VM, Munksgaard L, Robert P-E, Erhard HW, Thomsen PT and Friggens NC 2015 Lameness detection via leg-mounted accelerometers on dairy cows on four commercial farms. Animal 9: 1704-1712

Whay HR, Main DCJ, Greent LE and Webster AJF 2003 Animal-based measures for the assessment of welfare state of dairy cattle, pigs and laying hens: consensus of expert opinion. Animal Welfare 12: 205-217

Keywords: dairy cows, early detection, behaviour, automatic measurement

43 Environmental And Animal Physiological Influences On Pedometric Activity In Dairy Cows

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Introduction

Currently dairy farmers use pedometers in order to measure activity levels of dairy cows. Besides animal identification and step count, number of lying bouts and actual lying time for each lying bout are recorded at all times. Accumulated pedometric data is processed by an evaluation software creating an individual animal activity profile, which can be used for estrus detection. Furthermore several studies have shown the eligibility of pedometers usage for lameness detection and evaluation (Alsaaod et al., 2012; O'Callaghan et al., 2003; Mazrier et al., 2006). At this juncture the consideration of lying time proves especially suitable for lameness detection (Chapinal et al., 2009). In order to gain reliable data about lameness on the basis of pedometric data, they must be corrected for management, environmental and animal physiological influences. Thus, the goal of this study was to identify and evaluate these influences to make pedometric data available for lameness analysis. Several parameters which may influence activity are investigated, e.g. local alignment, insemination dates, milking frequency, breed and location of farms.

Materials and Methods

Activity data (average number of motion impulses per hour, lying bouts per day, average lying time for each lying bout) was collected for analysis over a period of one year from 4646 dairy cows from seven different dairy farms in Germany. Four farms were located in eastern Germany, three farms in southern Germany. All cows were equipped with Lemmer Fullwood differential-precisionpedometers. Only animals with more than 30 days of pedometric data were taken into account. All of the cows were free stall housed without access to pasture. Two farms were equipped with an automated milking system. Initially, data was examined comprehensively for each farm. Afterwards analysis was conducted separately for east and south and for each farm. Different parameters which may influence activity were examined. The Kolmogorov-Smirnov test showed that the acquired pedometric data does not follow a normal distribution ($p<0.0001$). Statistical significance was tested by the Wilcoxon-Mann-Whitney test.

Results

The cows took 125.98 ± 51.67 motion impulses per hour on average; the average number of lying bouts per day was 9.92 ± 3.88 with an average lying time of 74.09 ± 28.68 minutes for each lying bout. In order to restrict upward outliers activity values bigger than the threefold mean of each farm was set to the threefold mean. At comparing the activity levels from the east and south surveys, the fact that cows in south Germany were significantly more active ($p<0,0001$) than cows in eastern Germany stood out. This can especially be seen by the respective motion impulse count in table 1. There were also major farm specific differences. The average number of motion impulses per hour for each farm varies between 110.10 and 156.46, the average lying time range from 61.28 minutes to 93.88 minutes for each lying bout. The average number of lying bouts per day ranges from 8.38 to 11.13.

Tab.1: Activity data of panel east and panel south

Variable	Panel East		Panel South		Level of significance
	N	Mean ±SD*	N	Mean ±SD*	
Average number of motion impulses [n h^{-1}]	953320	118.98 ± 46.96	365591	144.23 ± 58.48	p<0.0001
Average lying time for each lying bout [min]	675001	72.72 ± 28.67	342201	76.80 ± 28.51	p<0.0001
Average number of lying bouts [n d^{-1}]	675134	10.22 ± 3.97	342238	9.33 ± 3.64	p<0.0001

* SD = Standard deviation

Discussion

When interpreting the results attention must be paid to the fact that these have neither been adjusted in terms of repeated clustering per farm, nor have they been corrected in terms of potential confounders. The average activity levels correspond with the expected level. For a stable reading while restricting the upward outliers, the threefold mean was used instead of the standard deviation. This procedural method is necessary due to the different numbers of animals on the farms. Concerning activity levels, major differences have been found while considering local alignment but also while evaluating each farm individually. This data situation is challenging for further analysis. Besides local alignment, further influences on activity will be examined. Thus breed, milking frequency, milking system, insemination date, floor type and heat stress will be also taken into account when evaluating the accumulated data.

Acknowledgements

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https://www.landtechnik.uni-bonn.de/research/livestock-technology/folder_projects/2015_07_02_klauenfitnet?set_language=en

This research was partly conducted by members of the Center of Integrated Dairy Research (CIDRe), University of Bonn (Bonn, Germany).

References

Alsaood M., Römer C., Kleinmanns J., Hendriksen K., Rose-Meierhöfer S., Plümer L., Büscher W. (2012): Electronic detection of lameness in dairy cows through measuring pedometric activity and lying behavior. Applied Animal Behaviour Science 142: 134-141

O'Callaghan K. A., Cripps P. J., Downham D. Y., Murray R. D. (2003): Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. Animal Welfare 12: 605-610

Mazrier H., Tal S., Aizinbud E., Bargai U. (2006): A field investigation of the use of the pedometer for the early detection of lameness in cattle. Canadian Veterinary Journal 47: 883-886

Chapinal N., De Pasille A.M., Rushen J. (2009): Weight distribution and gait in dairy cattle are affected by milking and late pregnancy. Journal of Dairy Science 92: 581-588

Keywords

Pedometric activity, dairy cows, lameness detection

44 Detection Of Digital Dermatitis: The Usage Of Cameras For Remote Detection Of DD On A Robotic Dairy Farm.

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Introduction

Bovine digital dermatitis (PDD) is the most important cause of lameness in modern dairy husbandry. This multifactorial infectious claw disease causes ulcers most often at the caudal aspect of the interdigital space which vary in appearance depending on stage of chronicity defined by M-staging. Invasion of the skin is caused by among others treponemes under hygiene deficits (1,2,3).

Materials and Methods

An observational cross-sectional study was performed by utilizing mobile cameras (Hero 4, US) installed in Lely Industry robotic milking systems (A3 and A4) on two Wisconsin dairy farms and images of forty-six dairy cows' feet generated for scoring of M-stages based on the M-scoring technique develop by Döpfer et al. 1997. The agreement between scoring DD lesions using images and scoring of feet by the investigator were compared for agreement.

Results

Depending on foot hygiene and the light source, the agreement using Cohen's Kappa analysis between visual scoring of feet and lesions scoring using the images from the cameras varied from 47% to 75% and could be increased to 97% if the light source and leg hygiene were optimal.

Discussion

The installation of cameras in robotic milking systems and in milking parlors could be useful for remote detection of DD lesions in dairy farms. The future of image processing will facilitate the automated detection of DD lesions using claw images for health alerts.

Acknowledgements

A big thank you to the producers and herdsmen who helped with this project.

References

1. Cheli R, Mortellaro CM. La dermatite digitale del bovino. In: 8th International Conference on Diseases of Cattle. Piacenza, Milan, Italy 1974; 208–213.

2. Read DH, Walker RL. Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. J Vet Diagn Investig Off Publ Am Assoc Vet Lab Diagn 1998 (10): 67-76.

3. Argáez-Rodríguez FJ, Hird DW, Hernández de Anda J, Read DH, Rodríguez-Lainz A. Papillomatous digital dermatitis on a commercial dairy farm in Mexicali, Mexico: incidence and effect on reproduction and milk production. Prev Vet Med 1997 (32): 275–286.

Keywords: digital dermatitis, claw images, detection, automated milking systems

45 The Dynamics Of Lameness In Two Danish Dairy Herds

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Introduction

Lameness in dairy herds is a welfare issue in Denmark as well as other countries in the western world. Delayed treatment can reduce the rate of recovery (4) but on average farmers only find about a third of the newly lame cows (1). A previous Danish control campaign involving mobility scores of 18.390 cows from 100 Danish dairy farms showed a herd prevalence of severely lame cows ranging from 0 to 9.6 % (3). In the present study we investigated the dynamics of lameness in two large Danish farms and the consequences of cows being lame for more than two weeks.

Materials and Methods

All lactating cows in two commercial farms were mobility scored fortnightly during a nine month period. Cows were scored by three professional technicians using a 5-point scale (5), and we classified lameness score (LS) 1 and 2 as non-lame, LS 3 as lame, and LS 4 and 5 as severely lame. Farm 1 was a conventional farm with 579 Danish Holstein cows and AMS milking system. Farm 2 was an organic farm with 639 Danish Holstein cows and rotary milking parlour. The two farmers agreed to perform claw treatment according to their normal husbandry procedures for lame and severely lame cows within a week after being detected. On Farm 1 cows were treated by a professional claw trimmer and on Farm 2 the farmer performed the treatments. Complete recovery was classified as two subsequent LS 1 or 2.

Results

The average prevalence of lame cows was 15.8 % and 17.7 % and the average prevalence of severely lame cows was 13,3 and 12,0 % for Farm 1 and 2, respectively. During the nine month study period, 69,4 % and 65,4 % of the cows became lame or severely lame at least once, 4,1 % and 4,5 % started lame and remained lame during all nine months and 23,3 % and 27,2 % started not-lame and remained not-lame during the study period.The average lameness score was reduced on both farms during the nine months (Figure 1).

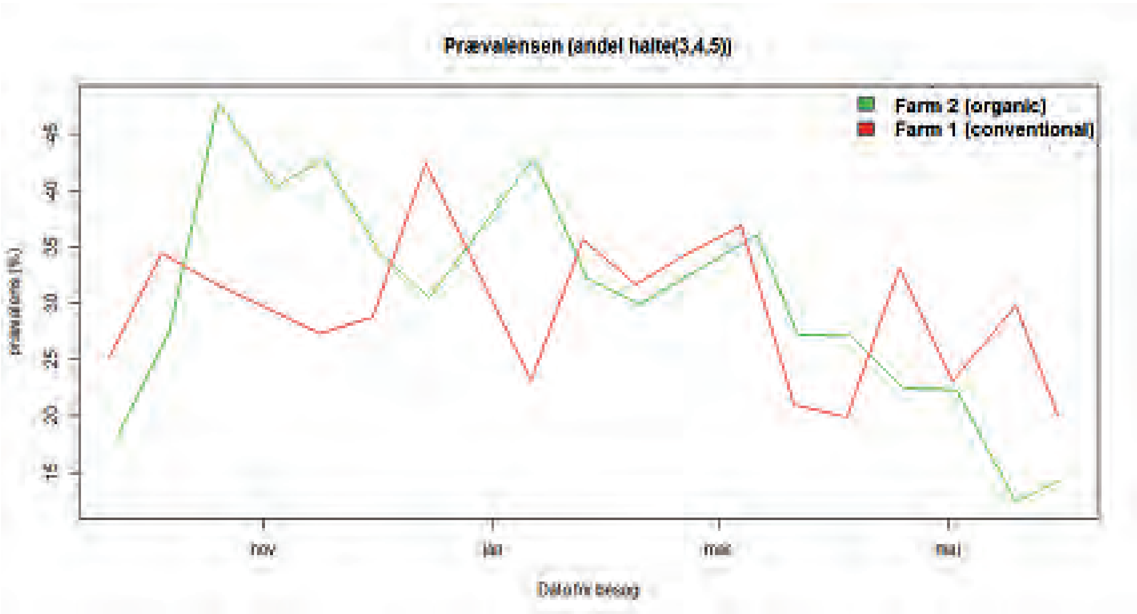

Fig. 1. Lameness scores during the nine months study period.

Lameness scores revealed that severely lame cows had a 38,9 % chance of complete recovery if they had been found non-lame 14 days before being detected severely lame but only 16,8 % chance of complete recovery if they had been detected lame 14 days before they got severely lame. The risk of remaining severely lame the next 28 days was 11,5 % for severely lame cows that were non-lame 14 days earlier and 21,6 % for severely lame cows that were lame 14 days before being detected as severely lame.

Discussion

In line with previous studies (2, 4) our results suggests that it is absolutely essential to find and treat lame cows as soon as they become lame. The large proportion of cows becoming lame during a nine months period calls for automatic systems that can detect lame cows on a daily basis.

Acknowledgements

The study was funded by the EU rural development funds and the Danish levy fund. A special acknowledgement to the three technicians Villy Nicolajsen, Jørgen Knudsen and Torben Andersen for their careful and thorough lameness scoring and to Heidi Lund Hyttel for her enthusiasm in dealing with data

References

1. Alawneh JI, Laven RA og Stevenson MA, 2012. Interval between detection of lameness by locomotion scoring and treatment for lameness: A survival analysis. The Veterinary Journal 193 (2012) 622‑625.

2. Leach KA, Tisdall DA, Bell NJ, Main DCJ, Green LE. The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. Vet J 2012 (193): 626–632.

3. Ministeriet for Fødevarer, Landbrug og Fiskeri, Fødevarestyrelsen. Slutrapport for kampagnen Halthed og klovsundhed i malkekvægbesætninger.. J.nr.: 2014-13-60-00057. 2016. Veterinær kontrolkampagne (in Danish)

4. Thomas HJ, Remnant JG, Bollard NJ, Burrows A, Whay HR, Bell NJ, Mason C og Huxley JN, 2016. Recovery of chronically lame dairy cows following treatment for claw horn lesions: A randomised controlled trial. Veterinary Record 178 (5):116-NIL_54; 30. januar 2016

5. Thomsen PT, Munksgaard L and Tøgersen FA. Evaluation of a Lameness Scoring System for Dairy Cows. Journal of Dairy Science 2007 (91): 119-126.

Keywords: locomotion scoring, dynamics, dairy cow

P 10-1 Evaluation Of The Semi-Automated Cow-Gait-Analyzer© To Determine Gait Cycle Variables In Dairy Cows

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Introduction

With increasing lameness prevalence in dairy herds over the past years, systems for the automated detection of locomotor behavior of cows are becoming more and more useful. This study presents the validation of a Cow-Gait-Analyzer© to detect gait cycle variables of normal and pathological gait in dairy cows using features derived from low-cost and stand-alone three dimensional (3D) accelerometers (400 Hz). We hypothesized that gait cycle variables can be derived from the Cow-Gait-Analyzer© with a high correlation as compared to visual data extracted from the pedogram and the synchronized video data (gold standard) in lame and non-lame cows.

Materials and Methods

The study protocol was approved by the animal experimentation committee of the canton of Bern, Switzerland (permission # 25601). Twelve dairy cows without any signs of lameness (group non-lame) and five cows (group lame) referred to the Clinic for Ruminants, Vetsuisse-Faculty, University of Bern for evaluation of a lameness problem in the area of the hind limbs were used. The Cow-Gait-Analyzer© automatically extracts the relevant gait events of foot load and toe off, which characterize the gait cycle duration, stance and swing phases during walking. If necessary, the detected peaks of foot load and toe off can be manually modified. The evaluation of the algorithm was performed by comparing the visual data extracted from the pedogram and the synchronized video data (gold standard) with the algorithm output. The measurement was carried out at the level of the metatarsi of paired hind limbs during walking. The overall differences between the Cow-Gait-Analyzer© and the gold standard were expressed as relative measurement error (RME). An RME of <1% was very low, and an RME of 1 to 5% was low.

Results

A total of 34 hind limbs with a mean of 9 gait cycles were analyzed.The median RME for gait-cycle duration and stance phases were 0 and 1.69%, respectively. The peaks of gait-cycle variables showed an RME of 0.67% and 0.24% for foot load and toe off, respectively.

Discussion

The semi-automated Cow-Gait-Analyzer© is a useful tool to determine gait-cycle variables using 400-Hz 3-dimensional accelerometers.The frequency and peaks of foot load and toe off can be adapted and used to extract gait-cycle variables with very low to low RME. This successful validation of the Cow-Gait-Analyzer© suggests its potential use as a semi-automated tool for research and clinical applications with a focus on individual cows. The Cow-Gait-Analyzer© is a promising tool to objectively assess gait in lame and non-lame cows.

Acknowledgments

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Key words: accelerometer, dairy cow, gait cycle

References:

Alsaaod, M., R. Kredel., B. Hofer, and A. Steiner. 2017. Validation of a semi-automated software tool to determine gait-cycle variables in dairy cows. J. Dairy Sci. 100:1–6.

P 10-2 Prevalence Of Lameness In A Dairy Freestall Housing System With Holstein Cattle In Aragón Binefar, Spain

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Introduction

Locomotion scoring (LS) system is a reasonably quick and easy way to diagnosis lameness in dairy herds (1), which helps to determine the prevalence and degree of pain of lameness in cattle, and based on this, make decisions related to therapeutic and control of this problem to provide animal welfare and improve productive and reproductive parameters in the herds.

Materials and Methods

Locomotion Scoring system (2) was performed for the first time as part of a lameness control program implementation in a herd with 299 lactating cows in a freestall housing system in Aragon Binefar, Spain. Two veterinarians executed the LS on November 18th of 2016 at the exit of the milking parlor and the data were recorded and analysed using descriptive statistics.

Results

The prevalence of lameness was 98,66%. Locomotion Score were performed in 299 lactating cows (100%), resulting in 4 cows (1,34%) LS 1; 128 (42,8%) LS 2; 145 (48,49%) LS 3; 21 (7%) LS 4 and one (0,33%) LS 5.

Discussion

The prevalence of lameness varies among farms, regions, and housing systems, although it is generally higher in freestall barns compared with tiestalls (3). In the United States, freestall dairies in Wisconsin and Minnesota had a lameness prevalence of 25% (3), whereas in California and the northeastern United States, lameness prevalence was 34 and 63%, respectively (4). British and German studies reported a lameness prevalence of 37 and 48% (3, 5). Highlighting the impact of lameness in reproductive (6) and productive parameters (7) in cattle, there should be implemented a lameness control program to reduce the prevalence of lameness. It is also important to consider that the prevalence of lameness in this study does not represent the status of lameness neither in the region not in the country.

References

Winckler C, Willien S. 2001. The Reliability and Repeatability of a Lameness Scoring System for Use as an Indicator of Welfare in Dairy Cattle. Acta Agriculturae Scandinavica, Section A — Animal Science Vol. 51 , Iss. Sup030.

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology , Volume 47 , Issue 6, 1179 – 1187

Cook, N. B. 2003. Prevalence of lameness among dairy cattle in Wisconsin as a function of housing type and stall surface. In: Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Zaffino Heyerhoff JC, Nash CGR, Haley DB, Vasseur E, Pellerin D, Rushen J, de Passillé AM, Orsel K. Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. 2015. Journal of Dairy Science Vol. 98 No. 10.

von Keyserlingk, MAG, Barrientos A, Ito K, Galo E, Weary DM. 2012. Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. . In: Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Zaffino Heyerhoff JC, Nash CGR, Haley DB, Vasseur E, Pellerin D, Rushen J, de Passillé AM, Orsel K. Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. 2015. Journal of Dairy Science Vol. 98 No. 10.

Barker, Z. E., K. A. Leach, H. R. Whay, N. J. Bell, and D. C. J. Main. 2010. Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. In: Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Zaffino Heyerhoff JC, Nash CGR, Haley DB, Vasseur E, Pellerin D, Rushen J, de Passillé AM, Orsel K. Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. 2015. Journal of Dairy Science Vol. 98 No. 10.

Somers JR, Huxley J, Lorenz I, Doherty ML, O'Grady L. 2015. The effect of Lameness before and during the breeding season on fertility in 10 pasture-based Irish dairy herds. Irish Veterinary Journal. 68:14.

Chen W, White E, Holden NM. 2016. The effect of lameness on the environmental performance of milk production by rotational grazing. Journal of Environmental Management. 172, 143–150

Key words: Prevalence, locomotion score, cattle, Holstein, Spain

P 10-3 Prevalence Of Lameness In A Dairy Freestall Housing System With Holstein Cattle In Madrid, Spain

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Introduction

Lameness is one of the most common problems affecting cattle welfare (1) productive (2), reproductive (3) and economic (4) parameters. Locomotion Score (LS) is a method to determine the pain scale and the prevalence of lameness in a herd, with the aim of checking and treating all the affected animals and to perform periodic monitoring of cattle to control lameness.

Materials and Methods

Locomotion Score (5) was performed for the first time as a part of a lameness control program in a herd with 399 cows in a freestall housing system in Madrid Spain. LS was performed on December 14th of 2016 at the exit of the milking parlor and the data were recorded and analysed using descriptive statistics.

Results

The prevalence of lameness was 74,2%. Locomotion Score were performed in 399 lactating cows (100%), resulting in 103 (25,8%) LS 1; 211 (52,9%) LS 2; 51 (12,8%) LS 3; 34 (8,5%) LS 4 and there was no found animals with LS 5.

Discussion

Lameness control programs should be implemented to promote animal welfare and productive parameters in cattle (6). Subsequent to the locomotion score, the next steps include treating all the affected animals starting with the most painful cases, and check and correct all the risk factors that could be generating this problem.

References

Shearer JK. 2010. Lameness and Welfare of Dairy Cattle. Iowa State University Animal Industry Report 2010 A.S. Leaflet R2520.

Chen W, White E, Holden NM. 2016. The effect of lameness on the environmental performance of milk production by rotational grazing. Journal of Environmental Management. 172, 143–150

Somers JR, Huxley J, Lorenz I, Doherty ML, O'Grady L. 2015. The effect of Lameness before and during the breeding season on fertility in 10 pasture-based Irish dairy herds. Irish Veterinary Journal. 68:14.

Enting H, Kooij D, Dijkhuizen AA, Huirne RBM, Noordhuizen-Stassen EN. 1997. Economic losses due to clinical lameness in dairy cattle. Livestock Production Science. 49, 3, 259-267

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, Volume 47 , Issue 6, 1179 – 1187

DeLaval Conference Procedings. 2013. Cow Longevity Conference. Harma Farm – Tumba, Sweden. August 28 and 29.

Key words: Prevalence, locomotion score, cattle, Holstein, Spain

P 10-4 icow – A New Approach For Lameness Detection-

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Introduction

Lameness remains one of the major causes of disease and loss in productivity in dairy cattle. The earlier a laming cow is detected, the earlier the causes of the disease can be treated. In this paper, we present iCow, an approach to detect lameness using machine learning algorithms. iCow is based on a wearable motion sensor that continuously monitors the gait of a cow. In contrast to other approaches for lameness detection using motion sensors [1, 2], our approach requires a single motion sensor attached to the hind left leg of a cow. Figure 1 shows the motion sensor we developed.

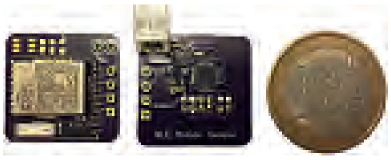

Figure 1 iCow Motion Sensor

Materials and Methods

We conducted a controlled experiment to collect data from 12 Fleckvieh and German Holstein cows in the livestock center, Veterinary Faculty of Munich. In order to develop an approach to detect changes in the walking pattern of cows, we intentionally caused a change in their walking pattern by attaching a plastic block to the outer claws of their hind legs. We conducted three runs per cow. During the first run, cows walked normally. During the second and third runs, cows walked with a plastic block attached to the outer claw of one of their hind legs. Each run lasted approximately five minutes. We recorded acceleration and device orientation at 100 Hz using an iPhone. In order to eliminate noise caused by the accelerometer, we low-pass filtered the recorded data using a second order Butterworth filter at 20 Hz. We then segmented the steps using a peak detection algorithm. For each step, we computed a set of features including step duration, average magnitude of acceleration and step symmetry. We averaged the features computed for every step that occurred within the same 30-second window. The averaged set of features computed for a 30-second window is called gait observation. We studied the performance of four machine learning algorithms at classifying gait observations as normal or abnormal (i.e. with a block). These algorithms are: a Support Vector Machine with a quadratic kernel, k-Nearest Neighbors, a Decision Tree and Logistic Regression. We trained these algorithms with normal and abnormal gait observations and validated them by means of the 10-fold cross-validation technique.

Results

On average, the different algorithms classified gait observations with an accuracy of 88.0% (80.2% true positive rate and 8.2% false positive rate). The Support Vector Machine classifier achieved an accuracy of 92.8% (88.0% true positive rate and 5.0% false positive rate).

Discussion

We presented a new approach to detecting lameness based on motion sensing. The results of our controlled experiment suggest it is possible to detect changes in the walking pattern of cows accurately using a single motion sensor and machine learning.

References

Pastell, M., Tiusanen, J., Hakojärvi, M., & Hänninen, L. (2009). A wireless accelerometer system with wavelet analysis for assessing lameness in cattle. Biosystems engineering, 104(4), 545-551.

Chapinal, N., de Passille, A. M., Pastell, M., Hänninen, L., Munksgaard, L., & Rushen, J. (2011). Measurement of acceleration while walking as an automated method for gait assessment in dairy cattle. Journal of dairy science, 94(6), 2895-2901.

P 10-5 The Challenges of Starting a Research Project on Lameness

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Introduction

Starting a research project on lameness can be very arduous due to the lack of scientific evidence for many aspects like hoof trimming technique and treatment of lesions and the difficulty to find unambiguous information on the topic (1). This contribution is an insight into the challenge of discovering that what has been taught and been taken for granted starts to unravel before the eyes of a researcher new to the field of lameness attempting to perform a prospective observational field study.

Materials and Methods

There are 25 different systems for scoring lameness that use a range of indicators, for example arching of the back, head bob, tracking up, joint flexion, tenderness and asymmetric steps (2). The authors had used the lameness scoring system of Sprecher et al. 1997 (3) and therefore intended to use it in this project. In the study hoof trimming on the farm was performed using the Dutch five step method with modifications according to Burgi (4). Lameness events and claw trimming data were recorded using the herd management program DairyComp 305© (Valley Agricultural Software, Tulare, CA, USA).

Several limitations need to be considered:

- Inter- and intraobserver agreement of lameness scores is by far less than perfect (5).
- The relationship between lameness scores and claw disorders is not linear.
- There are multiple environmental factors that can influence a cow's gait like flooring type, age and udder size (6).
- Data recording on farms has been shown to lack accuracy and consistency due to human deficiency (7, 8).
- Inconsistency in naming lesions between hoof trimmers and researchers, even though internationally a clear definition of diagnoses has recently been attempted (9).

Results

During the first sessions of lameness scoring at the exit lanes of the milking parlor on the farm it became evident that a system like the one according to Sprecher et al. (1997) that requires an evaluation of the cow walking and standing was not practical. Therefore the system according to Flower and Weary (2006) was used (10). The problem of lack of interobserver-agreement was solved by using the same observer for nearly all sessions of lameness scoring. Data recording seemed to be acceptably consistent due to the fact that hoof trimming was performed exclusively by two people who had always worked together, undergone the same training and shared the same reliable work ethics.

Discussion

For practical purposes on farm it might not matter if a cow is mildly or moderately lame because the outcome (immediate hoof trim) should be the same. Also, if the lesion is recorded perfectly might not matter immensely if the applied treatment leads to the recovery of the animal. However, for scientific investigations the correctness and validity of the data collected are mandatory for a true conclusion to be drawn. Therefore, looking at one's own work knowing that it is imperfect can be disheartening. However, when conducting clinical field studies unforeseen events cannot be avoided and handling these it is an important part of gaining experience as a researcher.

References

1. Potterton SL, Bell NJ, Whay HR, Berry EA, Atkinson OCD, Dean RS, et al. A descriptive review of the peer and non-peer reviewed literature on the treatment and prevention of foot lameness in cattle published between 2000 and 2011. The Veterinary Journal. 2012;193(3):612-6.

2. Van Nuffel A, Zwertvaegher I, Pluym L, Van Weyenberg S, Thorup V, Pastell M, et al. Lameness Detection in Dairy Cows: Part 1. How to Distinguish between Non-Lame and Lame Cows Based on Differences in Locomotion or Behavior. Animals. 2015;5(3):0387.

3. Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology. 1997;47(6):1179-87.

4. Burgi K, Cook NB, editors. Three adaptions to the functional trimming method. 15th international symposium on lameness in ruminants d: 2008; 196; 2008; Koupio, Finland.

5. O'Callaghan KA, Cripps PJ, Downham DY, Murray RD. Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. Animal Welfare. 2003;12(4):605-10.

6. Van Nuffel A, Van De Gucht T, Saeys W, Sonck B, Opsomer G, Vangeyte J, et al. Environmental and cow-related factors affect cow locomotion and can cause misclassification in lameness detection systems. Animal. 2016;10(9):1533-41.

7. Wenz JR, Giebel SK. Retrospective evaluation of health event data recording on 50 dairies using Dairy Comp 305. Journal of Dairy Science. 2012;95(8):4699-706.

8. Kofler J. Computerised claw trimming database programs as the basis for monitoring hoof health in dairy herds. The Veterinary Journal. 2013;198(2):358-61.

9. Egger-Danner C, Nielsen P, Fiedler A, Müller K, Fjeldaas T, Döpfer D, et al. ICAR Claw Health Atlas. ICAR Technical Series. 2014(No.18):45 pp.

10. Flower FC, Weary DM. Effect of Hoof Pathologies on Subjective Assessments of Dairy Cow Gait. Journal of Dairy Science. 2006;89(1):139-46.

Keywords: scientific evidence, lameness scoring, trimming method, treatment, data collection

P 10-7 Using A Three Point Lameness Scoring System Combined With A Clinical Examination To Increase The Reliability Of Visual Locomotion Scoring.

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Introduction

Because of both its economic relevance and impact on animal welfare, lameness remains a very significant subject of research in the field of dairy farming. It is a cause of pain for cows and results in economic loss due to reduced reproductive efficiency, milk production and cost of treatment (Bruijnis et al. 2010, Green et al. 2010). Locomotion scoring is a valid tool for recognizing lameness (Flower & Weary 2006); there are many different types of scores, some of them, such as the Manson and Leaver (Manson & Leaver 1988) or the Flower and Weary (Flower & Weary 2006) involve many different locomotion variables. Other methods, such as that developed by Sprecher et al. 1997, which assesses gait and back posture in a 5 point system, are more suitable for on field research and for everyday lameness detection on farms. A common problem in regard to locomotion scoring systems is their variable agreement and reliability (PA for interrater agreement and reliability estimates ranging from 37% (O'Callaghan et al. 2003), to 83% for Sprecher et al., (Hoffman et al. 2013) and 17 to 47% for Manson & Leaver (Channon et al. 2009), as shown by Schlageter-Tello (Schlageter-Tello et al. 2014. In a study by the Bavarian State Research Centre for Agriculture in Grub, Germany, 450 Simmental cows will undergo locomotion scoring on a weekly basis. This data will then be used as a reference for a lameness detection model that is to be built upon lying and feed intake data collected by the „Track a Cow“ pedometers fitted on each animal. In previous projects it was observed that Simmental cows tended to hide often used lameness traits such as an arched back or head bob when directly observed but do show these when observed indirectly, for example through video recording. The aim of this study is to test the interrater agreement and the reliability of a three point locomotion scoring system, and to combine this scoring system with a clinical examination of the claws of lame and unsound animals.

Materials and methods

For this study 91 animals were scored on video by two trained observers simultaneously, on a separate occasion another 86 animals were scored live by the same two observers. The animals were scored while they were coming out of the milking parlour and walking in single file. The three point scoring system has 4 locomotion variables chosen based on an analysis of the most commonly used scoring systems (Figure 1).The system can be represented graphically as a flow chart with a dichotomous decision boundary for each variable. The outcome of the observation can be either 1, meaning the animal is considered sound, 2 meaning the animal has some inconsistencies in its posture, or 3, meaning the animal is definitely lame. To increase the validity of the scoring system, it will be followed by a pain reaction test with hoof pincers for all animals scored 2 (unsound).If the pain reaction test is positive, the animals will be treated and considered score 3 (lame), so as will all animals initially scored 3 (lame).

Results

The scores (n=177) were compared between observers and showed a 90,7% percentage of agreement (PA) for the live scoring and PA=87,4% for the video scoring. Cohen's Kappa was calculated with linear weighting to determine the level of interobserver reliability and resulted in 0,71 for the live scoring and 0,63 for the video scoring respectively.

Discussion:
It has been shown (Channon et al. 2009) that interobserver agreement increases if the scoring system scale is reduced to three, or even two points. Seeing as in the current project the emphasis will be on a consistent detection of clinical lameness and its development through time, reducing the scale of the scoring system to 3 points and regularly examining the mildly lame animals could be a valid solution for studies which aim to investigate the relationship between hoof pathologies and gait scores as well as those that use the score as a reference for a lameness detection method. Further results will be presented with the final version of the poster.

References:
Bruijnis MRN, Hogeveen H and Stassen EN 2010 Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. *Journal of Dairy Science* 93: 2419–2432.

Channon AJ, Walker AM, Pfau T, Sheldon IM, Wilson AM and others 2009 Variability of Manson and Leaver locomotion scores assigned to dairy cows by different observers. *The Veterinary Record* 164: 388.

Flower FC and Weary DM 2006 Effect of hoof pathologies on subjective assessments of dairy cow gait. *Journal of dairy science* 89: 139–146.

Green LE, Borkert J, Monti G, Tadich N and others 2010 Associations between lesion-specific lameness and the milk yield of 1,635 dairy cows from seven herds in the Xth region of Chile and implications for management of lame dairy cows worldwide. *Animal Welfare* 19: 419–427.

Hoffman AC, Moore DA, Wenz JR and Vanegas J 2013 Comparison of modeled sampling strategies for estimation of dairy herd lameness prevalence and cow-level variables associated with lameness. *Journal of Dairy Science* 96: 5746–5755.

Manson FJ and Leaver JD 1988 The influence of concentrate amount on locomotion and clinical lameness in dairy cattle. *Animal Science* 47: 185–190.

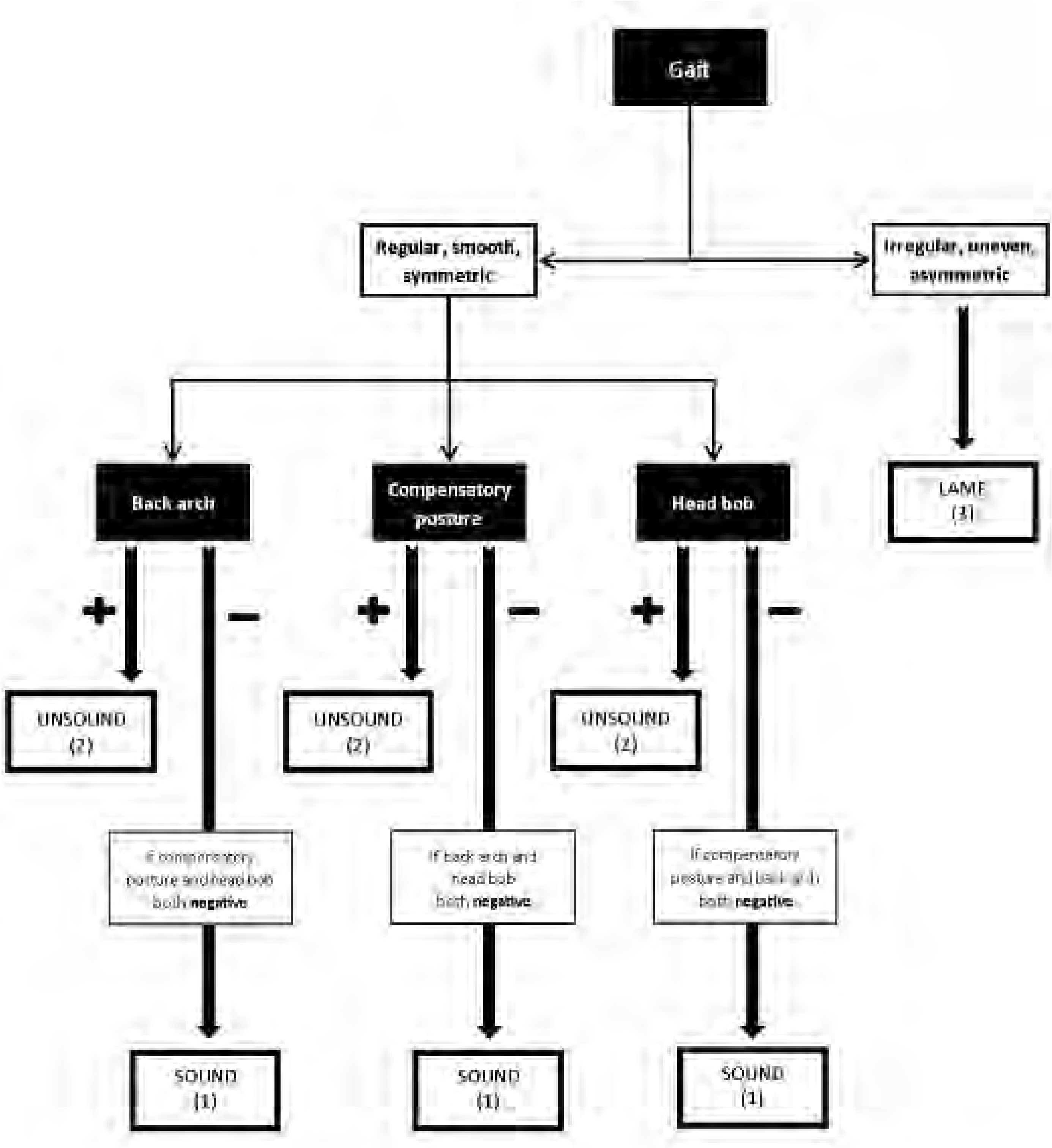
O'Callaghan KA, Cripps PJ, Downham DY and Murray RD 2003 Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. *Animal Welfare* 12: 605–610.

Schlageter-Tello A, Bokkers EAM, Koerkamp PWGG, Van Hertem T, Viazzi S, Romanini CEB, Halachmi I, Bahr C, Berckmans D and Lokhorst K 2014 Manual and automatic locomotion scoring systems in dairy cows: A review. *Preventive Veterinary Medicine* 116: 12–25.

Sprecher DJ, Hostetler DE and Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. *Theriogenology*: 1179–1187.

Keywords: Locomotion score, interobserver reliability

Figure 1 Diagram oft he scoring system



P 10-8 "Pro Gesund" - Support For Healthy Claws

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Introduction

Improvement of animal health is of paramount importance both to farmers and veterinarians. In addition, the consumer desires healthy animals and this criterion is of relevance for their purchasing behaviour. Therefore, the Bavarian State Ministry for Food, Agriculture and Forestry financed the development of an animal health monitoring system ("Pro Gesund") in order to improve cattle health in Bavarian dairy herds. The aim is to record and evaluate animal health data in Bavarian dairy farms in order to improve the management and to facilitate preventive measures, to support the integrated veterinary herd health care and to estimate breeding values for health traits for bulls used in artificial insemination (Zeiler et al., 2013). To evaluate lameness and claw health provides a good proxy for animal welfare, thus for a comprehensive view of dairy cow health, „Pro Gesund" cooperates with other stakeholders and integrates data from different sources e.g. claw-trimmers.

Materials and Methods

The animal health monitoring system "Pro Gesund" is based on several pillars - the electronic or manual recording of diagnoses by the veterinarian, the observations by the farmer, the descriptive findings of routine recording during hoof trimming according to ICAR (ICAR Working Group on Functional Traits and International Claw Health Experts, 2015) and the results of bacterial raw milk laboratory analyses of the Animal Health Service. By merging the individual data streams with results from milk recording, all partners involved, the veterinarian and the farmer can assess the overall health of the herd, but also the current health status of any individual cow (Zeiler et al., 2013).

Results and discussion

The collected data is processed in order to give a comprehensible overview to the farmer and to the veterinarian. The special Web application "Pro Gesund im LKV-Herdenmanager" and a printed health report deliver figures, charts and current numbers about the herd health status. In addition to data relating to their own farm, a benchmark chart compares the herd's achievements with those of other farms in Bavaria. In these reports specific values in various categories such as udder health, fertility, metabolic disorders calf diseases, and claw health on the specific farm are analyzed, thus enabling targeted intervention or prevention in the future (Zeiler et al., 2013). By means of the collected data, breeding values are estimated for the health traits mastitis, cystic ovaries, milk fever and early reproductive disorders in "Fleckvieh" (Simmental) and Brown Swiss Cattle (Egger-Danner, 2015). The descriptive findings of routine recording during hoof trimming as well as breeding values for claw disorders will be integrated in future. Until now, 2242 farmers and 148 veterinarians take part in „Pro Gesund". The "Pro Gesund" database includes 122.712 diagnoses and 88.559 observations in different categories from 2012 to 2017 (table 1).

Table 1: Number of diagnoses and observations from veterinarians and farmers from 2012 – 2017 within “Pro Gesund”, Bavaria

	Diagnoses	Observations
Prevention	34.090	2.532
Reproduction disorders	25.925	43.478
Udder disorders	19.055	4.608
Calf disorders	17.809	2.246
Locomotor system and claw disorders	12.278	9.593
Metabolism disorders	5.685	1.082
Others	7.878	4.708
Total	**122.712**	**68.247**

Concerning locomotor system disorders including claw disorders, the “Pro Gesund” database includes 17.360 records (12.256 diagnoses and 4.568 observations) relating to different findings (figure 1).

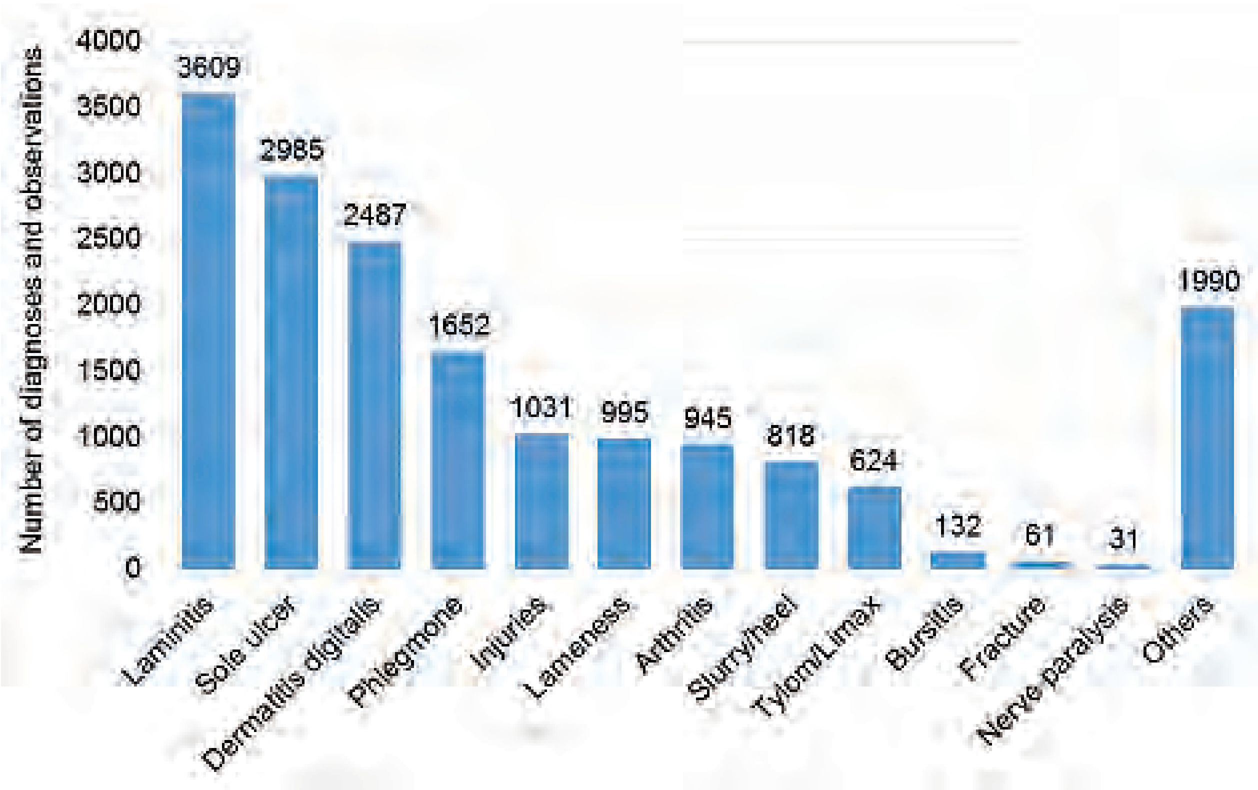

Figure 1: Locomotor system and claw- diagnoses and -observations from veterinarians and farmers from 2012 – 2017 in “Pro Gesund”, Bavaria. However, for a significant improvement of Bavarian dairy cow health and to increase the reliability of estimated breeding values many more diagnoses and observations are required. Several international studies demonstrate that improvement of claw health by using data from claw-trimmers (Fuerst, 2011) can be successful. Therefore, “Pro Gesund” is striving to establish a permanent cooperation with professional claw-trimmers.

Acknowledgements

The authors and “Pro Gesund” would like to thank the farmers and veterinarians for the good cooperation during the last years as well as the claw-trimmers for their willingness to support “Pro

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References

Egger-Danner C 2015 Züchterische Entwicklungen der Klauengesundheit – Internationale Entwicklungen und Situation in Österreich. In: Proceedings of the Seminar des Ausschusses für Genetik der ZAR, Gesunde Klauen und gute Fundamente, Einflussfaktoren und Verbesserungsmaßnahmen pp 33-43. Rinderzucht Austria.

ICAR Working Group on Functional Traits and International Claw Health Experts. ICAR claw health atlas 2015. http://www.icar.org/index.php/publications-technical-materials/technical-series-and-proceedings/atlas-claw-health-and-translations/

Fuerst C, Koeck A, Egger-Danner C and Fuerst-Waltl B 2011 Routine Genetic Evaluation for Direct Health Traits in Austria and Germany. *Interbull Bulletin No. 44:* 210-215.

Zeiler E, Goetz KU, Uebelhack S, Krogmeier D, Duda J, Randt A and Sauter-Louis C 2013 “Pro Gesund” – Bavarian animal health monitoring of dairy cows. In: Book of abstracts of the International Conference on Production Diseases in Farm Animals p 38. Faculty of Veterinary Medicine and Animal Science: Uppsala, Sweden.

Key words: „Pro Gesund“, health monitoring system, cattle health improvement, dairy cow, animal welfare

P 10-9 "Cowsandmore-Mobility Check"- Complementary Tool For The Assistance System "Cowsandmore" For The Determination Of Animal Welfare In Dairy Farms

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Introduction

Often cow comfort is taken as a criterion to evaluate animal welfare in dairy farms which means that housing conditions for dairy cows should be oriented towards the welfare of these animals. This, however, often stands in sharp contrast to the measurable needs, e.g. in terms of animal-friendly dimensions and appropriate interior of the cubicles and running surfaces. Therefore a targeted observation of qualitative and quantitative parameters regarding animal behaviour and hygiene is necessary to detect weak points at farm level more specifically. The aim of the project "CowsAndMore" was to develop an assistance system to identify weaknesses in animal husbandry. By objectively and systematically collecting defined animal and behavioural criteria as well as husbandry-related indicators, it is possible to discover weaknesses in husbandry and management.

Method

In view of the above, the software programme "CowsAndMore" was developed for all common touchpad systems. The digital weak point analysis is conducted by using selected, objective indicators and scores, simply and reliably to be collected in practice. Based on the comparison of an individual farm with defined goals and comparison values from a specific data pool, this programme can help consultants to advise farmers concerning animal welfare and productivity. Some of the scores such as the hygiene score for estimating the cleanliness of cows were newly developed for this system. (Other existing schemes referring to certain requirements have been adapted to the system, for example the DLG-scheme for classifying cow joints.). Complementary module: CowsAndMore – MobilityCheck: The term "animal welfare" is also often associated with mobility. Therefore a "CowsAndMore – MobilityCheck" was integrated as a complementary module to the software. The selected criteria and indicators in the "MobilityCheck" are based on proven scoring systems and newly defined evaluation methods.

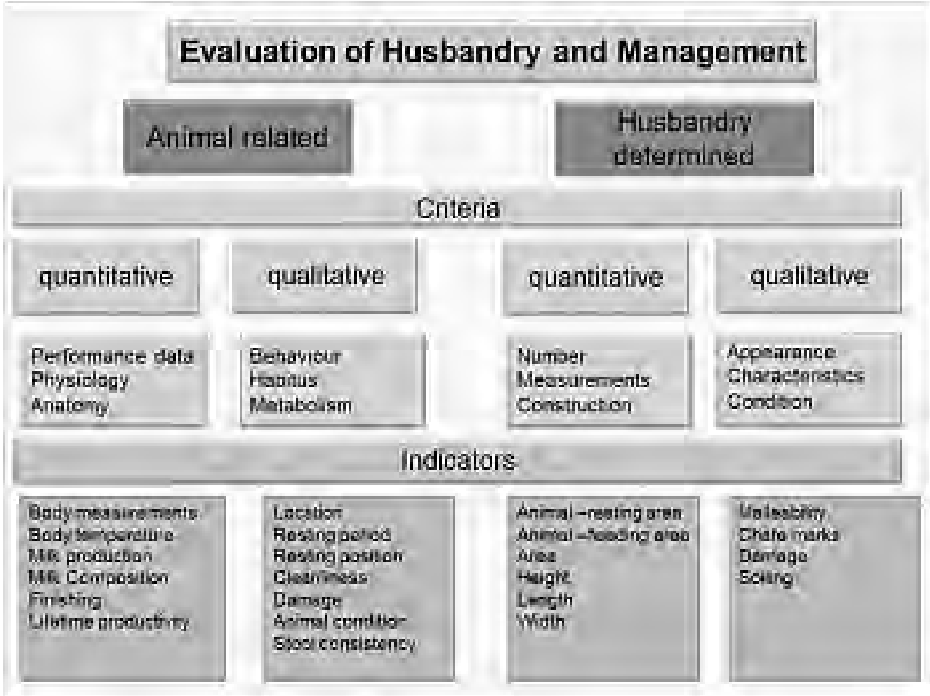
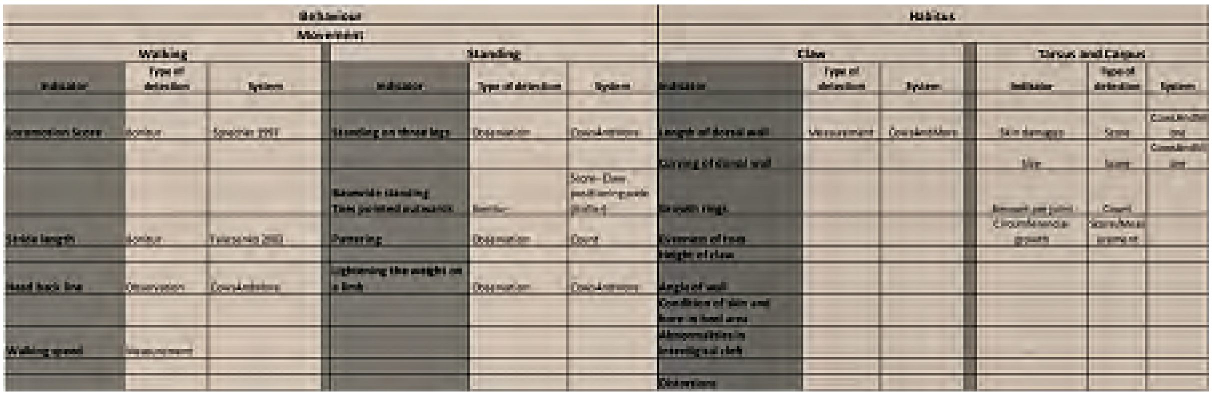


Fig. 1 Evaluation of Husbandry and Management

Specific indicators were selected and summarised in a digital acquisition matrix for the analysis of claw health and mobility. With the "MobilityCheck" farmers and advisors should be able to detect limitations in mobility / lameness at an early stage. For this purpose relevant indicators relating to the shape and position of the claw and special characteristics of walking and standing behaviour have been implemented in the digital assistance system of "CowsAndMore". At the same time, the programme analyses the results. Based on defined goals, this advising tool supports individual consultation by objectively collecting and systematically analysing qualitative and quantitative data of animal behaviour and other indicators at cow level.



Behaviour / Movement: Walking – Indicator	Type of detection	System	Behaviour / Movement: Standing – Indicator	Type of detection	System	Habitus: Claw – Indicator	Type of detection	System	Habitus: Tarsus and Carpus – Indicator	Type of detection	System
Locomotion Score	Monitor	Sprecher 1997	Standing on three legs	Observation	CowsAndMore	Length of dorsal wall	Measurement	CowsAndMore	Skin damages	Score	CowsAndMore
						Curving of dorsal wall			Size	Score	CowsAndMore
			Base-wide standing Toes pointed outwards	Monitor	Score- Claw positioning guide [illegible]	Growth rings			Amount per joint	Count	
Stride length	Monitor	[illegible]	Pattering	Observation	Count	Evenness of toes			Circumference joints	Score/Measurement	
						Height of claw					
Head back line	Observation	CowsAndMore	Lightening the weight on a limb	Observation	CowsAndMore	Angle of wall					
						Condition of skin and horn in heel area					
Walking speed	Measurement					Abnormalities in interdigital cleft					
						Distortions					

Fig. 2 Indicators

Conclusion

This matrix allows farmers and advisors to detect problems in lameness early and improve the health of dairy cows. Using these results, uniform evidence-based recommendations for optimising animal welfare, barn environment and management can be given.

References

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, 1997; 47: 1178-1187.

Baumgartner, C.; Distl, O.; Krausslich, H Suitability of indicator traits in breeding for claw health in German Simmentals. 1. Estimated heritabilities for claw measurements, leg posture score and claw shape, and diagnosis of claw diseases of cows at the start of the 1st lactation. Zuchtungskunde 1990; 62(3): 195-207.

Nuss K, Paulus N. Measurements of claw dimensions in cows before and after functional trimming: A post-mortem study. Veterinary Journal 2006; 172(2): 284-292.

Telezhenko E. Measurement of spatial gait parameters from footprints of dairy cows. Animal. 2009; 3(12):1746-53.

Fiedler A, Maierl J, Nuss K. Erkrankungen an Klauen und Zehen des Rindes. Hrsg. 2, völlig neu überarbeitete Ausgabe; Schattauer-Verlag, Stuttgart. Im Druck.

Keywords: mobility, lameness, animal health, evaluation, indicators

P 10-10 Dealing With Lame Cows – The Complete On Farm Package.

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Introduction

During 2013-2014 a number (18) of DairyCo (now AHDB) 'Healthy Feet Program' investigations were carried out in a large farm animal practice in the South West of England. A consistent finding in all the herds visited was a less than optimal assessment of some aspect of 'hoof trimming'. This included an absence of routine trimming, delayed detection and treatment of lame cows, sub-standard equipment and/or set-up, poor trimming skills (including inappropriate power tool use), poor record keeping, inadequate reassessment/referral of lame cows and delayed culling. It was concluded that novel and flexible approaches to foot care were required.

Materials and Methods

In September 2013 a 120 cow dairy herd with a lameness prevalence (score 2's and 3's) of 42% was offered a contract arrangement which included regular mobility scoring followed by attention to newly identified lame cows as well as regular reassessment of trimmed lame cows and referral of 'problem' lame cows for veterinary attention. In the case of newly lame cows being identified by the farmer in between two weekly mobility scoring sessions the arrangement was that he could request a visit which would in most cases would occur within 48 hours. One member of the practice veterinary technician service was appointed as the main hoof trimmer and another carried out the regular mobility scoring; a lead vet attended to referred cows. The action lists for cow treatments and re assessments were generated by the veterinary practice.

Results

A number of 'chronic' cases were referred for veterinary attention at the start of the contract period and were a mixture of solar ulceration and toe necrosis. Claw amputation was not favoured by the farmer and so alternative treatments were instigated (in many cases radical resection with repeated follow-up until 'resolution' or culling. Over the following 12 months the lameness prevalence dropped to below 10% with minimal culling and all cows that were culled for lameness were able to travel to the abattoir and realise a value. The financial return from these cows culled resulted in a net profit after payment of a 'contract fee' per cow in the herd.

Discussion

For some farms divesting the detection and treatment of lame cows is an appropriate service and is likely to lead to a rapid improvement in lameness prevalence, reduced culling and an increase in cull cow value.

Acknowledgements

The authors would like to thank the team at Synergy Farm Health and the farmer for agreeing to be involved with this study.

References

N/A

Keywords: Lameness – Mobility – Foot trimming – Contract

P 10-11 Assessing Farmer Detection Of Digital Dermatitis In Danish Dairy Herds

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Introduction

An infected host plays a key role in the epidemiology of digital dermatitis (DD) in dairy herds. Early detection of DD cases followed by adequate preventive and curative measures can reduce the spread of the disease within a herd (Döpfer et al., 2012). Farmers are the main responsible for implementation of those measures. In order for the farmer to identify and acknowledge DD as a problem, he/she must be able to detect the disease. The objective of this study was to compare the estimates of DD prevalence between a group of farmers and a researcher.

Materials and methods

This study is part of a project which aimed to investigate the relationship between biosecurity and DD in Danish dairy herds. Estimates from 36 farmers were obtained by asking them the percentage of lactating cows with DD in their herd at a given day. On the same day, the prevalence of DD was determined by a researcher scoring the hind feet of cows in the milking parlour as negative or positive to DD after washing the feet (Thomsen et al., 2008). The Spearman rank correlation test was used to analyse correlations between DD prevalences estimated by farmers and researcher.

Results

There was a positive correlation (Spearman's rho = 0.662, $P < 0.001$) between DD prevalences estimated by 36 farmers and the researcher (Figure 1).

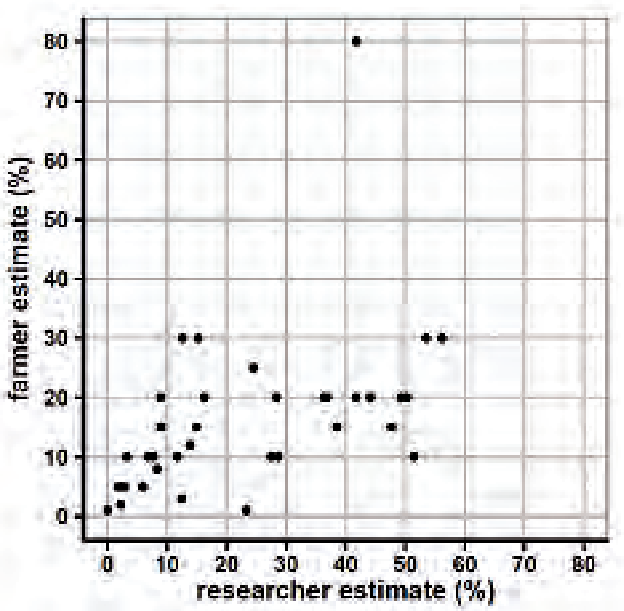

Figure 2 - Scatter plot of the relationship between the prevalence of digital dermatitis estimated by a group of farmers and recorded by a researcher.

Discussion

Previous studies have shown that farmers are generally only able to identify approximately one third of all truly lame cows in their herd (Whay et al., 2003; Espejo et al., 2006). It may therefore also be expected that farmers underestimate the prevalence of DD in their herds. The results from the present study showed that farmers are partly aware of problems with DD in their herds. On average, the DD prevalence estimated by the farmer was lower than the prevalence recorded by the researcher, but the underestimation was smaller compared to what is typically found comparing farmer and researcher estimates of the prevalence of lame cows. Reasons for a poor agreement between farmer and researcher could be a different definition of DD by farmers that might not consider all stages of the disease; or the lack of participation of farmers in hoof health activities that may be nominated to an employee.

Acknowledgment

Funding for this study was provided by Aarhus University and Science without Borders scholarship program from Brazil.

References

Döpfer D, Holzhauer M and van Boven M 2012 The dynamics of digital dermatitis in populations of dairy cattle: Model-based estimates of transition rates and implications for control. The Veterinary Journal 193: 648-653.

Espejo LA, Endres MI and Salfer JA 2006 Prevalence of lameness in high-producing Holstein cows housed in freestall barns in Minnesota. Journal of Dairy Science 89: 3052-3058.

Thomsen PT, Klaas IC and Bach K 2008 Scoring of digital dermatitis during milking as an alternative to scoring in a hoof trimming chute. Journal of Dairy Science 91: 4679-4682.

Whay HR, Main DCJ, Green LE and Webster AJF 2003 Assessment of the welfare of dairy cattle using animal-based measurements: Direct observations and investigation of farm records. Veterinary Record 153: 197-202.

Keywords: digital dermatitis, farmer, awareness, hoof health

P 10-12 Can Digital Dermatitis Be Scored During Milking Without Washing Cows' Feet?

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Introduction

Scoring digital dermatitis (DD) in the milking parlour after washing the feet of the cows has been considered an adequate method to diagnose presence or absence of the disease (Stokes et al., 2012; Solano et al., 2017). Besides being less stressful to cows, the method requires less costs, time and labour from the observer compared to scoring cows in a trimming chute (Thomsen et al., 2008). A drawback is that heifers, also commonly affected by DD (Laven and Logue, 2007), cannot be included in the assessment. Furthermore, farmers can be unwilling to allow the washing of cows' feet, since farmers tend to abandon treatments that require extra labour and cause discomfort to cows or may cause problems with udder hygiene (Relun et al., 2013). Our objective was to evaluate if DD prevalence can be determined during milking without prior washing of the feet of cows.

Materials and methods

Two methods to determine DD prevalence in lactating cows in the milking parlour were compared. Hind legs of cows were scored during the same milking. First, evaluations were performed according to the order of entry of cows into the parlour before washing their feet. Thereafter, all cows of the same group were examined at a random order subsequent to having their feet washed using a water hose (Thomsen et al., 2008). Digital dermatitis positive cows presented any clinical signs compatible to the M-stage classification (Berry et al., 2012) in at least one hind foot, while negative cows had normal hind feet skin. Correlations between DD prevalences determined before and after washing the feet were tested by Spearman's rank correlation statistics and the ratios of these prevalences were calculated.

Results

The study involved 22 Danish dairy herds in which the number of cows included ranged from 91 to 356 with a median of 185. In all herds, scoring cows after washing their feet resulted in higher prevalences of DD. Figure 1 shows the prevalences of DD determined not washing and washing the feet. These methods were highly correlated (Spearman's rho = 0.987, $P < 0.001$). The median value of the ratios obtained dividing the prevalence results after washing by before washing was 1.32 minimum = 1.14 and maximum = 2.0).

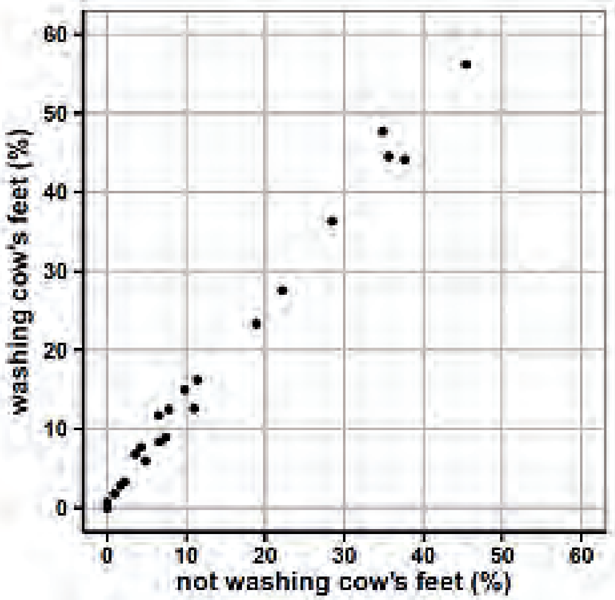

Figure 3 – Scatter plot showing DD prevalences in 22 Danish dairy herds determined in the milking parlour not washing and washing the hind feet of cows.

Discussion

Results from this study showed that on average 24% of DD cases were missed scoring the disease without washing the feet. Detection of DD may have been impaired by poor leg cleanliness of cows. Although we found a high correlation between the DD prevalence before and after washing, the ratios of DD prevalences without and with washing had a wide range. Some herds had 10-20% more cows diagnosed with DD after washing whereas other herds had twice as many cows diagnosed with DD after washing. This is possibly due to the exposure of cows in different herds to several herd- and cow-level factors associated with hind leg cleanliness (Nielsen et al., 2011). Overall, scorings of DD without washing the feet of cows should be interpreted with caution.

Acknowledgment

We thank Aarhus University and Science without Borders program.

References

Berry SL, Read DH, Famula TR, Mongini A and Döpfer D 2012 Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. *The Veterinary Journal* 193: 654-658.

Laven RA and Logue DN 2007 The effect of pre-calving environment on the development of digital dermatitis in first lactation heifers. *The Veterinary Journal* 174: 310-315.

Nielsen BH, Thomsen PT and Sørensen JT 2011 Identifying risk factors for poor hind limb cleanliness in Danish loose-housed dairy cows. *Animal* 5: 1613-1619.

Relun A, Guatteo R, Auzanneau MM and Bareille N 2013 Farmers' practices, motivators and barriers for adoption of treatments of digital dermatitis in dairy farms. *Animal* 7: 1542-1550.

Stokes JE, Leach KA, Main DCJ and Whay HR 2012 The reliability of detecting digital dermatitis in the milking parlour. *The Veterinary Journal* 193:679-684.

Solano L, Barkema HW, Jacobs C and Orsel K 2017 Validation of the M-stage scoring system for digital dermatitis on dairy cows in the milking parlor. *Journal of Dairy Science* 100: 1-12.

Thomsen PT, Klaas IC and Bach K 2008 Scoring of digital dermatitis during milking as an alternative to scoring in a hoof trimming chute. *Journal of Dairy Science* 91: 4679-4682.

Keywords: digital dermatitis, hoof disorder, hoof washing, diagnosis, milking parlour

P 10-13 Field-Ready Guide On Cattle Lameness Aids In Identification, Prevention And Control Of Claw Lesions

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Introduction

Lameness may be difficult to diagnose and even harder to prevent, yet ramifications of unchecked lameness can be devastating. *Cattle Lameness: Identification, Prevention and Control of Claw Lesions* is key to reducing this highly-prevalent challenge. Producers need an easy-to-read and follow manual that is designed to assist in improving animal wellness through prevention of lameness. Through coordinated efforts of a global team of industry experts, it is possible to create such a manual. The objective of this effort was to develop a reference guide for the dairy and beef industries. A field-ready guide would give producers or nutritionists an understandable field resource to quickly apply knowledge in identifying common lesions.

Materials and Methods

A committee of industry experts including nutritionists, veterinarians, academicians and foot trimmers was selected from the International Lameness Committee. This team selected hundreds of photos and developed dozens of original illustrations and schematics. These materials were designed to help aid in the understanding of how and why lameness occurs, and explain prevention and control measures needed to reduce lameness. Key components include:

- An Anatomy section discussing structure and function of the bovine foot. The authors highlight key anatomical features required for understanding pathogenesis, treatment and prevention of claw lesions and diseases.
- A Lesions section provides an in-depth discussion on both infectious and non-infectious lesions, how to identify them and their effects. The authors selected hundreds of photos and designed new easy-to-understand graphics that illustrate each lesion's relevance and implications in dairy and beef cattle performance.
- A Nutrition section reviews key roles that water, protein, energy, minerals and vitamins play in achieving optimum hoof health.
- A Hoof and Claw Care section outlines how proper trimming is essential for hoof health, along with a thorough review of trimming tools, goals and common mistakes.

Results

Visually recognizing the lameness issue, understanding the repercussions and taking proactive, preventive measures are key to reducing its prevalence in dairy and beef operations. This team produced an effective manual that will improve producer knowledge of lameness. The manual serves as a novel tool to help logically step livestock producers through identification of claw lesions, appropriate treatments per lesion, and how to prevent future problems.

Discussion

Development of the *Cattle Lameness* manual continues Zinpro Corporation's long involvement with cattle lameness prevention efforts. The committee designed this manual to serve as a valuable resource in assessing and preventing lameness and improving animal wellness and performance.

Acknowledgements
We acknowledge academic and industry initiatives to reduce bovine lameness. Knowledge obtained from controlled research studies and daily observations by producers and their hoof trimmers have led to an increased understanding of means to treat, control and prevent lameness in cattle. Efforts such as the International Conference on Lameness in Ruminants have kept the issue front and center, encouraging discussion and healthy debate.

References

Zinpro Corporation's *Illustrated handbook on Cattle Lameness*, by Paul R. Greenough, LaVerne M. Schugel and A. Bruce Johnson – first published in 1996.

Keywords: Cattle lameness, bovine foot anatomy, claw lesions, hoof and claw care

11 LAMINITIS

46 Claw Horn Disruption: An In Vitro Study Of Early Pathomechanisms

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Introduction

Claw horn disruption (CHD), formerly known as subclinical laminitis, is the most significant cause for lameness in cattle leading to a variety of secondary claw lesions such as white line lesions, sole ulcers and sole hemorrhages. CHD and its secondary lesions negatively impact on productivity of dairy cattle and are a major economic and welfare concern to the dairy industry (1, 3, 7, 8).The pathogenesis and pathomechanisms of CHD are still not well understood and there is a lack of models suitable to further elucidate them. The current hypotheses of the pathophysiology of CHD focus on events during the peri-partal period and comprise ischemic conditions in claw epidermis due to an impaired dermal microcirculation and more recently a glucose deficiency of epidermal keratinocytes as a result of a negative energy balance (2, 3, 5, 6, 7, 9, 10). The objective of the study was to establish an in vitro ischemia model and use this model to study keratinocytes' response to oxygen glucose deprivation (OGD) and glucose deprivation (GD) (4).

Materials and Methods

Keratinocytes isolated from bovine claw epidermis were exposed to OGD or cultivated only under hypoglycemic or hypoxic conditions (4). Experiments were followed by an investigation of cell viability using lactate dehydrogenase (LDH) cytotoxicity assay and the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) reduction assay. The influence on cell differentiation was measured by western blot analysis with focus on the terminal differentiation markers involucrin and loricrin.

Results

After exposure to OGD, keratinocytes show the highest cytotoxic effects and a time-dependent decrease of cell viability. Exposed to GD, keratinocytes show a considerable decreased cell viability accompanied by strong morphological alterations. Hypoxia is associated with the highest LDH activities accompanied by slightly morphological changes and an intact cell layer. Furthermore, all experimental groups cause a changed expression pattern with increased levels of involucrin and loricrin.

Discussion

OGD and glucose deficiency provoke a marked decrease in keratinocyte viability and cause an altered differentiation pattern. Particularly the glucose deficit had a high impact on cell viability. The effects measured in vitro are likely to represent the pathophysiological processes we find with an epidermal ischemia during the initial stage of CHD. Our results highlight the essential importance of glucose for functions and metabolism of the epidermal keratinocytes. The critical role of glucose may explain the detrimental effects a negative energy balance has on claw integrity. Our in vitro ischemia model seems suitable to further investigate the physiological processes of the claw epidermis as well as the pathophysiological response mechanisms occurring during CHD.

References

1. Bergsten, C. Causes, risk factors, and prevention of laminitis and related claw lesions. Acta Veterinaria Scandinavica. 2003 (Suppl. 98): 157–166.

2. Hirschberg, RM, Plendl J. Pododermal angiogenesis and angioadaptation in the bovine claw. Microscopy research and technique 2005 (66): 145–155.

3. Hoblet, KH, Weiss W. Metabolic hoof horn disease. Claw horn disruption. The Veterinary clinics of North America. Food animal practice 2001.17(1): 111–127.

4. Meloni, BP, Meade AJ, Kitikomolsuk D, Knuckey NW. Characterisation of neuronal cell death in acute and delayed in vitro ischemia (oxygen-glucose deprivation) models. Journal of neuroscience methods 2011 (195): 67–74.

5. Lübbe K. Entwicklung und Einsatz eines In-vitro-Ischämiemodells zur Untersuchung zellulärer Pathomechanismen der Klauenrehe des Rindes. Dissertation med vet, Leipzig 2015.

6. Mülling, CKW, Lischer CJ. New aspects on etiology and pathogenesis of lamintis in cattle, Hannover. XXII World Buiatrics Congress 2002: 236–247.

7. Newsome R, Green MJ, Bell NJ, Chagunda, MGG, Mason CS, Rutland CS, Sturrock CJ, Whay HR, Huxley JN. Linking bone development on the caudal aspect of the distal phalanx with lameness during life. Journal of dairy science 2016 (99): 4512–4525.

8. Oikonomou G, Banos G, Machado V, Caixeta L, Bicalho RC. Short communication: Genetic characterization of digital cushion thickness. Journal of dairy science 2014 (97): 532–536.

9. Spurlock DM, Dekkers CJM, Fernando R, Koltes DA, Wolc A. Genetic parameters for energy balance, feed efficiency, and related traits in Holstein cattle. Journal of dairy science 2012 (95): 5393–5402.

10. Vermunt JJ. One step closer to unravelling the pathophysiology of claw horn disruption: for the sake of the cows' welfare. Veterinary journal 2007 (174): 219–220.

Key words: bovine keratinocyte, ischemia, oxygen-glucose deprivation, claw horn disruption

47 *Ex vivo* and *in vitro* models to evaluate potential trigger factors for laminitis in horses and ruminants

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Introduction

Laminitis is one of the most common diseases in horses and ruminants. Still the pathogenesis of laminitis is not fully understood. Bacterial toxins, especially endotoxins are discussed as potential trigger factors (1,2). As *in vivo* trials are associated with pain and stress for the animal, alternatives are highly recommended. We, therefore, established an *ex vivo/in vitro* model cultivating hoof and claw explants to evaluate the possible contribution of endotoxins during laminitis. Furthermore, we established a 3D cell culture model using primary equine keratinocytes together with fibroblasts.

Materials and Methods

Ex vivo/in vitro cultivation of explants: Equine hooves and bovine claws were obtained from an abattoir. Explants were prepared as described by Pollitt (3). Lipopolysaccharides (LPS) were added to bovine [0, 1, 10, 100 µg/mL] and equine [0, 2.5, 10, 100 µg/mL] explants for 24 hours. Viability was assessed after incubation with the WST-1 assay. A calibrated force transducer was used to measure tissue integrity (= separation force).

Establishment of a 3D cell culture model: For the 3D model, equine hoof fibroblasts were seeded onto scaffolds and after one week, keratinocytes were seeded onto the fibroblast layer. To evaluate, if the 3D culture mimics the structure and function of the equine hoof tissue, the following tests were performed on day 8, 21, 28 and 37: A standard staining method was used to evaluate morphology of the 3D culture. Cell proliferation was tested with the MTT assay. To assess biological function of the model, the activity of the matrix metalloproteinases (MMP) 2 and 9 was measured (SDS page).

Results

Ex vivo/in vitro cultivation of explants: Viability of hoof as well as claw explants was not affected after 24 hours incubation. LPS (10 and 100 µg/mL) significantly decreased the separation force in bovine explants by 50 and 65%, respectively. LPS (10 and 100 µg/mL) also led to a significant reduction of separation force in equine explants by 45% and 49%, respectively.

Establishment of a 3D cell culture model: Morphological evaluation revealed no clear separation between the fibroblast and keratinocyte layer. Increased proliferation of cells could be measured until day 28, thereafter, a slight decrease was observed. An increase of the MMP-2 and MMP-9 activity was observed in the course of the experiment.

Discussion

The presented models provide a possibility to test several laminitis trigger factors *in vitro*. Using explants we could demonstrate a possible role of endotoxins in the pathogenesis of laminitis. Morphological evaluation as well as the MTT assay revealed that cells proliferated in the 3D hoof model, at least until day 28. Furthermore, MMP-2 and 9 activity increased during the experiment. This function is important as MMPs might play a key role in the pathogenesis of laminitis. However, it was not possible to completely mimic the *in vivo* situation as it was not possible to separate the fibroblast layer from the keratinocyte layer. The 3D model, hence, needs to be improved and incubation time needs to be adjusted especially to ensure the optimal time point to add laminitis trigger factors.

References

Katz LM and Bailey S. A review of recent advances and current hypothesis on the pathogenesis of acute laminitis 2012 Equine Veterinary Journal 44:752-761.

Nocek JE. 1997 Bovine acidosis: Implications on laminitis Journal Dairy Science. 80:1005-1028

Pollitt, CC. Basement membrane pathology: a feature of acute equine laminitis 1996 Equine Veterinary Journal. 28(1):38-46.

Keywords: Laminitis, Endotoxin, *Ex vivo*, *In vitro*

48 Heel Bulb Palpation And Inspection As A Clinical Tool In Diagnosis Of Complicated Claw Lesions

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Introduction

Lameness in dairy cows has a huge negative impact on production economy and animal welfare (1,2,3). Complicated, non-healing horn related lesions are potentially the costliest claw lesions, due to their chronic, irreversible and debilitating nature. Sole ulcer, toe necrosis, and white line diseases can occur with ascending infection (4) leading to various degrees of pathological changes of both soft tissue and bone structures in the claw. Complicated claw lesions are described as being exceptionally painful (5). Therefore, it is important to have clearly defined clinical findings that aids in decision making for diagnosis, therapy and prognosis of complicated claw lesions.The purpose of this study was to evaluate the association between findings on inspection and palpation and with irreversible changes of structures within the claw.

Materials and methods

A case-control study performed on 152 hind claws from 42 Danish Holstein cows collected at an abattoir. All claws were palpated for firmness of the heel bulb (0=soft, 1=firm when elasticity to pressure was partially or completely impaired). Cows with firm heel bulb on one or both feet were assigned to the test group (74 feet from 42 cows). Cows in the control group had four soft (normal) heel bulbs (**6** feet from 3 cows). Lesions, dorsal wall shape, toe width, heel width, heel bulb width, and height were recorded (6,7). Following sagittal section of the claws, toe and distal phalanx angles, fibrosis/degeneration of the digital cushion, digital phalanx displacement and new bone formation (exostoses and osteophytes) were recorded (1 = presence and 0 = absence).

Results

Mean parity for cows was 3.0 (parity range 1-7; SD 1.17) and mean days in milk was 290 (DIM range 35-526; SD 152.3). Nine cows had sole ulcer on one lateral claw and one with sole ulcers on both lateral claws. Twelve cows had white line disease in one lateral claw, of those two cows had white line lesions in both lateral claws. Asymmetry (<10%) was associated with firm heel bulbs ($P=0.015$). There were significant differences ($P<0.001$) between firm heel bulbs and control heel bulbs for concave dorsal wall, toe width, heel width, heel bulb width, and height. There were significant differences ($P<0.001$) between firm heel bulbs and control heel bulbs for fibrosis and degeneration of digital cushion, displacement of distal phalanx and new bone formation. Firm heels were associated with sole ulcer and white line disease ($P<0.001$).

Discussion

Asymmetry of claws and loss of elasticity in the heel bulb are both indicators of irreversible changes within the claw, characterized by fibrosis and degeneration of digital cushion, displacement of distal phalanx and new bone formation. Asymmetry and loss of elasticity should be considered during clinical evaluation of lame cows and claw lesions. There are many other indicators of inflammation and infection that should be used for the therapeutic decision making, but when it comes to valid prognostic indicators it is some times more difficult in the field in the farm with no access to x-ray or ultrasonography. The results from this study provides some valid indicators that can aid in the prognostic evaluation of the complicated cases.

Acknowledgements

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References

1.Warnick LD, Janssen D, Guard CL, Grohn YT. The effect of lameness on milk production in dairy cows. J Dairy Sci 2001 (84): 1988-1997.

2.Sogstad AM, Osteras O, Fjeldaas T, Nafstad O. Bovine claw and limb disorders related to culling and carcass characteristics. 2007. Livestock Sci (106):87-95.

3.Garbarino EJ, Hernandez JA, Shearer JK, Risco CA, Thatcher WW. 2004. Effect of lameness on ovarian activity in postpartum Holstein cows. J Dairy Sci 2004 (87:12):4123-4131.

4.Blowey R, Nazhvani SD. Lameness in dairy cows. Iranian Journal of Veterinary Surgery. 2007 (24:4): 69-82.

5.Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown JM, Murray R, Paton RJ, Carter SD. 2011. Association between bovine digital dermatitis treponemes and a range of 'non-healing' bovine hoof disorders. Vet Rec 2011 (168:8): 214-217.

6.Lischer CJ, Ossent P, Raber M, Geyer H. Suspensory structures and supporting tissues of the third phalanx of cows and their relevance to the development of typical sole ulcers (Rusterholz ulcers). Vet Rec 2002 (151:23):694-698

7.Nuss K, Sauter-Louis C, Sigmund B. 2011.Measurements of forelimb claw dimensions in cows using a standardised sole thickness: a post-mortem study. Vet Jour 2011 (190:1):84-89.

Livestock Sci 2011 (106):87-95.

Keywords: Asymmetry; Complicated claw lesion; Dairy cow; Heel bulb; Palpation

12 SMALL RUMINANTS

49 Influence Of Dietary Zinc Source On The Morphology, Integrity, Proliferation And Biomechanics Of The Claw And Interdigital Skin Of Healthy Sheep

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Introduction

Claw diseases threaten sheep health and are major welfare issues. Several studies have shown that zinc supplementation improves claw integrity. However, zinc supplements may differ markedly regarding zinc bioavailability. Zinc bound to single amino acids, such as Availa®Zn zinc amino acid complex (Zinpro Corporation, Eden Prairie, USA) has been shown to be more bioavailable than inorganic zinc sources. The objective of this study was to determine the effect of different zinc supplements on the morphology, integrity, proliferation and biomechanics of the ovine claw and interdigital skin.

Material and Methods

At weaning 30 Merino lambs were randomly allocated to three different feeding groups regarding the pelleted concentrates: 1) no supplemental zinc (**0Zn**); 2) 40 mg/kg Zn as zinc sulphate (**SZn**); 3) 40 mg/kg organic zinc as zinc amino acid complex (**CZn**). Barley straw and concentrate were given ad-libitum. The diets were designed to meet the nutritional requirements for growing lambs and contained 210 g/kg DM crude protein and 13 MJ/kg DM metabolizable energy. All specimens analyzed in this study were collected postmortem. After 8 weeks the lambs were slaughtered and the following specimens were collected immediately after death: blood serum, liver, head of femur, sole and coronary band of the claw, interdigital skin. Claw and skin samples were fixed in 4% formaldehyde and submitted to pathohistological examination. Ki-67 immunohistochemistry was used to determine keratinocyte proliferation in the basal layer. Samples for electron microscopy were preserved in 2.5% glutaraldehyde with 1% lanthanum nitrate as tracer to assess intercellular permeability. Horn sample of fresh claws were submitted to Shore-C hardness and tensile strength testing (2,6,9). The Franz-Cell-Diffusion System was used to determine the permeability of the interdigital skin (5). Statistical analysis was conducted using the Shapiro-Wilk-Test, Analysis of variance, the Tukey-Test and the Wilcoxon Rank Sum Test.

Results and Discussion

The preliminary results indicate that dietary treatment did not affect concentrations of zinc and copper in serum and liver. These findings are in agreement with those from previous studies (1,3,7,8). 0Zn lambs showed higher claw horn copper concentrations ($p<0.05$) compared to both zinc supplemented groups (mean ± SD: 8.6±1.6, 5.9±2.3, 4.3±1.4 mg/kg wet weight (ww) for 0Zn, SZn, CZn, respectively). Zinc interacts with several metals like copper. That could be a possible reason for the higher copper concentration in claw horn of 0Zn lambs than in zinc supplemented lambs. Claw horn zinc concentration was not affected by dietary treatment. Zinc concentration in claw horn (median, interquartile range (IQR)) was 89.9 mg/kg ww, IQR 76.0-97.1 (0Zn); 97.0 mg/kg ww, IQR 92.2-103.1 (SZn); 84.3 mg/kg ww, IQR 67.2-87.0 (CZn). Routine pathohistology did not show significant morphological differences between the three dietary treatment groups. However, proliferation (Ki-67 proliferation index) was significantly higher in the CZn group compared to the 0Zn group. There was a trend towards elevated proliferation in the SZn group. Stimulation of keratinocyte proliferation by zinc has been reported in several in vitro studies and is in accordance with the established positive effect of zinc on wound healing (4). Dietary treatment did not affect Shore C hardness significantly. The Shore C values were numerically slightly higher in the SZn and CZn groups compared to the 0Zn group. Evaluation of results regarding zinc concentration of the head of the femur, electron microscopic assessment of the permeability of the intercellular space and tensile testing are in progress and will be discussed.

Acknowledgments

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References

1. Aliarabi H, Fadayifar A, Tabatabaei MM, Zamani P, Bahari A, Farahavar, Dezfoulian AH. Effect of Zinc Source on Hematological, Metabolic Parameters and Mineral Balance in Lambs. Biol Trace Elem Res 2015 (168): 82-90

2. Collis VJ, Green LE, Blowey RW, Packington AJ, Bonser RH. Testing white line strength in the dairy cow. J Dairy Sci 2004 (87): 2874-80.

3. Droke EA, Gengelbach GP, Spears JW. Influence of Level and Source (Inorganic vs Organic) of Zinc Supplementation on Immune Function in Growing Lambs. Asian-Australas J Anim Sci 1998 (11): 139-144

4. Emri E, Miko E, Bai P, Boros G, Nagy G, Rózsa D, Juhász T, Hegedűs C, Horkay I, Remenyik É, Emri G. Effects of non-toxic zinc exposure on human epidermal keratinocytes. Metallomics. 2015 (3):499-507.

5. Franz TJ. Percutaneous absorption on the relevance of in vitro data. J Invest Dermatol 1975 (64): 190-195.

6. Hinterhofer C, Zöscher M, Gabler C, Stanek C. The hardness of horn in different segments of the bovine claw. Berl Munch Tierarztl Wochenschr 2005 (118): 334-40.

7. Kinal S, Slupczynska M. The bioavailability of different chemical forms of zinc in fattening lambs. Archiv Tierzucht 2011 (4): 391-398.

8. Siciliano-Jones JL, Socha MT, Tomlinson DJ, DeFrain JM. Effect of Trace Mineral Source on Lactation Performance, Claw Integrity, and Fertility of Dairy Cattle. J Dairy Sci 2008 (91): 1985-1995

9. Zenker W, Josseck H, Geyer H. Histological and physical assessment of poor hoof horn quality in Lipizzaner horses and a therapeutic trial with biotin and a placebo. Equine Vet J 1995 (27): 183-191.

Keywords: zinc, ovine claw, interdigital skin, epidermal proliferation, sheep

50 Survival Of Contagious Ovine Digital Dermatitis (CODD) Associated Treponemes On Disposable Gloves After Handling CODD Affected Feet

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Introduction

Bovine DD is distributed worldwide and CODD is now common in the UK and Republic of Ireland with approximately 35-53% of UK farms affected (Duncan et al., 2014). Many consider that contact between animals is the most likely route of transmission, although the isolation of treponemes from hoof trimming knives (Sullivan et al 2014) has raised the issue that manual transmission may be involved. When treating infected feet, wearing gloves is a reasonable personal hygiene and biosecurity measure. The objective of this study was to investigate the potential to transmit CODD associated *Treponema* spp. via gloves.

Method

Twelve sheep affected by CODD were handled for routine foot examination. Five clean sterile gloves were used for each CODD affected foot, each being used to examine the affected foot in the same way. At the laboratory gloves were placed on a sterile tray at room temperature and exposed to the air. Each day, two dry sterile cotton swabs were used to take a sample of material from one glove per case. One swab was then inoculated into media for culture to ascertain viability, whilst the other was subject to diagnostic PCR analyses. This process was then repeated using a different glove, for five consecutive days to determine the length of time bacteria could remain detectable and remain alive and therefore potentially viable and infectious.

Results

For *Treponema. medium*, bacteria were cultured from gloves from eight sheep (67% (95%CI: 33-89%)) and were viable for up to one day. For *Treponema phagedenis*, bacteria were cultured from gloves from nine sheep (75% (95%CI: 43-95%)) and detected by PCR from 10 (83% (95%CI: 46-97%)). For *Treponema pedis*, bacteria were cultured and detected by PCR from eight ((67% (95%CI: 33-89%)). For both *T. phagedenis* and *T. pedis*, the treponemes were viable for up to three days (median 2 days (range 0-3 days)). For all the sheep where treponemes were detected from the gloves by PCR, the treponemes remained detectable for all five days (Table 1).

Animal ID	Detection Method	Day treponemes were detected				
		1	2	3	4	5
40	Isolation	1,2,3	2,3	-	-	-
	PCR	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3
37	Isolation	1,2,3	2,3	2,3	-	-
	PCR	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3
39	Isolation	2,3	2, 3	-	-	-
	PCR	2,3	2,3	2,3	2,3	2,3
46	Isolation	1,2	2	-	-	-
	PCR	1,2	1,2	1,2	1,2	1,2
48	Isolation	1,3	3	-	-	-
	PCR	1, 3	1, 3	1, 3	1, 3	1, 3
35	Isolation	2	2	-	-	-
	PCR	2	2	2	2	2
7	Isolation	1,3	3	-	-	-
	PCR	1, 3	1, 3	1, 3	1, 3	1, 3
4	Isolation	1,3	3	-	-	-
	PCR	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3
12	Isolation	2	2	-	-	-
	PCR	2	2	2	2	2
14	Isolation	2,3	2, 3	-	-	-
	PCR	2,3	2,3	2,3	2,3	2,3
44	Isolation	1,2	2	-	-	-
	PCR	1,2	1,2	1,2	1,2	1,2
42	Isolation	1,2,3	2,3	2,3	-	-
	PCR	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3

Table 1. Detection of isolates by phase contrast microscopy (isolation) and PCR analysis of swabs taken from gloves used to handle CODD affected feet and sampled daily. Greyed out boxes indicate no treponemes were isolated from the swab.

Key: 1 - *T. medium* phylogroup, 2 - *T. phagedenis* phylogroup and 3 - *T. pedis* phylogroup.

Discussion

This study shows that CODD associated treponemes can survive and remain viable on the gloves of personnel working with CODD affected sheep feet. The high percentage (91% (95%CI: 69-98%)) of gloves that were contaminated reiterates the importance of control measures both between sheep and between farms, for example changing or cleaning gloves. In a recent study (Angell et al in press) use of hand soap and common disinfectants removed live bacteria, and in most cases, all traces of bacterial DNA. The survival of treponemes on gloves for 2-3 days in air in this study suggests that these bacteria may not be strict anaerobes, but may be able to tolerate oxygen for short periods

Acknowledgments

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References

Duncan JS, Angell JW, Carter SD, Evans NJ, Sullivan LE, Grove-White DH. Contagious ovine digital dermatitis: an emerging disease. Vet J. 2014;201:265-8.

Sullivan LE, Blowey RW, Carter SD, Duncan JS, Grove-White DH, Page P, Iveson T, Angell JW, Evans NJ. Presence of digital dermatitis treponemes on cattle and sheep hoof trimming equipment. Vet Rec. 2014;175:201.

Key words – DD, transmission gloves

51 Treatment And Outcome Of Limb Fractures In 32 Small Ruminants

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Introduction

Reports of treatment of small ruminant limb fractures are rare (*Kaneps et al, 1989; Morin et al, 1989; Anderson and St-Jean 1993; Adamiak 2010; Piórek et al, 2012*) and describe individual or just a few cases only. The objective of the present study was to evaluate the records of a larger number of small ruminant patients treated due to limb fractures during the period from 2001 to 2014.

Material and Methods

The records of 32 small ruminant patients of one University Clinic suffering from limb fractures were analyzed retrospectively regarding the species, breed, and age of the animals, the age, localization and the type of fractures, the applied treatment method (conservative, internal fixation) and the final outcome.

Results

The patients were 16 goats and 16 sheep (18 male, 14 female) of various breeds with a mean age of 1.5 years (± 29.1 months) and a mean body weight of 37.8 kg (± 23.6 kg) showing in total 35 fractures. The age of the fracture ranged between one and six days in 23 animals (71.8%), from 12 to 60 days in five animals (15.6%), and was not known in four (12.5%) other animals. In 20 (57.1%) fractures were located in the rear limb and in 15 cases (42.9%) in the forelimb. Fractures involved most frequently the femur (28.6%), followed by the radius and ulna (22.8%), the metatarsus (20.0%) and the metacarpus (14.3%). In 17 animals (63.0%) the fractures had been treated conservatively (by one person JK) by cast application and finally in eleven animals (40.7%) an internal fixation (Table 1) was carried out (by one person BV). The success rate by conservative treatment was 94.1%, and 81.9% by surgical treatment. In six animals (22.2%) complications were observed during and after fracture treatment, however four out of them had a good final outcome. Two goats with femoral fractures had to be euthanized, one intraoperatively due to fragmentation of the femur during insertion of Kirschner-drill wires and the other due to postoperative femoral instability caused by implant loosening. The age and the body weight of the animals and the age of the fracture were not statistically correlated with the treatment success. However, a general tendency was observed that the success rate decreased with a higher age of the fracture.

Discussion

Due to these results with an overall success rate of 92.6% for treatment of limb fractures in small ruminants it has to be recommended that even in practice in particular the conservative treatment of limb fractures in sheep and goats should be carried out. These species are ideal fracture patients due to their low body weight (*Kaneps et al. 1989*). In particular metacarpal, metatarsal and phalangeal fractures in small ruminants, that can be diagnosed frequently already by careful and thorough clinical palpation, proved to be very suitable for conservative treatment. In contrast, for proximal limb fractures, the internal fixation (*Kaneps et al. 1989; Anderson and St-Jean 1993; Nuss et al, 2011; Piórek et al, 2012*) is the applied method of choice.

Surgical treatment technique	Localisation of fracture	Outcome
Intramedullar Kirschner-drill wires & plate	Femoral diaphysis	successful
Intramedullar Kirschner-drill wires & plate	Femoral diaphysis	successful
Intramedullar Kirschner-drill wires & plate	Femoral diaphysis & additional fissures reaching proximally	euthanized due to intraoperative fragmentation of femur
Insertion of two Kirschner-drill wires in a cross-shape manner	Distal femoral physeal fracture (Salter-Harris type I)	successful
Insertion of two Kirschner-drill wires in a cross-shape manner & wire cerclage	Apophyseal fracture of major trochanter & distal metatarsal physeal fracture	euthanized 10 days after surgery due to instability of the implants
Internal fixation with 2 plates	Metatarsal diaphysis	Mild lameness
Internal fixation with 2 plates	Metatarsal diaphysis *	successful
Internal fixation with 2 plates	Diaphysis of radius & ulna	successful
Insertion of two Kirschner-drill wires in a cross-shape manner & wire cerclage	Apophysis of tuber calcis	successful
Limb amputation	Metacarpal diaphysis: infected fracture with extended osteolysis of large parts of the bone	successful
Limb amputation	Infected fracture of tibial diaphysis & purulent arthritis of fetlock joint of the same limb	successful

Table 1: Surgical treatment techniques and outcomes in 10 (11*) animals;
* in one sheep an internal fixation was applied after an unsuccessful conservative treatment

References

Adamiak Z 2010 Use of semicircular external fixators to treat tibial, radial and ulnar fractures in sheep. Vet. Rec., 166: 335-337.

Anderson DE, St-Jean G 1993 Repair of fractures of the radius and ulna in a ewe using positive profile transfixation pins and casting. Can. Vet. J., 34: 686-688.

Kaneps AJ, Schmotzer WB, Huber MJ, Riebold TW, Watrous BJ, Arnold JS 1989 Fracture repair with transfixation pins and fiberglass cast in llamas and small ruminants. J. Am. Vet. Med. Assoc., 195 (9): 1257-1261.

Morin DE, Smith RM, Kneller SK, Whiteley HE 1989 Fractured capital femoral epiphysis in twin ewes. J. Am. Vet. Med. Assoc., 195 (10): 1387-1390.

Nuss K, Spiess A, Feist M, Köstlin R 2011 Treatment of long bone fractures in 125 newborn calves – retrospective study. Tierärztl. Prax. 39 (G): 15-26.

Piórek A, Adamiak Z, Zhalniarovich Y, Jaskólska M 2012 Treatment of tibial shaft fractures in sheep using interlocking nails, Schranz screws and type I external fixators. Pol. J. Vet. Sci., 15: 651-659.

Key Words: Limb fractures, cast, internal fixation, sheep, goat, small ruminants

52 Different Transmission Routes Of Footrot

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Introduction

Footrot is a contagious bacterial disease affecting the claw of sheep and other ungulates (Bennett and Hickford, 2011). It is a multifactorial disease and Dichelobacter nodosus (DN) is known as the causative agent, while Fusobacterium necrophorum plays a secondary role in the pathogenesis (Egerton et al., 1969). D. nodosus occurs naturally on claws only. A study found that the prevalence of footrot increases with a higher frequency of routine foot trimming (Wassink et al., 2003). Currently little is known about the vector-associated transmission of DN. Regarding a possible elimination program in Switzerland, more research is needed to evaluate transmission of this bacterium. The aim of the presented study was to investigate different transmission routes of DN, and further testing disinfection protocols.

Materials and Methods

The study protocol was approved by the animal experimentation committee of the canton of Bern, Switzerland (permission # 27632). All sheep included in the study showed a footrot score ≥ 2 according to the scoring system (http://bgk.caprovis.ch/cms09/showsingle.asp?lang=1&urlid=9) adapted from (Egerton and Roberts, 1971). A swab was taken from the outer rim of the lesion to show that *DN* can be isolated under the given conditions, and then all underrun claw horn material was removed using a sterilised trimming knife. After having trimmed all feet of one animal, the entire knife blade was sampled with a sterile cotton swab and then streaked out on a 4% hoof agar plate (Stewart and Claxton, 1993). Additionally fingerprints, trimmed claw horn material and boot samples were investigated during the study. All swab samples were, after being streaked out on a plate, soaked into Lysis buffer. So it was possible to analyse the samples using RT-PCR (Stauble et al., 2014).

Results

Lesions of 62 animals were sampled in order to culture *DN*, and the isolation was successful in 95.2% (59/62) of the cases. The Trimming-knives were tested by swabbing 86 blades. Isolates of DN were obtained in 89.5% of these cultures. Fingerprints were in 52.5% and claw horn material in 82.4% positive for viable *DN*. It was not possible to isolate *DN* in any boot sample. However, it was observed that all boot samples were positive in the PCR for the virulent genotype of *DN*.

Discussion

Generally, it can be concluded that the used trimming knives and the removed claw horn material are highly susceptible to transmitting viable *DN*. Important is to disinfect the knives and also the correct disposal of the trimmed claw horn material (waste incineration). Concerning potential transmission by the hands of the claw trimmer, which were positive in more than half of the cases, disposable gloves should be worn during foot trimming. The boots have the lowest transmission risk, but they cannot be excluded as vector, given that all PCR results were positive for virulent strains of *DN*.

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References

Bennett, G.N., Hickford, J.G., 2011. Ovine footrot: new approaches to an old disease. Vet.Microbiol. 148, 1-7.

Egerton, J.R., Roberts, D.S., 1971. Vaccination against ovine foot-rot. J. Comp. Pathol. 81, 179-185.

Egerton, J.R., Roberts, D.S., Parsonson, I.M., 1969. Aetiology and Pathogenesis of Ovine Foot-Rot .I. A Histological Study of Bacterial Invasion. J. Comp. Pathol. 79, 207-215.

Stauble, A., Steiner, A., Frey, J., Kuhnert, P., 2014. Simultaneous detection and discrimination of virulent and benign Dichelobacter nodosus in sheep of flocks affected by foot rot and in clinically healthy flocks by competitive real-time PCR. J. Clin. Microbiol. 52, 1228-1231.

Stewart, D.J., Claxton, P.D. 1993. Ovine foot rot: Clinical diagnosis and bacteriology, In: Corner, L.A., Bagust, T.J. (Eds.) Australian standard diagnostic techniques for animal diseases. CSIRO Publications, Victoria, Australia, 1-27.

Wassink, G.J., Grogono-Thomas, R., Moore, L.J., Green, L.E., 2003. Risk factors associated with the prevalence of footrot in sheep from 1999 to 2000. Vet. Rec. 152, 351-358.

Keywords: Footrot, *Dichelobacter nodosus,* Transmission, culture, trimming knife

P 12-1 Foot Disorders Causing Lameness: Prevalence And Clinical Findings In Sheep Presented To The Veterinary Teaching Hospital, University Of Abuja, Nigeria

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Introduction

Lameness due to foot disorder represents the third most important health-related cause of economic loss in ruminant (Booth *et al.,* 2004). It results in significant reduction in productivity of small ruminant (Aliyu *et al.,* 2005).

Materials and Methods

A study was conducted to investigate the prevalence and type of foot disorders causing lameness in sheep presented to the Veterinary Teaching Hospital (VTH), University of Abuja, Nigeria, from January 2016 to December 2016. The affected sheep, feet involved and lesion type were recorded. In sheep that had foot pathologies, swabs were also taken for culture.

Result

A total of 59 sheep were presented to the VTH with lameness. Foot disorders accounted for lameness in 54 (91.5%) sheep while systemic diseases were the cause of 5 (8.5%) lame sheep. All the sheep were on semi management feeding system. Hoof overgrowth (10/18.51%), Foot rot (20/37.03%), Interdigital pouch infection (5/9.25%), automobile accident fracture (8/14.81%) and fracture from animal trap (6/11.11%) were the type of foot disorder seen. Of the affected sheep, 12(22.22%) had one foot affected, 20 (37.03%) had two feet affected while 22 (40.74%)) had all four feet affected.

Conclusion

Animal owners should be well informed on the risk factors associated with foot rot, because the disease is a major cause of lameness in sheep. In addition, the practise of semi-intensive management system should also be discouraged in environments with harsh and rugged terrain, and abrasive vegetation. These will reduce the incidence and prevalence of lameness in sheep.

References

C. J. Booth, L. D. Warnick, Y. T. Grohn, D. O. Maizon, C. L. Guard, D. Janssen. 2004. Effect of lameness on culling in dairy cows. *J. Dairy Sc.,* 87: 4115

M. M. Aliyu, M. M. Bukar and A. B. Zira. 2005. Occurrence of small ruminant lameness in Maiduguri and its environs. *Sokoto Journal of Veterinary Sciences,* vol. 6 (supplement)

P 12-2 Digital Radiographic Of Distal Extremities Of Limbs In Sheep With Acute Ruminal Lactic Acidosis Experimentally Induced

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Introduction

The intensification of sheepmeat industry has led to the emergence of some diseases such as nutritional and metabolic disorders (1). The acute ruminal lactic acidosis (ARA) is known to cause economic losses (2), and this disorder is a result of rapid and excessive intake of easily fermentable carbohydrates, causing different clinical signs (3). The clinical evolution of laminitis caused by ARA in sheep is an underexplored subject in research. The development of reliable diagnostic method can help control it, and this study aimed to verify the effectiveness of digital radiological examination as a diagnostic tool of laminitis in sheep with ARA.

Materials and Methods

It was used 10 healthy ewes, kept in pens and maintained on a basal diet of Tifton hay *ad libitum*, with free access to water and mineral mixture. Three times before the beginning of the experiment, it was obtained, weekly, digital X-ray images of distal extremities of all limbs (control images). For ARA induction, the animals received 15 g/kg of body weight of sucrose orally, and the X-rays analysis were performed at the following moments: 24, 48, 72, 96, 120,144 hours; and on the second, third and fourth week completing one month. Radiographic images of the podal region of all limbs, in anterior-posterior position, were obtained in direct digital X-ray equipment (Portable DR system PDX-1417, Poskom Co.), under physical restraint in hoof trimming crush, using 2.9 kV and 60 mAs. This study received ethical approval from Ethics Commission in Use of Animals (Protocol nº 03888/14).

Results

All animals developed ARA and five of them showed clinical signs of acute laminitis that started with 24 hours and were evident until 72 hours. Although the clinical signs were noticed, the X-rays images showed that during the period it could not be detected any radiographic changes indicative of laminitis and no other pathological alteration in the region. The lateral-medial position was not used, because the digits overlapping occurred and it was not possible to evaluate the occurrence or not the rotation and displacement of the distal phalanx.

Figure 01: X-Rays at dorsalpalmar (A and B) and dorsalplantar (C and D) of sheep digits: thoracic digits before ARA induction (A) and four weeks later (B); pelvic digits prior to ARA induction (C) and (D) at the fouth week. L: left digits; R: right digits.

Discussion

It is noticed that the use of digital radiography facilitates the scientific research by the short time required to obtain the image, the possibility of immediate analysis and the high quality of the images. Although it was observed clinical signs of acute laminitis, during all experimental period it could not be detected any X-rays changes indicative of laminitis and no other pathological alteration at three phalanges. It can be concluded that digital radiology is not an efficient tool for early detection of laminitis in sheep, besides the occurrence of acute laminits after ARA experimental induction.

Acknowledgements

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References

1 - Vieira ACS, Afonso JAB, Mendonça CL., Costa NA., Souza M. Estudo retrospectivo da acidose láctica em caprinos e ovinos atendidos na Clínica de Bovinos, Câmpus Garanhuns/UFRPE. Revista Brasileira de Ciências Agrárias, 2006 (1): 97-101.

2 - Dirksen G. Enfermedades de los órganos digestivos y lapared abdominal. In: Medicina Interna y Cirugía del Bovino. Dirksen G, Gründer HD, Stöber M, eds. Buenos Aires: Editorial Inter-Médica 2005; 325-631.

3 - Barros NN, Simplício AA, Fernandes FD. Terminação de borregos em confinamento no Nordeste do Brasil. Sobral: Embrapa-cnpc, 1997 24p.

Keywords: acute lactic ruminal acidosis, laminitis, sheep, X-ray.

P 12-3 Survey Screening For Footrot Resistant Gene Markers In US Hair Sheep And Their Crossbreds

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Introduction

Footrot is one of the most costly and impactful animal welfare diseases in the small ruminants. Sporadic footrot outbreaks in sheep, goat, and cow herds have been reported frequently throughout the US region (1,2). In Missouri, sheep and goat breeding stock numbers are steadily increasing and becoming a major alternative income source for diversified farming enterprises. Therefore, developing a sustainable breeding program for genetic resistance to footrot is a tangible, long-term strategy for sheep producers. The Major Histocompatibility Complex (MHC) is thought to be controlled by a group of genes that plays a central role in the immune response of vertebrates. The polymorphisms in the MHC region indicate an immune response to footrot infections in sheep and cattle (2,3,4). The putative gene group DNA marker (DQA2) is being developed for marker assisted selection (3,5) in sheep. Experimental use of animals was approved (#2010 Rev) by ACUC of Lincoln University.

Materials and Methods

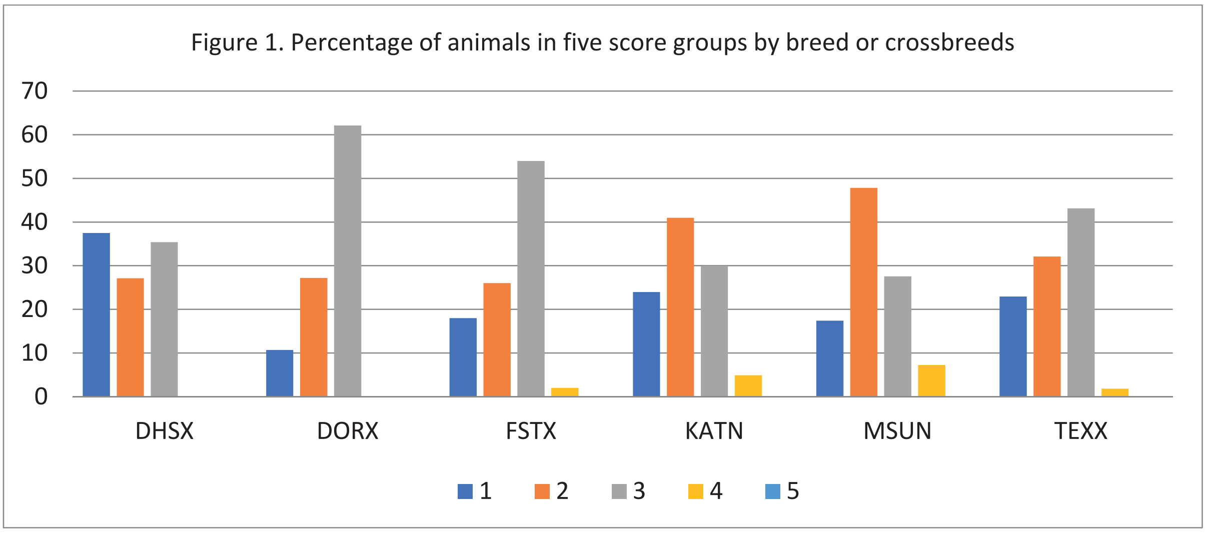
Blood samples were collected from Katahdin, Dorper, and crossbred sheep from Lincoln University and collaborating farms. Blood specimens were collected on FTA blood DNA collection paper cards. DNA extraction and the gene marker test were performed at Lincoln University Gene Marker Laboratory in New Zealand. The footrot gene marker test reports in five basic footrot scores (1, 2, 3, 4 and 5) corresponding to alleles of the MHC DQA2 and DQA2-like loci. This gives 15 possible score combinations (1,1; 1,2; 1,3; 1,4; 1,5; to ... 5,5), where 1,1 is claimed to have the highest and 5,5 is the lowest resistance to footrot infection. However, footrot resistant genes are assumed to exert a dominant effect, therefore, animals were classed into five categorical group orders (1, 2, 3, 4, and 5). A chi-square test was used to validate difference in variant alleles, animal genotypes, and score group distribution frequency.

Results

There were 1055 sheep samples returned with gene marker test results. Variant allelic distribution for five score groups 1, 2, 3, 4, and 5 were 22.5%, 37.8%, 35.7%, 3.9%, and 0.1% respectively. Both allelic distribution and genotypic distributions were significantly ($P < 0.01$) different among the five score groups. The ratio of animals in the footrot resistant groups (I and 2) combined to be the larger portion of the flock at 60.3%. Animals classed by breed or crossbreeds in five score groups indicated the trend that showing high frequency in score group 1, 2, and 3 (Figure 1). Whereas, animals with lower resistant scores (4 or 5) were presented zero to 7% by breed or crossbreds.

Discussion

The selection and response to footrot resistant gene marker screening in sheep were undocumented for US hair sheep. Heritability for footrot resistance in the Merino was estimated from 0.09 to 0.41 (6). However, no difference was reported for footrot resistance in the progeny of different maternal or paternal breeds (7). This experiment indicated that an adoption of molecular genetic marker screening for footrot resistant trait may have a greater advantage over the traditional subjective or objective assessments for sheep selection.



Legend: DHSX: Dorset, Hampshire, Suffolk or crossbreds; DORX: Dorper or Dorper crossbreds; FSTX: Florida Native, St. Croix, Tunis or crossbreds; Katahdin or Katahdin crossbreds; MSUN: Misc. and mixed crossbreds; TEXX: Texel or Texel crossbreds.

References

1. Espejo LA, Endres MI, Salfer JA. Prevalence of lameness in high-producing Holstein cows housed in freestall barns in Minnesota. J. Dairy Sci. 2006 (89):3052–3058.

2. Casas E, Snowder GD. A putative quantitative trait locus on chromosome 20 associated with bovine pathogenic disease incidence. J. Anim. Sci. 2008 (86):2455-2460.

3. Escayg AP, Hickford JGH, Bullock DW. Association between alleles of the ovine major histocompatibility complex and resistance to footrot. Research in Veterinary Science 1997 63 (3):283-287.

4. Hickford JGH, Zhou H, Slow S, Fang Q. Diversity of the ovine DQA2 gene. Journal of Animal Sciences 2004 (82):1553-1563.

5. Hickford J. Development of a sustainable method of natural footrot control. Report to the NZ Meat Research and Development Council. NZ: Lincoln University 2000; 1-100.

6. Raadsma HW, Egerton JR, Wood D, Kristo C, Nicholas FW. Disease resistance in Merino sheep.III. Genetic variation in resistance following challenge and subsequent vaccination with an homologous rDNA pilus vaccine. Journal of Animal Breeding and Genetics 1994 111 (5-6):367-390.

7. Burke JM, Parker CF. Effect of breed on response to footrot treatment in mature sheep and lambs. Small Ruminant Research 2007 (71):165-169.

Keywords: Hair sheep, Katahdin, Allele, Footrot resistant gene marker

P 12-4 Digital Contrast Venography In Sheep And Goat: Technical Failures

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Introduction

Venography is a radiographic contrast diagnosis technique applicable in different species. In ruminants can be used to predict vascular pattern of the limbs in foot diseases (1).

Materials and Methods

Ten sheep and ten goats, adults and clinically healthy were submitted to all limbs distal venography. The animals were sedated with intravenous Diazepam (0.3 mg/kg), restrained and positioned in lateral recumbency during the venograms. A rubber tourniquet was tied in the proximal metacarpus and metatarsus, followed by a scalp vein (21G) anterograde venopunction. The medial deep branch of the radial vein was used in the forelimbs of both species for venopunction (4). The dorsalis pedis vein was used in sheep's hindlimbs, whereas the deep branch of the III dorsal metatarsal vein was used in goats' hindlimbs (Santos et al. 2015). The x rays were performed 30 - 45 seconds after administration of 10 mL of diatrizoate meglumine 60% (Reliev®) trough a 10 mL hand-held leur-lock syringe attached to the distal end of the scalp tubing. The scalp was removed from the vein right after the contrast was administered. The images were acquired through digital radiography (Vatech®) with radiographic exposure of 60 kVp, 5 mAs and 70 cm film focus distance. The X-rays were performed in lateromedial, dorsopalmar, dorsoplantar, plantodorsal and palmorodorsal projections. The venograms were analyzed using the EcoView® software.

Results

All animals showed limb retraction at the time that the contrast was injected. Local swelling was observed in 20% (2/10) of the sheep´s limbs and in 10% (1/10) of the goats' and derived from contrast perivascular extravasation (Fig. 1). The predominance was in the thoracic limb of sheep.

Discussion

Venographic exams can help understanding etiology of digital vascular disorders in locomotor diseases. Studies regarding normal venograms in ruminants can be found in the literature (1, 2, 3, 4). On the other hand, no reports concerning technical failures of venographic exam in small ruminants were conducted.

Limbs' retraction during the contrast injection could be associated with heating sensation (low pH of the contrast) and venous distention. This problem can be avoided with anesthetic block use (4).

Fig. 1: Venograms of the distal region of metatarsus; proximal, middle and distal phalanges in sheep hindlimb. Normal venograms (A, C) and venograms with perivascular contrast extravasation (B, D). (Digital X-ray: 60 kVp; 5 mAs).

Acknowledgements
CAPES and *FUNDUNESP.* Approved by the committee of ethics CEUA-FMVZ 65/2011.

References

1. Burns J, Cornell C. Angiography of the caprine digit. Vet. Radiol. Ultrasound 1981 (22):174-176.

2. Murli M, Kumar R, Bhargava AK, Tyagi RPS. Angiographic studies of the bovine (*Bubalis bubalis*) foot.

Vet Rad 1973 (14):81-86.

3. Nazhvani SD, Abbasi S, Tadjalli M. Arteriographical Evaluation of Normal Digit and Hoof in Goat. Iran J Vet Surg 2007 (2):43-48.

4. Santos IFC, Hussni CA, Rodrigues CA, Watanabe MJ, Alves ALG, Charlier M. Técnica venográfica contrastada in vivo dos dígitos de ovinos e caprinos. Arq. Bras. Med. Vet. Zootec 2015 (67):1630-1638.

Keywords: venography, sheep, goat, x ray.

13 UNGULATAE

53 Claw Health Assessment In Fattening Pigs

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Introduction

Lameness in pigs is one of the major reasons for culling and early loss in pig fattening. As a suspected cause of lameness several aspects and contexts like feeding, housing and breeding have been discussed. The present study was conducted to evaluate the claw health of two groups of fattening pigs, which were housed in different housing systems.

Material and Methods

A number of 64 pigs were studied. This number is divided in two experimental groups: group I (Piétrain x German Landrace (Pi-GL); n=30) and group II (Piétrain x Piétrain-Duroc (Pi-PiDu); n=34). All animals received a claw health check (CCI) at day 74 of life. After CCI, each group was divided into two subgroups, which were randomly splitted in two housing condition: OCB (outdoor climate barn, with deep straw on concrete floor) and FSF (fully slatted floor). All animals were kept according to the German national animal welfare regulations (1-3). With an age of 150 days a second claw health check (CCII) was performed.During claw check, 9 parameters were assessed including the claw angle of the outer claw of each leg. For all claw parameters, a chi square test was used to identify significant differences regarding housing or genetic. Additionally a GLM was used to analyse the claw angle data.

Results

The results show significant differences between the genetic lines and the housing system. Bleeding in the wall is not detected in OCB, but in FSF. More animals show an extension of the dew claw in FSF. Additionally, cracks in the wall are more often detected in Pi-PiDu than in Pi-GL. The claw angle is significantly higher in Pi-GL than in Pi-PiDu (CCII).

Discussion

Significant differences could be obtained although the number of experimental animals is small. Further research is necessary to evaluate the impact of these detected claw health issues and to evaluate the impact on lameness in pigs. To generate data about genetic differences additionally pure breeds have to be examined.

Acknowledgements

This project was financially supported by the Lehre@LMU project of the Ludwig-Maximilians-Universität Munich (LMU), funded by the German Ministry of Education and Research (grant 01PL12016).

References

1 Tierschutzgesetz in der Fassung der Bekanntmachung vom 18. Mai 2006 (BGBl. I S. 1206, 1313), das durch Artikel 4 Absatz 90 des Gesetzes vom 7. August 2013 (BGBl. I S. 3154) geändert worden ist. Neugefasst durch Bek. v. 18.5.2006 I 1206, 1313; zuletzt geändert durch Art. 1 G v. 4.7.2013 I 2182 (Animal Protection Law). http://www.gesetze-im-internet.de/tierschg

2 Verordnung zum Schutz landwirtschaftlicher Nutztiere und anderer zur Erzeugung tierischer Produkte gehaltener Tiere bei ihrer Haltung (TierSchNutztV) in der Fassung der Bekanntmachung vom 22. August 2006 (BGBl. I S. 2043), die durch Artikel 1 der Verordnung vom 1. Oktober 2009 (BGBl. I S. 3223) geändert worden ist. Neugefasst durch Bek. v. 22.8.2006 I 2043; geändert durch Art. 1 V v. 1.10.2009 I 3223. http://www.gesetze-im-internet.de/tierschnutztv/index.html

3 Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes. *Off J Eur Union L276*, 33-79. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0033:0079:en:PDF

Keywords: claw health, pig, claw angle

54 First Validation Of Three Different Sensor Technologies For Possible Lameness Monitoring In Sows

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Introduction

Lameness is a major problem in breeding sows due to its high prevalence (ranging from 5% to 35%), the related financial losses and impaired welfare of the sows. A better understanding and detection of lameness is crucial, e.g. for deciding when to cull or treat sows. Sensor technologies offer promising tools for monitoring individual sow behavior and thus provide possibilities for 'management-by-exception'. In this project, three sensor-technologies are validated in pilot studies: (1) electronic sow feeders (ESF) which provide data on feeding behavior, (2) Sow Stance Information System (SowSIS) which assesses the standing behavior of a sow and (3) individual positioning system (IPS) that provides data on the spatial behavior.

Materials and methods

All three sensor technology were validated at different levels in their development. For the Electronic Sow Feeder, variables relating to feeding behaviour were compared between groups of non-lame and lame pigs using the lameness scoring system developed by Nalon et al. (2014) [1]. For the IPS system, the location of tags (in time and space) were tested in a preliminary study using both static positions and dynamic positions of the tags (height of approximately 1 m). For the SowSIS system, several variables were tested for their applicability to detect lameness in sows by comparing them between groups of lame and non-lame sows [2].

Results

Feeding rank (P=0.040) and the maximum duration between visits (P=0.004) were significantly higher for lame sows compared to non-lame sows. Both the static and the dynamic tests show a satisfactory accuracy in time and space (error <0,5m) with a data loss less than 5 % and less than 10% respectively. Concerning the standing behavior of sows, relative weight exerted to the painful leg, weight shifts and number and duration of kicks were significantly different between groups of non-lame and lame sows (P<0.05) [2].

Discussion

The results of these pilot studies indicate that all three sensor technologies are promising for sow lameness monitoring. More specifically, lame sows seem to postpone their visits to the ESF, suggesting that they are less able to compete and/or more reluctant to walk to the feeder. The accuracy of the individual positioning system for sows in a barn environment shows great potential for automatically and continuously collecting data on sow locomotor behavior. However, the link of derived variables with lameness still needs to be investigated. Last, daily measurements of the standing behavior of individual sows shows great potential to support lameness research in sows.

Acknowledgements

The authors wish to thank all the technicians and pig-caretakers at ILVO for their support on the practical work.

References

Nalon E., Maes D., Van Dongen S., van Riet M.M.J., Janssens G.P.J., Millet S., Tuyttens F.A.M., 2014. *Comparison of the inter- and intra-observer repeatability of three gait-scoring scales for sows.* Animal 8, 650–659.

Pluym L., Maes D., Vangeyte J., Mertens K., Baert J., Van Weyenberg S., Millet S., Van Nuffel A., 2013. *Development of a system for automatic measurements of force and visual stance variables for objective lameness detection in sows: SowSIS.* Biosystem Engineering 116,64-74.

Keywords: Precision Livestock Farming, sow, SowSIS, ESF (electronic sow feeder), IPS (individual positioning system)

55 Identification, Classification And Diagnosis Of Treponeme Associated Hoof Disease In North American Wild Elk *(Cervus Elaphus)*

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Introduction

In early 2000s, free-ranging elk (*Cervus elaphus*) with abnormal hooves were reported in in the Cowlitz river basin, south-western Washington State, with numbers reaching epidemic proportions by 2008. Histopathology of the hoof lesions revealed changes to the keratinocytes (hyperkeratosis), lamellar perivasculitis, areas of necrotic ulceration and neutrophilic infiltrates, consistent with digital dermatitis (DD), a hoof disease of domestic livestock (Han and Mansfield, 2014). Spirochetes isolated from these lesions belonged to the family *Treponema*, and were genetically similar to those found in DD (Clegg *et al.*, 2014). Thus the elk hoof disease has been named Treponeme Associated Hoof Disease (TAHD). To date, TAHD has been concentrated on the rainy side of the Cascade Mountains, however sporadic cases occur extending northward into Olympic Peninsula, southward into Oregon and in the northeastern corner of Oregon in arid regions.

Materials and Methods

To address long term effects of TAHD on the Washington elk population, WDFW initiated a 5 year study in herds within the endemic area. Female elk in the Mount Saint Helens region were fitted with radio collars to monitor health status, survival and calf production. In addition, other heath metrics were collected at time of capture, including swabs of the feet to confirm presence of TAHD, photographs of the feet for disease severity scoring and blood for immunological assays.

Results

In the first year (February 2015), a total of 75 animals were live-captured, 76% had visible hoof abnormalities consistent with TAHD. Swabs were sent to USDA-research lab for culture and PCR testing. 17 of 30 samples sent were culture positive, 41% were PCR positive for *Treponema* associated with DD (*T. phagedenis, T. medium* and *T. pedis*) (Evans *et al.*, 2008). In the second year (December 2015), 45 elk cows were captured, including 29 from the previous February capture. 66% had visible hoof lesions in the field consistent with TAHD, 46% were culture positive and 75% were PCR positive for DD-associated treponemes. To track disease severity, a grading system similar to a scoring system published for CODD was developed (Angell et al., 2015). Most of the captured animals had lesions similar to grades 3 or 4 (partial or complete ulceration of coronary band or sole, sloughing of the hoof horn) and many had more than one foot with some stage of disease. This study is ongoing and data is continually being analyzed as annual winter captures continue.

Discusion/Conclusion

With the results of just the inital years of this studyundergoing analysis, some preliminary conclusions are being considered. The disease can progress rapidly. Several recaptured animals advanced from grades 0 (healthy) to 4 (loss of hoof capsule) in 8 months. Rarely does the disease regress as little to no resolution was seen. The research teams are working on non-lethal diagnostic tools as culture and PCR were confirmatory in many cases, but did not detect all cases. Work will continue in developing diagnostics and case definition of TAHD, which currently relies heavily on histopathology for confirmation.

References

Clegg SR, Mansfield KG, Newbrook K, Sullivan LE, Blowey RW, Carter SD and Evans NJ 2014. Isolation of digital dermatitis treponemes from hoof lesions in wild North American elk (Cervus elaphus) in Washington State, USA. J Clin Microbiol.

Evans NJ, Brown JM, Demirkan I, Murray RD, Vink WD, Blowey RW, Hart CA and Carter SD 2008. Three unique groups of spirochetes isolated from digital dermatitis lesions in UK cattle. Vet Microbiol 130, 141-150.

Han S and Mansfield KG 2014. Severe hoof disease in free-ranging Roosevelt elk (Cervus elaphus roosevelti) in southwestern Washington, USA. J Wildl Dis 50, 259-270.

56 Hoof Growth And Wear In Pre-Weaned Calves Kept At Pasture

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Introduction

Outbreaks of laminitis and pedal osteitis in dairy calves are a sporadic but significant problem in New Zealand (1). Investigation of these outbreaks is hindered by the difficulty of identifying when the initial insult to the hoof occurred as animals are usually seen by veterinarians when the hoof changes are quite advanced and often chronic in nature. One consistent finding in such cases is the presence of a marked horizontal groove in the horn of the dorsal wall (1). The distance from this groove to the coronary band could be used to estimate the likely timing of the insult. However this calculation requires information on the likely growth rate of the hoof horn in healthy calves; such data are limited and completely absent in calves at pasture. This study was designed to provide baseline data on hoof growth and wear in pre-weaned calves at pasture.

Materials and Methods

This study was undertaken on a spring-calving dairy farm in the North Island of New Zealand . Pre-weaning management of the calves consisted of housing on straw until the weather conditions were suitable for them to be kept outside on pasture (usually within 2-4 weeks of birth). Calves were fed whole milk and concentrate until weaning on to grass alone (at 80-100kg BW depending on breed). Hoof growth and wear measurements were made as per Offer et al 2000 (2), with measurements made of dorsal and lateral wall. The first 71 spring-born heifer calves were used in the study. These calves were Friesian or Friesian X Jersey. The initial hoof marks were created when calves were disbudded (i.e. 1-3 weeks of age) and measurements of growth and wear were made monthly for three months or until weaning, which ever was earlier. Estimated marginal means for growth and wear were created using a repeat measures mixed model with time as the fixed effect and calf as a random effect.

Results

The results of the 4 measurements are presented in Figure 1. Growth was faster in the lateral wall than in the dorsal wall; the differences between the two sites in wear were not so marked. Both growth and wear were fairly consistent across the three periods; although there were statistical differences with time, the differences were likely to be biologically unimportant (<1 mm per month)

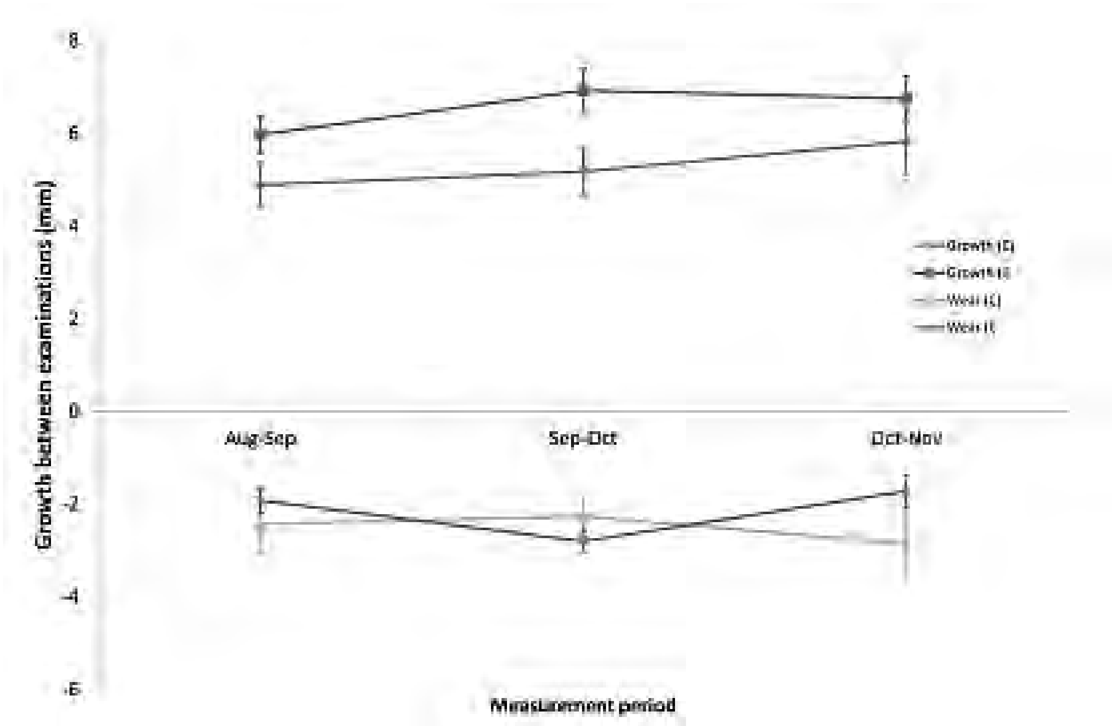

Figure 1: Effect of time on growth and wear of wall horn. C, dorsal wall; l, lateral wall

Discussion

The growth rates are consistent with similar measurements in older calves at pasture (3) and adult cattle on the same farm (4). The consistency across time and between calves strongly suggest that measurement from the coronary band to the horizontal groove could provide an accurate estimate of when that insult occurred, thus aiding the investigation of outbreaks of laminitis and pedal osteitis.

Acknowledgements

Thanks to Lisa Bickner who undertook the data collection and Priyanka Welsman who assisted with the data organisation.

References

Laven LJ, Laven R, Carr R, Stevenson M, Cohen E, Tulley W. *Laminitis and pedal osteitis complex in dairy replacements. Proceedings of the XVIII World Buiatrics Congress.* 2014; 191.

Offer JE, Logue DN, McNulty D. Observations of lameness, hoof conformation and development of lesions in dairy cattle over four lactations. Vet. Rec. 2000;147:105-109

Prentice DE. Growth and wear rates of hoof-horn in Ayrshire cattle. Res. Vet. Sci. 1973; 14: 285-90

Tranter WP and Morris RS. Hoof growth and wear in pasture-fed dairy cattle. New Zealand Vet. J. 1992; 40(3), 89-96

Keywords: Hoof growth and wear, calves, pasture

57 Comparison Of Hind Leg Conformation In Calves Housed Kept On Yielding And Hard Surfaces.

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Introduction

Deviations in conformation of legs and claws is a factor contributing to claw lesions and lameness (1,2,3). Marked deviations in hind leg conformation has been described in 18 months old heifers and has been related to asymmetric claws, horn related lesions and lameness (3). Estimation of heritability of hind leg conformation ascribe 12-22% to genetics, which leaves a large proportion of effect ascribed the environment and management (4,5,6). The objective of this study was to evaluate development of hind leg conformation of dairy calves reared on hard surfaces and on yielding surfaces. The hypothesis that there was an effect of surface on conformation in calves and young stock was tested.

Materials and methods

Nine Holstein dairy herds were included in the study with herd sizes between 117 and 461 cows (average 285 cows). Four herds kept their calves on deep bedding up to at least 6 months of age (soft surface) and five herds that kept their calves on concrete floors from 6 weeks of age (hard surface). Hind leg conformation was scored from side view and from rear view and scored according to ICAR using a 9-point scale (7). Groups of 10-20 calves from each age-group of 0 to 9 months was selected resulting in inclusion of 60-99 (average 79) from each herd depending on herd size. Calves were scored every 3-4 months for a period of 12 months.

Results

Data consist of 311 calves in the hard surface group and 401 calves in the soft surface group. More straight hocks (score 1-3) were recorded in the young calves (0-2 months) 12.8% on hard surface and 15,4% on soft surface compared to heifers (12-16 months) 3.5% and 2.4% respectively. Frequency of sickle hocked (score 6-9) were lower in the young calves (0-2 months) 3.6% on hard surface and 8.6% on soft surface, compared to 11% and 16% of the heifers (12-16 months) on hard and soft surface, respectively. The majority of the calves and heifers had more or less ideal hock angles (score 4 and 5). There was a large variance of hock angle scores between herd within the same group “soft surface” and “hard surface”. More than 95% of the calves across ages were cow-hocked (score 7-9). In the group of young calves (0-2 months) 17.7% had normal hock position (score 7-9) with no significant difference between groups, compared to the older group (12-16 months) where the percentage had dropped to 5.1% on soft surface and 1.6% on hard surfaces ($P<0.05$).

Discussion

Even though genetics account for merely 12-18% of conformation in hind legs, there was a majority of calves that are born with and maintain an undesirable hind leg conformation in the first 12-16 months of their lives. From the result of this study there seemed to be some effect of housing, but not even a dry non slippery concrete floor could compensate for the deviations in conformation we have seen in the young calves. Less than 5% of the heifers had an ideal hock position, >95% were cow-hocked. This poses a big problem for prevention of lameness and claw lesions in dairy cows. New strategies for improvement of conformation seems warranted.

Acknowledgements

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References

1.Boettcher PJ, Dekkers JCM, Warnick LD, Wells SJ. Genetic analysis of clinical lameness in dairy cattle. J Dairy Sci 1998 (81):1148–1156.

2.van der Tol PPJ, Metz JHM, Noordhuizen-Stassen EN, Back W, Braam CR, Weijs WA. The pressure distribution under the bovine claw during square standing on a flat substrate. J Dairy Sci 2002 (85):1476–1481.

3.Capion N, Thamsborg SM, Enevoldsen C. Conformation of hind legs and lameness in Danish Holstein heifers. J of Dairy Sci 2008 (91):2089-2097.

4. Brotherstone S, McManus CM, Hill WG. Estimation of genetic parameters for linear and miscellaneous type traits in Holstein-Frisian dairy cattle. Livestock Prod Sci 1990 (26):177-192.

5. Brotherstone S. Genetic and phenotypic correlations between linear type traits and production traits in Holstein-Friesian dairy cattle. Anim Prod 1994 (59):183-187.

6. Van der Waaij E H, Holzhauer M, Ellen E, Kamphuis C, de Jong G. Genetic parameters for claw disorders in Dutch dairy cattle and correlations with conformation traits. J Dairy Sci 2005 (88):3672-3678.

7. ICAR - International Committee for Animal Recording. ICAR recording guidelines. International agreement of recording practices. http://www.icar.org/wp-content/uploads/2016/03/Guidelines-Edition-2016.pdf

Keywords: conformation, calves, heifers, cow-hocked, hock-angle, housing

P 13-1 Bone mineral density in swine

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Introduction

In human medicine dual energy X-ray absorptiometry (DXA) is used to evaluate bone mineral density (BMD) and bone mineral content (BMC) as indicator for osteoporosis or osteochondrosis. Both diseases affect health due to lameness and pain. In pigs, these diseases could result in early losses and are therefore an important issue in pig fattening and animal welfare. The present study aimed at evaluating BMD/BMC during growth in fattening pigs of three male gender types (entire, immunocastrated, and surgical castrated). This could be of major concern, as surgical castration without anaesthesia will be banned in Europe and boar fattening or "immunocastration" are favoured as alternatives. If this trend affects bone mineralisation it could result in more lameness during fattening.

Materials and Methods

A total number of 101 male pigs were used. The data consisted of 34 entire boars (EB), 34 immunocastrated boars (IB), and 33 barrows (CB); all piglets of a Piétrain sire mated with German Landrace sows. They were examined in 3 experimental groups representing different seasons. Each gender type was equally distributed to each group. All animals were kept according to the German national animal welfare regulations (1-3). The animal experiment was licensed by the District Government of Upper Bavaria (registry numbers 55.2-1-54-2532.2-12-13).

All pigs were scanned via DXA at an age of 30, 60 and 90 kg body weight. Data were analysed by creating 9 body parts: total body, head, left & right front leg, loin area, left & right femur and left & right lower hind leg.

A mixed model was used to calculate LSM + SEE by using a REML procedure. Gender and group were used as fixed effect and age and weight as random effect.

Results

The results showed significant differences between the gender types. EB showed the lowest BMD/BMC over all examination days, starting with 60 kg (90 kg; EB: 0.958 ± 0.008 g/cm^2, IB: 0.974 ± 0.007 g/cm^2, CB: 0.991 ± 0.007 g/cm^2). Additionally, significant differences were found between the experimental groups already at 30 kg, showing seasonal differences. Animals raised in a season with increasing daylight showed the highest BMD/BMC.

Discussion

There seems to be differences in rearing finishing pigs according to the season and regarding the gender. These differences could result in more lame animals in a season or especially in finishing groups related to the gender type. To provide sufficient information about lameness and bone mineralization further studies are necessary including lameness scorings during fattening compared with BMD/BMC measurements.

Acknowledgements

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References

1 Tierschutzgesetz in der Fassung der Bekanntmachung vom 18. Mai 2006 (BGBl. I S. 1206, 1313), das durch Artikel 4 Absatz 90 des Gesetzes vom 7. August 2013 (BGBl. I S. 3154) geändert worden ist. Neugefasst durch Bek. v. 18.5.2006 I 1206, 1313; zuletzt geändert durch Art. 1 G v. 4.7.2013 I 2182 (Animal Protection Law). http://www.gesetze-im-internet.de/tierschg

2 Verordnung zum Schutz landwirtschaftlicher Nutztiere und anderer zur Erzeugung tierischer Produkte gehaltener Tiere bei ihrer Haltung (TierSchNutztV) in der Fassung der Bekanntmachung vom 22. August 2006 (BGBl. I S. 2043), die durch Artikel 1 der Verordnung vom 1. Oktober 2009 (BGBl. I S. 3223) geändert worden ist. Neugefasst durch Bek. v. 22.8.2006 I 2043; geändert durch Art. 1 V v. 1.10.2009 I 3223. http://www.gesetze-im-internet.de/tierschnutztv/index.html

3 Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes. *Off J Eur Union L276*, 33-79. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0033:0079:en:PDF

Keywords: bone mineralization, pig, season effect

14 GENETICS

58 Evaluation Of Different Data Sources For Genetic Improvement Of Claw Health In Austrian Fleckvieh (Simmental) And Brown Swiss Cattle

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Various studies worldwide have shown the need to work on genetic improvement of claw health. The challenge is the availability of phenotypes. Within the Austrian project “Efficient Cow” various different phenotypes related to claw health have been recorded in 167 farms and about 3.500 Fleckvieh (Simmental), 1.000 Brown Swiss and 1.000 Holstein cows during the observation period of 1 year. Within the project claw trimming was documented and recorded. Additionally lameness was assessed at each time of milk recording by the trained staff of the milk recording organizations using the scoring system of ZINPRO. Within the health monitoring in Austria veterinarian diagnoses are recorded on routine bases. The same is true for culling data. Heritabilities and genetic correlations between the traits have been estimated for veterinarian diagnoses, lameness scores, claw health based on claw trimming data and culling information with a linear animal model. The heritability based on veterinarian diagnoses is 0.025 for Fleckvieh (Simmental) and 0.013 for Brown Swiss. The respective values based on claw trimming data are 0.042 for Fleckvieh (Simmental) and 0.075 for Brown Swiss. The trait was defined as 0/1 or including the number of events as the second value of the results. Based on the lameness score a lactation lameness value was calculated taking the frequency of different severity cases into account. The heritability for this value is 0.092 for Fleckvieh and 0.109 for Brown Swiss. The genetic correlations between veterinarian diagnoses, claw trimming data and lactation lameness value are in the range of 0.3 – 0.9. The results confirm the usability of various data sources for genetic improvement of claw health.

59 Genome Wide Association Analysis And Regional Heritability Mapping For Lameness Causing Foot Lesions And Digital Cushion Thickness In UK Holstein Dairy Cows

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Introduction

Foot lesions account for most lameness cases in dairy cattle and are usually of infectious or non-infectious classification. Low to moderate heritability estimates have been reported for most of these lesions[1]. The digital cushion is a complex structure composed mostly of connective and adipose tissue located underneath the distal phalanx and plays an important function in dampening compression of the corium tissue. In a recently published study, the heritability estimate of digital cushion thickness was 0.33 ± 0.09, whereas a statistically significant genetic correlation was estimated between digital cushion thickness and prevalence of claw horn lesions (−0.60 ± 0.29)[2]. Our objective here is to present the first results from an ongoing project aiming to detect genomic regions of interest for these traits.

Materials and Methods

The study was approved by the University of Liverpool Veterinary Research Ethics Committee. 267 Holstein cows from one herd were genotyped with a genome-wide 50K Affymetrix DNA array. Information regarding five lameness causing foot lesions (sole ulcer, sole haemorrhage, white line disease, digital dermatitis and interdigital hyperplasia) was collected by the researchers and from the farm's records. Additional phenotypes for digital cushion thickness were available for a subset of animals (~125) before calving, at calving and 60 days after calving. Three genomic analyses for each trait were performed: 1) Variance component estimation[3], 2) Genome-wide association (GWA) analysis[4], 3) Regional heritability mapping (RHM)[3] of consecutive genomic regions of 20 SNPs. In models 2 and 3, significant (one false positive in 20 genome scans) and suggestive (one false positive per genome scan) thresholds were computed using a Bonferroni correction for multiple testing. Quantitative trait loci were explored by matching significant outcomes of the above analyses to the bovine reference genome.

Results

All traits except for sole haemorrhage exhibited genomic heritabilities significantly greater than 0 (0.20-0.42). GWA analysis revealed a significant peak on BTA6 for interdigital hyperplasia. RHM identified two significant regions on BTA6 for this trait, one of which included the significant SNP from GWA; these regions accounted for 66% of the total genomic (SNP) variance and harboured or were close to a gene related to the immune system (*CLNK*), a gene related to protein-protein interactions (*WDR1*) and a two-gene cluster related to bone and skeletal development (*EVC* and *EVC2*). Furthermore, RHM resulted in additional suggestive regions identified for interdigital hyperplasia (BTA10), digital dermatitis (BTA11 and BTA27) and sole ulcer (BTA12). Digital cushion thickness at calving showed significant results, with RHM, revealing a significant region on BTA12 close to a relevant gene related to lipid and hormone metabolism (*DHRS12*) and two suggestive regions on BTA1 and BTA7. Regional variance estimates were larger than the total genetic variance, potentially indicating an oligogenic architecture for this trait.

Discussion

Interdigital hyperplasia, digital dermatitis, sole ulcer and DCT at calving may be improved based on genomic analysis results.

Acknowledgements

V. Bay is gratefully acknowledging support from the Turkish Ministry of Education. G. Oikonomou is gratefully acknowledging support from the Wellcome Trust (Wellcome Trust ISSF non clinical fellowship).

References

[1]Bicalho R, Oikonomou G. Control and prevention of lameness associated with claw lesions in dairy cows. Livestock Science 2013 (156): 96 – 105.

[2]Oikonomou G, Banos G, Machado V, Caixeta L, and Bicalho RC. Short communication: Genetic characterization of digital cushion thickness. Journal of Dairy Science 2014 (97): 532 - 536.

[3]Gray A, Stewart I, Tenesa A. Advanced Complex Trait Analysis. Bioinformatics. 2012 (28): 3134-3136.

[4]Zhou X, Stephens M. Genome-wide efficient mixed-model analysis for association studies. Nature Genetics. 2012 (44): 821 – 824.

Keywords: genomic, regional heritability mapping, foot lesions, digital cushion

60 Incidence Rates For Claw Disorders In Relation To Status Of Female Ancestors Based On Assessments At Routine Hoof Trimming In German Holstein Dairy Cattle

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Introduction

Recording of disorders at time of hoof trimming has been proven to be highly valuable for statistical analysis of environmental as well genetic influences on claw health (Swalve et al., 2011). Genetic analyses usually present estimates of heritability although this figure often is not well understood by non-geneticists. Here we present an alternative way of evaluating resemblances between relatives in an analysis of daughter records in relation to records from their dams and granddams.

Material and Methods

From the entire data set consisting of assessments for claw disorders by the first author for 36,094 cows with a total of 128,384 observations including repeated trimmings, only records from the first trimming in first lactation of 25,043 cows were used for analysis. Later lactations and trimmings were not used to avoid a bias due to selection, i.e. cows with more lactations and/or trimmings can be expected to be healthier than cows leaving the herd early. For each cow, the data set was scanned for the availability of dams with a record and for cows with dams found also granddams were searched for. This yielded a total of 9,654 cows with an identified dam and thereof 3,740 cows with an identified granddam. Frequencies within the classes of identified ancestors and found to be affected or not affected were compared using a X^2-Test. A further analysis (full model) considering herd-date-visit effects as well as days in milk at time of trimming under a logit-link model was used to estimate Odds Ratios for specific contrasts.

Results and Discussion

Results for frequencies of affected animals according to class group are summarized in Table 1.

Table 1: Incidence rates for three claw disorders as assessed at routine hoof trimming in relation to status of disorder for dams (D) and/or granddams (GD). Only first trimmings in first lactation were used.

	Sole Hemorrhage		Dermatitis digitalis		Interdigital Hyperplasia	
	Class N	% affected	Class N	% affected	Class N	% affected
D and GD not found in data	15,389	39.5	15,389	27.8	15,389	4.1
D found, GD not found						
D healthy	3,837	38.7	4,247	26.5	5,703	3.7
D affected	2,077	46.0	1,667	40.6	211	13.7
D and GD found						
D and GD unaffected	1,477	35.0	1,818	26.9	3,481	3.6
D affected, GD unaffected	931	44.4	723	41.9	127	18.9
D unaffected, GD affected	678	41.3	672	35.6	108	5.6
D and GD affected	654	44.7	527	43.6	24	29.2
N Total / Ave % affected	25,043	40.0	25,043	29.3	25,043	4.1
X²-Test, P-value[1)]	< 0.0001		< 0.0001		< 0.0001	
Odds Ratio for "affected": DD, GD not affected vs. DD, GD affected[2)]	0.826		0.813		0.118	

[1)] Based on raw frequencies (% as given in table) / [2)] Calculated under full model

The results show pronounced effects of the status of female ancestors. Highest frequencies for "affected" are always found if D and GD are affected. Most drastic effects are found for Interdigial Hyperplasia. The results underline the need for genetic selection as one tool to prevent the respective claw diseases.

References

Swalve HH, Alkhoder H, Pijl R. Genetic background of disorders of the bovine hoof from data collected at hoof trimming. In: Proc. 16th Int. Symposium & 8th Conference on Lameness in Ruminants, Rotorua, New Zealand 2011.

Keywords: Hoof trimming data, genetic effects, genetic selection

61 Correlations Between Breeding Values For Claw Health Traits And Implications For Future Genetic Evaluation In German Holstein Dairy Cattle

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Introduction

Lameness and associated claw disorders are of major concern for the dairy industry, implying great interest in applications for monitoring, efficient control, and targeted improvement of claw health also by genetic selection. However, implementation of routine recording and use of claw data is challenging and requires considerable efforts to ensure high data quality. Different data sources and approaches of data collection raise the question whether recordings will be sufficiently similar to result in consistent implications for selection. To address this issue, we have in this study examined the relationships between breeding values for claw health traits from independent genetic evaluations.

Material and Methods

Based on standardized claw data recording in dairy farms, genetic evaluations (GE) for claw health in German Holstein dairy cattle have been set up. GE in the GKUHplus project is based on continuous recording of diagnoses of individual cows, whereas records from regular hoof trimming are systematically included in routine GE in the Profit Plus program including contract herds of breeding organizations. From each GE, estimated breeding values (EBV) for six individual claw health traits (interdigital hyperplasia, IH; laminitis, LA; white line disease, WL; claw ulcers, UL; digital phlegmona, PH; digital dermatitis, DD) and the derived claw health index (weights: 30% DD, 15% LA, WL, UL, PH, 10% IH) were available for this study (Table 1). Pearson correlation coefficients and Spearman rank correlations between corresponding EBVs were determined for all Holstein AI bulls with daughters in both GE (N=1,869; B0) and for those with minimum EBV reliabilities of 0.5 (B50) and 0.7 (B70).

Table 1: Outline of genetic evaluations for claw health traits in German Holstein dairy cattle

Characteristics of genetic evaluation	GKUHplus project	Profit Plus program
No. of parity records (animals)	188,195 (96,421)	410,665 (180,927)
No. of Holstein AI bulls with daughters (average no. of daughters)	4,655 (18.0)	4,641 (35.8)

Results and Discussion

Based on heritabilities of the claw health traits of 0.03-0.15 and means of 32 and 55 daughters within GE, B0 bulls had approximated EBV reliabilities of on average only 0.2-0.3 (B50: 0.7-0.8, B70: 0.8-0.9). However, patterns of EBV correlations were consistent across the bull samples and test statistics, and indicated that, regardless of the proportion of routine trimming records included, generally the same bulls were identified as genetically predisposed resp. robust for particular claw disorders. Higher correlations were found for IH, UL, PH, DD and claw health index (r^2 and ρ ≥0.5 in B0, ≥0.6 in B50 and 0.7-0.8 in B70) than for LA and WL. Information on claw disorders is available through both documentation of clinical cases and records from routine trimming. EBV correlations found in this study indicate feasibility of integration of all available data as basis of optimum data usage in future routine genetic evaluation for claw health traits in German Holstein dairy cattle.

Acknowledgements
The project GKUHplus was supported by funds of the German Government's Special Purpose Fund held at Landwirtschaftliche Rentenbank. The authors gratefully acknowledge usability of the results from the genetic evaluations for this research.

Keywords: standardized claw data recording, heritability, estimated breeding values, genetic evaluation for claw health traits, selection

62 Genetic Trends For Resistance To Claw Disorders In Nordic Holstein Cattle Population

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Introduction

Every year claw trimming results of more than 40% of the total dairy cow population in Sweden, Finland and Denmark are gathered by professional claw trimmers. Those records are the strong basis for effective preventive management programs and genetic improvement of claw health. Since 2011 claw health is included in Nordic total merit index (NTM) for the Nordic cattle populations of Red Dairy Cattle, Holstein and Jersey. The claw health index is based on records made in the first three lactations and includes the following 7 groups of disorders: 1) sole ulcer, 2) sole hemorrhage, 3) heel horn erosion, 4) digital and interdigital dermatitis, 5) limax and verrucose dermatitis, 6) corkscrew claw, 7) double sole and white line separation (1). The purpose of this study was to assess genetic trend for the claw health index as well as for the groups of disorders included in the index in the Nordic population of Holstein AI bulls.

Materials and Methods

Estimated breeding values and genomic breeding values of claw health index as well as its sub-traits of 3 642 Nordic Holstein bulls born 2002–2015 (260 bulls in average per year) were used in the study. The breeding values were estimated by Nordic Cattle Genetic Evaluation 1st of November 2016 (http://www.nordicebv.info) and were presented as relative deviations from the rolling base (cows born 01-11-2011–01-11-2013) with average equals 100, and SD for progeny tested bulls of 10. Genetic trends for the groups of claw lesions was possible to assess only for the years with complete assessment of the bulls' progeny, therefore only bulls born 2002-2009 were included there (N=2 599). Higher breeding values mean better genetic ability to resist claw disorders. To evaluate genetic trends, the averages of breeding values of claw lesions were regressed on year of the bull birth (JMP 8, SAS Inst.).

Results

As shown on Figure 1 the breeding values for claw health index in population of Nordic Holstein bulls showed significant positive trend (estimate=0.94, SE=0.11, P<0.001).The genetic trends for resistance to specific disorders were assessed only for bulls born before 2010 and significant positive genetic trends were found for heel horn erosion (estimate=0.89, SE=0.15, P<0.001) and digital and interdigital dermatitis (estimate=0.65, SE=0.18, P<0.01). There was a tendency for positive trends for resistance to limax and verrucose dermatitis (estimate=0.38, SE=0.19, P=0.09) and sole ulcer (estimate=0.66, SE=0.29, P=0.07). Yet, for corkscrew claw, double sole and separation of white line, along with sole hemorrhages neither significant positive nor negative trends for the period 2002-2009 were evident.

Conclusions

There is a clear positive trend for genetic improving general claw health in the Nordic population of Holstein AI bulls. Analysis of the trends for the specific claw disorders in bulls born until 2010 revealed increasing genetic resistance to infectious claw diseases. Since the claw health until 2011 was not in the scope for selection, the positive trends may be explained by correlated positive effect of long-term improvement of the other fitness traits in Nordic Holsteins.

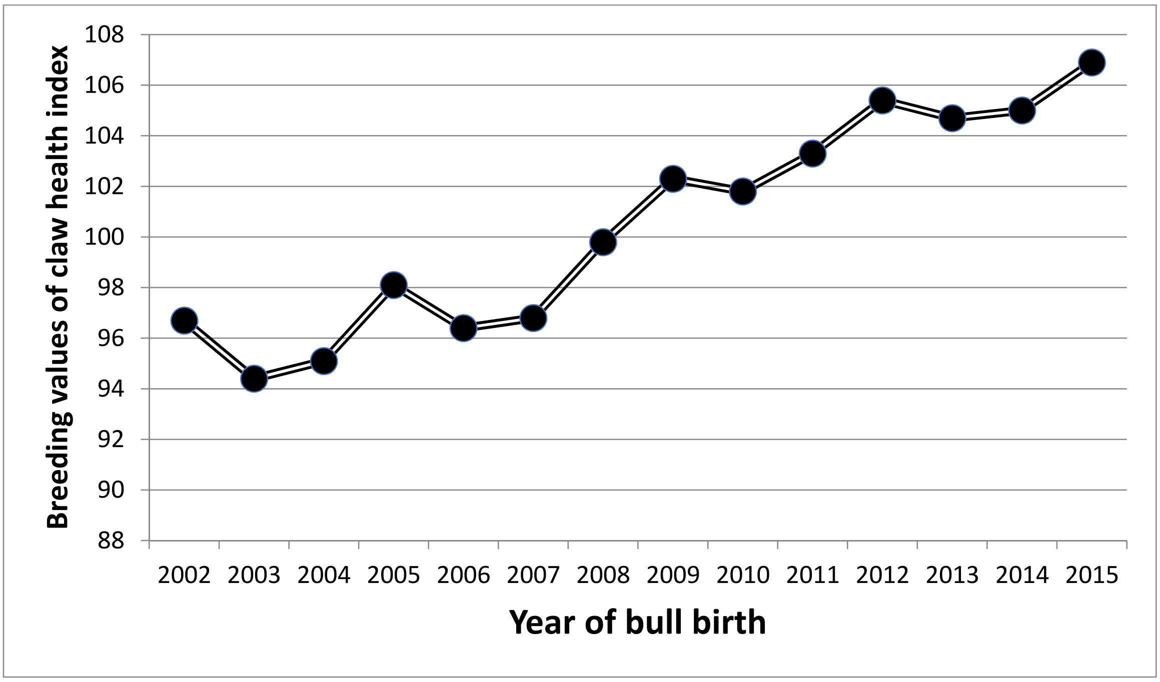

Figure 1. Genetic progress (the average estimated breeding values per birth year) for claw health index in Holstein AI-sires in Sweden, Denmark and Finland (N=3 642). Higher breeding values mean better genetic ability of bulls' daughters to resist claw disorders.

References

1. Johansson K, Eriksson J-Å, Sander Nielsen U, Pösö J and Pedersen Aamand G. Genetic Evaluation of Claw Health in Denmark, Finland and Sweden. Interbull Bulletin 2011 (44): 224-228.

Keywords: breeding, claw health index, genetics, Holstein

15 NEW APPROACHES

63 Introduction of biplane high-speed fluoroscopic kinematography or “XROMM” to bovine gait analysis

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Introduction

Biplane high-speed fluoroscopic kinematography or “XROMM - X-ray reconstruction of moving morphology” (1) is a relatively new method for high precision motion analysis of skeletal structures. It enables measurement of joint and bone kinematics in six degrees of freedom in three-dimensional (3D) space with a methodological error that can be as small as 0.12±0.08 mm and 0.09±0.08° (2). So far it has been applied to dogs (3) and horses (4, 5) but not to cattle.

Materials and Methods

A facility for biplane high-speed fluoroscopic kinematography consists of two X-ray tubes and two image intensifiers (fluoroscopes) retrofitted with high-speed cameras (Figure 1). The X-ray tubes and fluoroscopes are positioned such that the central beams cross at a 50-90° angle forming an imaging volume that both cameras capture simultaneously. The imaging volume is calibrated using a cube consisting of 4 layers of acrylic sheet and 64 evenly spread metal markers. Using this set-up, biplane X-ray video recordings of the bones or joint in question can be taken with 30-500 frames per second. In addition, computer tomographic data is used to reconstruct 3D individual surface models of the investigated skeletal structures. Subsequently, these individual 3D bone models are registered against the biplane X-ray video recordings resulting in a precise 3D animation of the investigated subject’s bones in motion.

Results

It is possible to use this innovative new method for bovine gait analysis. There are three techniques for the registration of bone models to X-ray recordings. The first one relies on the surgical implantation of 3-5 radio-opaque markers into each examined bone. This technique is hardly applicable to bovine distal limb kinematics in live animals because of its invasiveness. The other two circumvent marker implantation entirely and register bone models to recordings based on their contours and texture either manually or with dedicated software. The actual measurements in six degrees of freedom are carried out on the 3D animations. The biplane fluoroscopic set-up allows for a walkway of 1.10 m to be kept clear so that for in-vivo applications cattle can be trained to walk within the set-up (with or without a treadmill) in order to perform reproducible locomotive behavior.

Discussion

Biplane high-speed fluoroscopic kinematography is an exciting new way of investigating bovine motion. It will enable research into skeletal kinematics in six degrees of freedom during motion with a hitherto unprecedented accuracy. It will enrich research into cattle locomotion and especially cattle lameness by investigating the influence of trimming methods, ground conditions (concrete, rubber, etc.) on claw biomechanics and the development of pathologies for example. It may also be applied to the question of distal phalanx motion within the horn capsule of sound and diseased claws.
It is, however, an expensive and complex method that remains reserved for lab-based research in the foreseeable future.

Acknowledgements

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References

1. Brainerd EL, Baier DB, Gatesy SM, Hedrick TL, Metzger KA, Gilbert SL et al. X-ray reconstruction of moving morphology (XROMM): precision, accuracy and applications in comparative biomechanics research. J Exp Zool A Ecol Genet Physiol 2010 313(5):262–79.

2. Miranda DL, Schwartz JB, Loomis AC, Brainerd EL, Fleming BC, Crisco JJ. Static and dynamic error of a biplanar videoradiography system using marker-based and markerless tracking techniques. J Biomech Eng 2011 133(12):121002

3. Tashman S, Anderst WJ. In-VivoMeasurement of Dynamic Joint Motion Using High Speed Biplane Radiography and CT: Application to Canine ACL Deficiency. J Biomech Eng 2003 125:238–45.

4. Panagiotopoulou O, Rankin JW, Gatesy SM, Hutchinson JR. A preliminary case study of the effect of shoe-wearing on the biomechanics of a horse’s foot. PeerJ 2016 4(3):e2164.

5. Geiger SM, Reich E, Böttcher P, Hagen J. Validation of the Accuracy of Non-Invasive Tracking Techniques in Biplane High-Speed Fluoroscopy for the Equine Distal Extremity. Equine Vet J 2016 48:24.

key words: bone model, three-dimensional gait analysis, computer tomography, XROMM

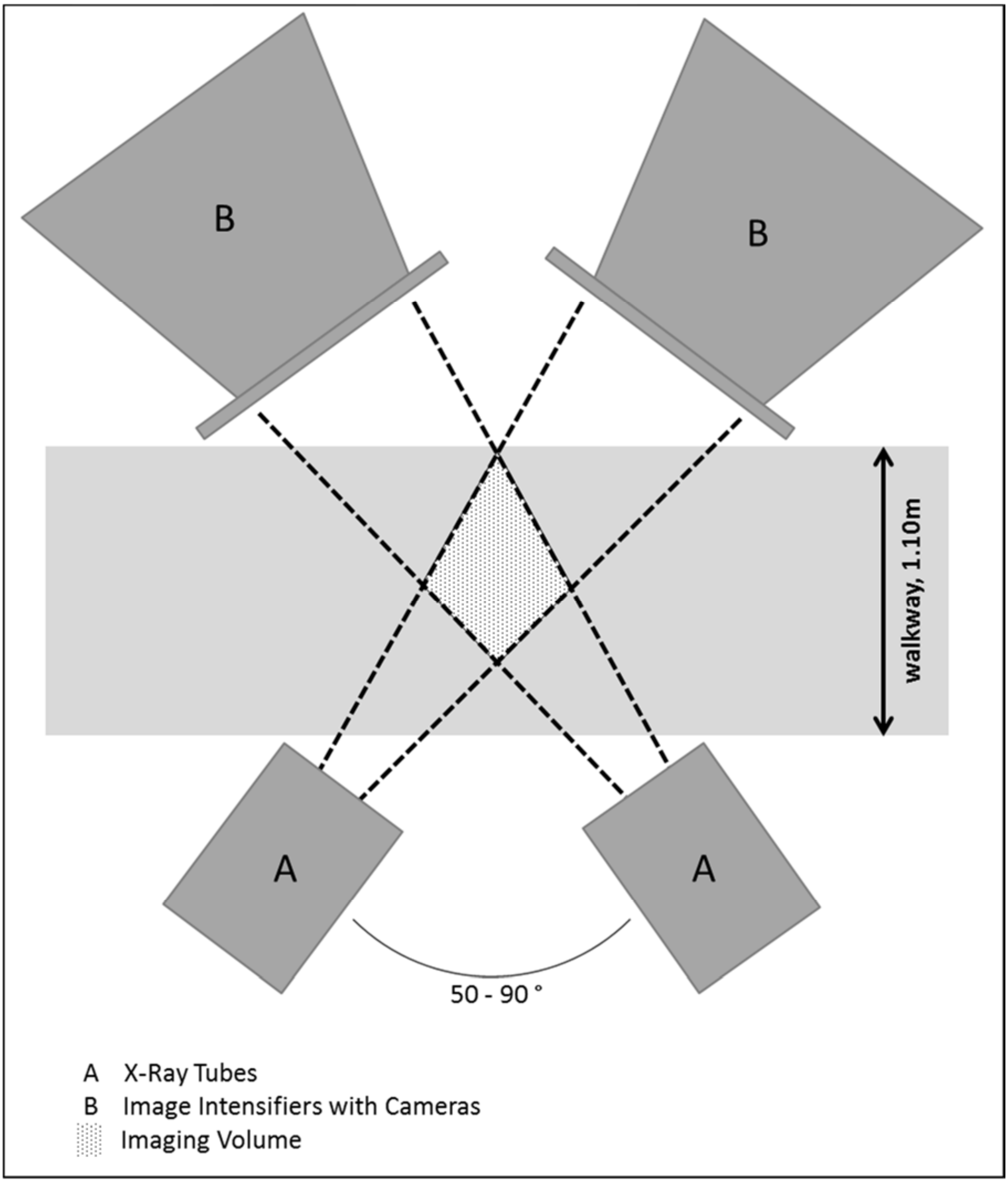

Figure 1: Schematic drawing of a high-speed fluoroscopic kinematography facility

64 Evaluation Of Non-Invasive Reconstruction Using Biplane High-Speed Fluoroscopic Kinematography For 3D Research Of Bovine Distal Limb Kinematics

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Introduction

For the detection and prevention of lameness scientific analysis and biomechanical understanding of underlying causes are decisive (2). Biplane high-speed fluoroscopic kinematography is a new technology enabling direct and highly precise measurements of bone elements in live animals during locomotion. Together with bone models from computed tomography scans, this technique allows for three-dimensional (3D) animation of bone movement in 3D space in order to investigate claw biomechanics. The gold standard, markerbased animation, comes with a known systematical error of 0.12±0.08 mm and 0.09±0.08° (3), but requires surgical implantation of at least three radio-opaque markers in each bone (1). In order to circumvent invasiveness in future in vivo studies, this study evaluated the accuracy of two non-invasive markerless animation techniques (semi-automatic and manual) by comparing it to marker-based animation.

Materials and Methods

The distal, middle and proximal phalanges of 5 isolated bovine forelimbs were implanted with three to four radio-opaque tantalum markers. Biplane high-speed fluoroscopic recordings of a simulation of one step were taken. Computer-tomography scans were performed in order to generate 3D bone models of each of the phalanges. These bone models were 3D animated using markerbased, semi-automatic and manual tracking methods. The semi-automatic technique performs the animation of the bone models for a consecutive image sequence independently after initial manual adjustment of the bone models to the biplane X-ray images. For the manual method every bone model was aligned manually to every eighth image of the biplane video sequence. To measure the disparity of semi-automatic and manual animations, they were compared to markerbased animations in terms of translational and rotational values.

Results

Biplane high-speed fluoroscopic kinematography was applied to the bovine distal limb. 3D reconstructions of the proximal, middle and distal phalanges during locomotion were realized. Mean translational and rotational disparity ranged from 0.63±0.26 mm to 0.80±0.49 mm and from 2.41±1.43° to 6.75±4.67°, median disparity from 0.58-0.71mm and 2.09-5.63° for the manual animation technique. Mean translational and rotational disparity ranged from 1.26±1.28 mm to 2.75±2.17 mm and from 3.81±2.78° to 11.7±8.11°, median disparity from 0.76-2.09mm and 3.26-10.25° for semi-automatic technique.

Discussion

This study presents a fundamentally new basis for future bovine lameness research. We successfully adapted the method of biplane high-speed fluoroscopic kinematography to the bovine distal limb for the first time and measured the accuracy of two non-invasive markerless animation techniques for 3D reconstruction of bovine distal limb kinematics. The results demonstrate that kinematics can be measured with sub-millimeter accuracy which makes invasive marker implantation redundant. Applied to the bovine distal limb, this technique may facilitate new insights into claw-biomechanics and claw-floor-interactions. These new insights contribute to improving the prevention of lameness to maintain the well-being, performance and productivity of dairy cows.

Acknowledgements

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References

1. Brainerd EL, Baier DB, Gatesy SM, Hedrick TL, Metzger KA, Gilbert SL, Crisco JJ. X-ray reconstruction of moving morphology (XROMM): precision, accuracy and applications in comparative biomechanics research. J Exp Zool 2010 (313):262–279.

2. Main DCJ, Leach KA, Barker ZE, Sedgwick AK, Maggs CM, Bell NJ, Whay HR. Evaluating an intervention to reduce lameness in dairy cattle. J Dairy Sci 2012 (95):2946–2954.

3. Miranda DL, Schwartz JB, Loomis AC, Brainerd EL, Fleming BC, Crisco JJ. Static and dynamic error of a biplanar videoradiography system using marker-based and markerless tracking techniques. J Biomech Eng 2011 (133):121002-2-121002-8.

Keywords: dairy cow, locomotion, 3D-animation

65 In Vivo Distal Limb Joint Kinematics Measured With Biplane High-Speed Fluoroscopic Kinematography In Two Holstein Friesian Heifers

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Introduction
Biplane high-speed fluoroscopic kinematography allows for 3D measurements of skeletal motion and joint kinematics in six degrees of freedom with high precision (1). Detailed knowledge about the range of motion of bovine interphalangeal joints will offer new insights in claw biomechanics and lesion pathogenesis. Therefore, this study investigated the range of motion of the proximal and distal interphalangeal joints (PIPJ and DIPJ respectively) in the right forelimb of two Holstein Friesian heifers on a concrete and rubber (KURA P, Gummiwerk KRAIBURG GmbH & Co. KG, Waldkraiburg, Germany) floor.

Materials and Methods
Two healthy Holstein Friesian dairy heifers (aged 13 months, ~450kg, TVV 44/15, Landesdirektion Sachsen, Leipzig, Germany) were adapted to the experimental set-up over the course of several weeks. Computer tomographic data (slice thickness 0.8 mm, increment 0.4 mm) of the right forelimb phalanges were acquired under general anesthesia and 3D reconstructions of the bones generated. The biplane high-speed fluoroscopic facility was arranged at a 60° inter-beam angle at 1.40 m source to image distance. One biplane fluoroscopic recording (70-75kV, 100-125mA) of one step was taken per flooring and animal. The manual tracking technique was employed to register the bone models to the biplane recordings to generate 3D animations. Bone coordinate systems based on the motions' helical axes and anatomical directions were aligned to the phalanges in order to describe the range of motion of the medial and lateral PIPJ and DIPJ.

Results
The ranges of motion in flexion and extension of the medial PIPJ was 26° and 23° on concrete and KURA P rubber mat respectively. Corresponding results were 26° and 21° for the lateral PIPJ, 25° and 28° (medial DIPJ) and 28° and 24° (lateral DIPJ). Ranges of motion for axial rotation and abduction/adduction have not yet been evaluated.

Discussion
This is a pilot study establishing the feasibility of in vivo biplane high-speed fluoroscopic kinematography in cattle and the measurement of valid results. Future studies will have to provide the necessary sample size for statistical analysis. While the range of motion of the bovine fetlock joint has been investigated in previous studies (2, 3) there are no references for the interphalangeal joints. The results for the DIPJ in this study are, however, in accordance with those published for the horse, while the range of motion of the bovine PIPJ seems to be higher than that of the horse (4).

Acknowledgements
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References
1. Brainerd EL, Baier DB, Gatesy SM, Hedrick TL, Metzger KA, Gilbert SL et al. X-ray reconstruction of moving morphology (XROMM): precision, accuracy and applications in comparative biomechanics research. J Exp Zool A Ecol Genet Physiol 2010 313(5):262–79.

2. Blackie N, Bleach ECL, Amory JP, Scaife JR. Associations between locomotion score and kinematic measures in dairy coes with varying hoff lesion types. J Dairy Sci 2013 (96):3564-3572
3. Pluk A, Bahr C, Poursaberi A, Maertens W, van Nuffel A, Berckmans D. Automatic measurement of touch and release angels of the fetlock joint for lameness detection in dairy cattle using vision techniques. J Dairy Sci 2012 (95):1738-1748
4. Roach JM, Pfau T, Bryars J, Unt V, Channon SB, Weller R. Sagittal distal limb kinematics inside the hoof capsule captured using high-speed fluoroscopy in walking and trotting horses. Vet J 2014 (202):94-98

Keywords: range of motion, interphalangeal joint, XROMM

66 A Simple Method to Detect Locomotion Scoring in Dairies Using Image Processing Techniques

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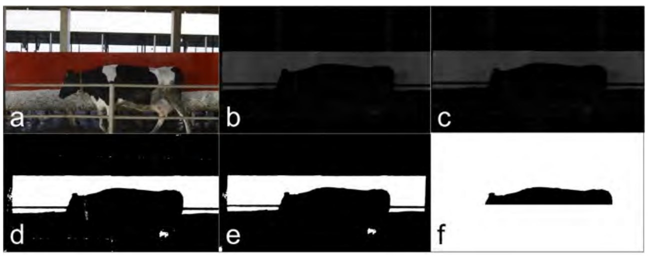
Introduction

Currently, several locomotion detection/scoring (LS) systems are used in practice (1). In traditional method, LS ought to be made by competent person at regular intervals in dairies and hence it is time-consuming and tedious work. On the other hand, this method is observer/human dependent and different observers may give different scores for same cow. Using computer based methods including image processing techniques to detect the LS would be economic, time-saving and independent from the observer based errors, hence it would be subjective (2). In this study, a simple method is proposed to find the LS in dairies. The results are obtained both using proposed method and observations of a competent observer. Then, the validity of the method is evaluated by comparing both results.

Materials and Methods

The image-based method was tested in a commercial dairy farm located in Aydın, TR. Total 50 cows were selected semi-randomly among 231 milking cows as including cows has different LS (3) by competent observer attentively. Videos were recorded when cows were walking from the milking parlor to the pasture ground and passing a 1.2-m wide and 4-m long corridor. A red-colored background was placed to the corridor to make easy the LS as shown in Fig. 1a. Nikon D3200 camera was located 5m away from the corridor as horizontally centered to it and 1.35m high above the ground. The videos were recorded continuously and in real dairy condition to see the effect of heavy cow traffic. $1080 \times 1920 \times 3$ sized videos were recorded with 30 fps (frames per second). Then, the video streams were converted into AVI files and each frame was stored in computer for lameness detection process. In the next stage, frames were separated cow by cow and each cow was analyzed separately (Fig. 1a). For each cow, first of all, the analyzed colored (RGB) frame (or image) was converted to $1080 \times 1920 \times 1$ sized image including only Red dimension due to easy extraction of the image in front of the red background (Fig. 1b). The obtained image was median filtered to obtain smoother image (Fig. 1c). Then, the image was converted to a “black & white” (B&W) image for image extraction (Fig. 1d). Following, the small and distinct white areas were deleted to obtain a complete B&W image (Fig. 1e). As the method deals only with the back posture of the cow, the obtained image was clipped to get the desired region (Fig. 1f).

Figure 1. Image extraction process for a typical image. a) Original colored image in front of red background, b) Gray-scaled image, c) Median filtered gray-scaled image d) Black & White image, e) Cleaned image, f) Clipped image to get the desired region (back posture) of cow.



At the later stage, the maximum height (in pixels) of each clipped black image (as in Fig. 1f) is calculated for current image (frame). This calculation is repeated for each frame and walking analyze figures were obtained for each milking cow. Finally, computer program decides the locomotion score by using walking analyze figures. The maximum values of height and peak numbers are important parameters for lameness detection and locomotion scoring.

Results

The locomotion scoring performance of the proposed method is summarized in Table 1. As seen from Table 1. high locomotion scores, 4 and 5, can be detected and scored accurately whereas the performance of the method decreases for medium and low scores 1, 2 and 3. Overall accuracy of the locomotion scoring is 66%.

Table 1. Locomotion Scoring Performance of the Proposed Method

	Score					Total
	1	*2*	*3*	*4*	*5*	
Total	20	14	10	2	4	50
Detected	14	8	5	2	4	33
Accuracy	70%	57%	50%	100%	100%	66%

Lameness detection performances can be obtained using Table 1. The proposed method detects lame cows (with scores 2, 3, 4, 5) with 87% accuracy. As it can be seen from column 1 of table 1, 20 healthy cows (with score 1) are analyzed and 6 cows are scored wrongly (5 cows are scored as 2 and 1 cow is scored as 3). Hence, the false detection (say lame when the cow is not) ratio of the proposed method is almost 30%. Actually, 5 of these 6 cows are evaluated as score 2 and only 1 of 6 is scored as score 3. Hence, the exact false positive value is almost 5% without a doubt. To increase the performance of the method, the cows with scores 1-3 are tested 4 times and the results are obtained by averaging the results. Final accuracies are found as 85%, 71% and 70% for scores 1, 2 and 3 respectively.

Discussion

The reviews on issue (1, 2) mentioned that, incomparable results may be experienced in different lameness detection methods, and automated results might solve this problem. It has been also stated that, they will be challenging. In this paper, a simple lameness detection and scoring method based on image processing techniques is proposed. Image processing methods are rarely used for locomotion scoring but in general these methods have high computational complexities. Alternatively, our method is not much complex and it can be applied easily and cheaply in commercial dairy farms to detect lame cows. Although the method is quite simple, the performance is satisfactory. The accuracy of the proposed method for both lameness detection and locomotion scoring is high as well. The performance of the method can be increased by using multiple observations and averaging the results of them.

Acknowledgements

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References

Van Nuffel A, Zwertvaegher I, Pluym L, Van Weyenberg S, Thorup VM, Pastell M, Bahr C, Sonck B, Saeys W. Lameness Detection in Dairy Cows: Part 2. Use of Sensors to Automatically Register Changes in Locomotion or Behavior. Animals 2015, 5, 861-885.

Van Nuffel A, Zwertvaegher I, Pluym L, Van Weyenberg S, Thorup VM, Pastell M, Sonck B, Saeys W. Lameness Detection in Dairy Cows: Part 1. How to Distinguish between Non-Lame and Lame Cows Based on Differences in Locomotion or Behavior. Animals 2015, 5, 838-860.

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, 1997; 47, 1178-1187

Key words: Lameness, dairy cow, image processing

P 15-1 Can Interdigital Phlegmon (Foot Rot) Be Treated Without Antibiotics?

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Introduction

Foot rot is a common disease in cattle typically caused by *Fusobacterium necrophorum*. Cows with foot rot are typically acutely lame, with swelling of the foot, fever and a malodorous interdigital cleft [1]. Recommended treatment in Sweden is intramuscular penicillin injection for three days, while broad-spectrum antibiotics should be avoided. Topical treatment of foot rot by farmers requires early detection and prompt cleansing, disinfection and bandaging. Topical application of salicylic acid is common practice in treating digital dermatitis and a similar treatment could be used to treat foot rot. Topical treatment aims to reduce antibiotic consumption, development of resistance, treatment costs and milk discards. However, the treatment effect of salicylic acid has not been scientifically evaluated. Thus this study investigated whether topical treatment with salicylic acid has beneficial therapeutic effects on foot rot in dairy cows under practical conditions.

Materials and Methods

Cows with foot rot were identified by farmers based on any degree of increased temperature, swelling of the foot, lameness and affected general condition, and brought to a trimming chute. Farmers followed a treatment protocol recording cow ID, date and symptoms. The affected foot was lifted, the circumference around the coronet was measured, the interdigital space was washed and inspected, and the site of the lesion was described [2]. A swab was taken from the interdigital skin lesion and sent to the laboratory for bacteriological examination and antibiotic resistance testing of obtained *F. necrophorum* isolates. The topical treatment comprised applying a tablespoon of dry concentrated salicylic acid powder to the interdigital lesion site and covering with an elastic bandage. After 1, 2 and or 3 days, all disease parameters were again assessed by the farmer. The protocol data were analysed statistically with paired t-test, Kolmogorov-Smirnov test.

Results

A total of 61 cases from 24 herds were included in the study. In 89% of cases only rear feet were affected. *F. necrophorum* was isolated from 30 of 61 samples, while in remaining samples no or a mixed flora was found and 24 isolates tested for resistance were susceptible to penicillin (MIC 0.016-0.06 mg/L). General condition of cows did not differ significantly between day 0 and day 1-2 or day 3. Lameness was less severe on day 3 compared with day 0. Temperature and coronet circumference were significantly lower on day 1-2 and day 3, respectively, compared with day 0.

Discussion

The clinical diagnosis of foot rot was confirmed by bacteriological sampling in half the cases and in ll cases by clinical examination by farmers. It is debatable whether farmers' perception of lameness and diagnosis of foot root were correct. The subjective parameters lameness and affected general condition are uncertain because other digital disorders produce similar symptoms. However, the symptoms swelling and elevated temperature are objective measurements and distinguish foot rot from digital dermatitis, which could otherwise be confused with foot rot. Under present conditions and with a motivated farmer with common-sense, foot rot can be successfully treated topically without antibiotics.

Acknowledgements

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Keywords: foot rot, antibiotics, lameness,

References

1. Bergsten C. Infectious diseases of the digits. In: Lameness in Cattle.

Greenough PR, Weaver AD, eds. Philadelphia, Pennsylvania, USA: Saunders 1997; 89–100.

2. Bergsten, C. and C. Carlsson, Behandlingsresultat av två olika preparat vid klövspaltflegmon hos ungtjur (Results from foot rot treatment of beef calves). Svensk Veterinärtidning 1996 (48-9): 389-393.

P 15-2 Developing And Testing A Novel Integrative Approach Without Antibiotics For Reducing Claw Health Problems In Dairy Cows

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Introduction

Claw disorders impair the cow's welfare and negatively affect the farmer's economy (Bruijnis et al 2010; Ettema et al 2010). Multiple and versatile strategies have been developed for mitigating claw health problems, including claw trimming, footbaths and nutritional supplementation. Digital and interdigital dermatitis (DD and ID) are infectious diseases which are most likely to occur when the environmental infection pressure is high or when the cow's resilience is compromised (Sullivan et al 2015; Whitcomb et al 2015). The first objective of this project was to quantify the efficacy of individual strategies for improving claw health or underlying risk factors. The second objective was to assess effects of a novel approach, in which these strategies were combined, on claw health and cow performance.

Materials and methods

The efficacy of 4 preventive and curative strategies was examined in separate pilot studies: 1/ a nutritional supplement (2 farms; 12 months), 2/ a footbath (1 farm; 6 months), 3/ an adhesive for wound healing (4 farms; 1 month), and 4/ environmental disinfection (1 farm; 8 replicates; 3 days). Claw health was scored by independent claw trimmers in the first 3 studies and bacterial activity was measured by the Dutch Animal Health Service in the 4th study. Based on the results, an integrative approach was developed and tested on 2 experimental farms (LBZ Echem, Germany; KU Leuven, Belgium). This approach included a non-antibiotic footbath without heavy metals, individual dietary supplementation, disinfection of slatted concrete floors, and curative treatment with non-antibiotic adhesive for healing DD. Treated cows were compared with control cows during 4 consecutive months. Claw health and performance indicators were measured.

Results

Results from the pilot studies are summarized in Table 1. In general, claw health was positively affected in each of the first 3 studies. In the footbath study, treated cows with DD after 6 months were all classified as M0 or M1, whereas control cows with DD classified as M2 or higher. Disinfection inhibited (P<0.001) bacterial activity on the slatted floors, reducing exposure of dairy cows to (detrimental) bacteria.

Table 1. Overview of results from the pilot studies

	n		Trt effect		
Treatment (Trt)	farms	cows	Start	End	Response variable
1. Supplement	2	224	68	30	% of cows with claw disorders[1]
2. Footbath	1	115	-14[2]	-49	# claws with DD
3. Adhesive	4	390	215	9	# claws with DD
4. Disinfection	1	-	3,325	78	# bacteria (log CFU/mL)

[1]Claw disorders included DD, ID, sole hemorrhage, white line disease, interdigital hyperplasia and sole ulceration.
[2]For study 2, a parallel control group was included and presented values were calculated as treatment minus control.

The studies with the integrated approach are ongoing and results are pending.

Discussion

The pilot studies indicate that each of the intervention strategies may contribute to improving bovine claw health. A combined approach including healing (curative adhesives), sanitation and hygiene (footbath and floor disinfection) and nutritional support is hypothesized to maintain healthy claws in dairy cows without using antibiotics or heavy metals.

Keywords**:** footbath, disinfection, adhesive, nutrition, claws

References

Bruijnis MRN, Hogeveen H & Stassen EN 2010 Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. Journal of Dairy Science 93: 2419-2432.

Ettema J, Østergaard S & Kristensen AR 2010 Modelling the economic impact of three lameness causing diseases using herd and cow level evidence. Preventive Veterinary Medicine 95: 64-73.

Sullivan LE, Clegg SR, Angell JW, Newbrook K, Blowey RW, Carter SD, Bell J, Duncan JS, Grove-White DH, Murray RD & Evans NJ 2015 High-level association of ovine digital dermatitis Treponema spp. with contagious ovine digital dermatitis lesions and presence of Fusobacterium necrophorum and Dichelobacter nodosus. Journal of Clinical Microbiology 53: 1628-1638.

Witcomb LA, Green LE, Kaler J, Ul-Hassan A, Calvo-Bado LA, Medley GF, Grogono-Thomas R & Wellington EM 2014 A longitudinal study of the role of Dichelobacter nodosus and Fusobacterium necrophorum load in initiation and severity of footrot in sheep. Preventive Veterinary Medicine 115: 48-55.

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67 Meta-Analysis DD Intervention Trials: International Lameness Abstracts

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Introduction

Control of DD is managed on many farms through use of disinfecting footbaths. Copper and formalin are widely used, and numerous other active substances or combinations are also used. Foot bathing is used to control DD prevalence via prevention and/or treatment. Various routines for product application are used. The advisor or consumer would look to published information to understand what results to expect from various disinfecting compositions or routines. Reported here is an assessment of International Lameness Congress Abstracts to determine patterns for the actives substances and routines.

Materials and Methods

Abstracts, 2002 – 2015 for intervention studies were reviewed. Data on active substance, control, frequency of application, outcome(s) measured and results were tabulated. Abstracts were included in this analysis if they contained the information indicated. Several abstracts included 2 or more trials, which were analyzed separately if enough information was available. Data were analyzed to look for correlations between active substances or routines and outcomes. The treatment results were scored: 1= improved outcome; 2= outcome unchanged; 3= outcome worse.

Results

Abstracts from 2002-2015 included 42 trials. Active substances included copper or copper with acid, QAC, PAA, organic acids or tea tree oil/organic acid, and calcium hydroxide. All treatments were liquid solutions except one trial with a thickened colloidal solution and three trials with foam. Controls included: negative, historic, copper, formalin, QAC and antibiotic. Trial results were reported in a variety of ways: lesion change, new DD, DD cure, DD score versus a threshold value, or DD stage transitions, or non-M2. The trials typically used Lesion Score (Britt) or M (Dopfer) outcome scoring schemes. Results were reported for prevention and/or treatment. Frequency of application ranged from 2 to 14 times per week. Two studies investigated different application frequencies for copper. Eight studies had a higher application frequency of treatment versus control, with 50% of those studies showing a benefit for the higher application rate. Treatment frequency is associated with a positive outcome. In 21 studies with application >/= 5 per week, improved outcome was reported in 62%. In 21 studies with < 5 improved outcome was seen only 33%. Given a limited number of studies for certain actives, and the likely interaction of active substance and application frequency, a trend based on active substance cannot be made.

Discussion

The trend for increased efficacy with increased application frequency is not un-expected as contact time for the disinfecting agents would be correlated with bacterial kill. Means of extending contact time such as standing footbaths, thicken solutions, or spraying should be further investigated. The analysis presented is complicated by the lack of a standard protocol. The major scoring system evolved overtime from the lesion score to the M-scale. Some studies reported a positive prevention but no cure. Other studies look solely at prevalence resulting from prevention plus cure. It is not clear that all claimed positive outcomes are truly positive. This review supports the need to establish a standard protocol for evaluating DD control products.

Acknowledgements

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References:

Britt J.S. et al. A Uniform Protocol for Evaluating Response to Treatment of PDD Lesions. Bovine Pract 1999(33-2): 149-154.

Dopfer D. et al. Histological and Bacteriological Evaluation of Digital Dermatitis in Cattle, with Special Reference to Spirochaetes and Campylobacter Faecalis. Veterinary Record. 1997(140): 620-623.

International Symposium on Lameness in Ruminants. 2002: 363; 366; 374. 2004: 25; 27. 2006: 203; 208. 2008: 178; 180; 186; 304. 2011: 2; 4; 5; 136; 140; 156; 185. 2013: 164; 206; 210; 218; 224; 228; 233. 2015: 80; 87; 104; 126; 136.

Keywords: Digital Dermatitis, prevention, footbath, protocol, review

68 Repeatability Of Visual Scoring Of Digital Dermatitis Lesions From Photographs Of Standing Animals

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Introduction

Recognising and grading the visual characteristics of digital dermatitis lesions has been well described (1, 2), and despite some alternative grading concepts proposed based on new insights into lesion progression (3) it remains perhaps the most widely used, researched and cited method for investigating digital dermatitis. Using the M-score approach in the parlour appears both sensitive and specific at identifying the presence of lesions in the parlour (4), whether assisted by a mirror mounted on a spatula (5) or not (6) with some misclassification of certain lesions such as the M4.1 when compared with examining lesions in the trimming chute (7). However, in the absence of publicly available training guides, the reliability and repeatability of scoring by researchers depends heavily on accurate and consistent interpretation of detailed lesion descriptors written in English language. No studies (as far as the authors are aware) have compared the performance of independent researchers working in different centres. The study examines the repeatability of researchers using photographs of M-scores taken from animals in the standing position, as would be done in the parlour or during pen walks.

Materials and methods

This small study was conducted involving 10 researchers from three European countries who have scored digital dermatitis regularly in the past using the M-score system. All participants were given access to the modified M-score descriptors (1) but received no formal training or standardization before the exercise. Four of the co-authors provided pictures from their own libraries, giving a total of 88 photographs of digital dermatitis lesions of dairy cattle and heifers in the standing position. M-scores were captured without conferring or consultation, by means of Google Forms. Modal scores were used as the gold standard for this initial study.

Results

The modal scores resulted in 10 M0, 4 M1, 19 M2, 14 M3, 34 M4 and 7 M4.1. At the level of the scorer, percentage agreement with the modal score was median 63% (range 45-75%) and at the level of the photograph it was 60% (range 20-100%). Only 60 of the 88 photographs were scored by all 10 participants and so including only these scores meant percentage agreement increased slightly at the level of scorer (median 71%, range 43-90%) and photograph (median 70%, range 30-100%). Only five photographs achieved 100% agreement (four M0 and one M4 lesion) and 51 (58.0%) photographs were better than 50% agreement.

Discussion

This study is the largest of its kind as far as authors are aware. This study highlights the different interpretation of M score descriptors occurring when observed scores from 10 researchers working across eight European groups were compared using photographs of standing dairy cattle. We conclude that further work is required for M-score standardization between International research centres to ensure research remains comparable and generalizable. This has particular implications for case selection for clinical treatments and treatment trials. The creation of scoring guidance and training materials could aid improved standardization.

References

Berry SL, Read DH, Famula TR, Mongini A, Döpfer D. Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. The Veterinary Journal. 2012 (193):654-8.

Döpfer D, Koopmans MF, Szakáll I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten J, ter Huurne AA. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. The Veterinary Record. 1997 (140): 620–3.

Krull AC, Shearer JK, Gordena PJ, Coopera VL, Phillips GJ, Plummer PJ. Deep Sequencing Analysis Reveals Temporal Microbiota Changes Associated with Development of Bovine Digital Dermatitis. Infection and Immunity. 2014 (82): 3359-3373

Relun A, Guatteo R, Roussel P, Bareille N. A simple method to score digital dermatitis in dairy cows in the milking parlor. Journal of Dairy Science. 2011 (94):5424-34

Stokes JE, Leach KA, Main DCJ, Whay HR. The reliability of detecting digital dermatitis in the milking parlour. The Veterinary Journal. 2012 (193): 679–684

Solano L, Barkema HW, Jacobs C, Orsel K. Validation of the M-stage scoring system for digital dermatitis on dairy cows in the milking parlor. Journal of Dairy Science. 2017 (100): 1592–1603

Keywords: Digital dermatitis, M-score, repeatability

69 Seven Groups Of Chronic Consequences For Bovine Digital Dermatitis.

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Introduction

Digital dermatitis (DD) in cattle is the major causes of lameness, production and welfare losses that compromise claw health under intensive cattle husbandry systems, both dairy and beef. Herdmens' major focus of control is on treating active ulcerative lesions along the coronary band of the foot using either topical antimicrobials or other disinfecting topical treatment agents. Vast resources are invested into disinfecting hoofbaths to prevent recurrence of DD outbreaks without managing risk factors such as bad foot hygiene. Often, the absence of standard treatment protocols and prevention strategies results in increased reservoir formation in chronic lesions that are prone to be associated with treatment failure and major outbreaks of DD. We are provoking our own DD reservoirs exposing DD lesions to caustic chemicals! There is a need to increase awareness about chronic consequences of DD in endemically affected farms. More attention should be given to prevention of chronic reservoirs of DD in order to prevent topical treatment failure and vicious cycles of recurrent outbreaks associated with lameness.

Materials and Methods

Using pictures and clinical evaluation of claw lesions associated with DD, chronic consequences of DD were grouped according to findings in time. A schematic representation of the groups of conditions associated with chronic DD was derived.

Results

Seven groups of chronic consequences of DD are described (1), among which (1) proliferation of epithelium in and around active lesions resulting in an increased skin 'pouch' at the exit of the interdigital space, (2) heel horn erosions in layers and dysfunctional heel horn, (3) overgrown heelhorn in ballhorn regions associated with (3) microtrauma to interdigital skin due to unbalanced weightbearing of the heelhorn, (4) microtrauma is port of entry for other pathogens associated with infectious claw diseases such as interdigital phlegmones, (5) mechanical non-infectious claw lesions as a consequence of unbalances weightbearing of claw horn (sole ulcers, wall abscesses, blocky claws) and (6) treponemes infected skin lesions in atypical locations such as udder base, teat skin, knee folds, hocks, sole ulcers, and wall abscesses.

Discussion

It is of great importance to customize foot bathing strategies and use less caustic topical treatment agents in order to reduce formation of DD lesions associated signs of chronicity such as proliferations. Foot bath fluids should avoid extreme pH values (the advisable pH of 3.5- 5.5 is more similar to normal skin pH), overly high concentations of chemicals and too high frequencies of foot bathing. Time has come to think about how to manage cows chronically affected by DD differently from first case cows. First case lesions when detected early with smaller diameter of active lesion and no signs of chronicity ave a better prognosis for clinical cure. Topical treatment upon 'first case shot' may be the only 'shot' at effective treatment. The role of hoof trimmers for the management of reversible and irreversible claw conformation problems associated with DD needs to be recognized. DD is not an acute short-term condition and therefore, we have not even begun to estimate the true economic losses of DD.

Acknowledgements
Hoof trimmers and producers who discussed this topic actively, their photographs of DD lesions over time and opinions about claw health. Zinpro Corp. is thanked for helping with the making of the schematic representations for the seven groups of chronic consequences of DD.

References

D. Dopfer and A. Gomez (2014) Digital dermatitis – die Chronischen Folgen, MilchPur, December 2014

Keywords: digital dermatitis, signs of chronicity, awareness

70 Genetic Parameters For Improved Phenotypes Of Susceptibility For Digital Dermatitis In Holstein Dairy Cattle

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Introduction

Breeding for lower incidences of digital dermatitis (DD) would be a benefit for economic as well as for animal welfare aspects of dairy farming. Heritabilities for DD were estimated in a low range (1, 2) while improved definitions of clinical status resulted in higher heritability estimates (3). Aim of our study was to investigate the genetic background of DD using repeated observations of improved phenotypes.

Material and Methods

Holstein dairy cattle (8,148) from 7 commercial German dairy farms were scored for DD-status of their hind legs during milking between October 2015 and April 2016. In each farm scoring was performed three times, recording M-stages: M0, M2, M4 according to Döpfer et al. (4) and signs of chronicity, classified as none: smooth skin without thickening/ extra tissue, hyperkeratotic: thickened skin and proliferative: diffuse, filamentous or mass-like overly grown epidermal tissues. After editing, phenotypes were defined for 18,322 observations of 7,215 cows (dataset 1) as binary traits, describing the presence (1) vs. absence (0) of M-stages M2 or M4 (TBIN_R), M2 (TBINA_R) and proliferation of the skin (TCHRONA_R). For 6,230 cows with repeated observations (dataset 2) phenotypes were defined throughout the observation period as binary traits if a cow had at least one observation with M2 or M4 (TBIN), with M2 (TBINA) or proliferation (TCHRONA) and by counting the number of M2 (TCTM2), M4 (TCTM4), and proliferative events (TCTMP). Variance components were estimated using linear and threshold models considering environmental as well as genetic effects in ASREML3.0 (5).

Results and Discussion

Heritability estimates (Table 1) for traits describing acute disease events (TBINA, TCTM2) were lower than estimates for the other traits, pointing to a stronger genetic background for chronic lesions. For traits describing acute disease events estimates were lower than previously found in a heifer dataset from a US herd (3).

Table 1. Heritability estimates from univariate linear animal models for datasets 1 and 2, with No=number of observations, Na=number of animals and standard error in the range of 0.011 to 0.068

Dataset 1				Dataset 2			
Trait	All parities N_o= 18,322 N_a=7,215	Parity 1 N_o=6,276 N_a=2,450	Parity ≥2 N_o= 12,046 N_a=4,765	Trait	All parities N=6,230	Parity 1 N=2,121	Parity ≥2 N=4,109
TBIN_R	0.286	0.221	0.279	TBIN	0.282	0.207	0.270
TBINA_R	0.025	0.039	0.032	TBINA	0.031	0.029	0.042
TCHRONA_R	0.219	0.101	0.246	TCHRONA	0.237	0.146	0.232
				TCTM4	0.335	0.291	0.323
				TCTM2	0.041	0.062	0.053
				TCTMP	0.309	0.144	0.319

Heritabilities from threshold models ranged between 0.081 and 0.375 (dataset 1) and between 0.024 and 0.160 (dataset 2). Genetic correlations between the traits and Spearman rank correlations for breeding values of 67 sires with at least 20 daughters were all high and positive.

Conclusion

Using improved phenotypes revealed comparatively high heritability estimates and strong genetic relationships between traits and thus is favorable for genetic selection for a decrease in susceptibility for DD. Future studies should investigate relationships with other functional and production traits.

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References

1. Koenig S, Sharifi AR, Wentrot H, Landmann D, Eise M, Simianer H. Genetic parameters of claw and foot disorders estimated with logistic models. J Dairy Sci 2005 (88): 3316–25.

2. Häggman J, Juga J. Genetic parameters for hoof disorders and feet and leg conformation traits in Finnish Holstein cows. J Dairy Sci 2013 (96): 3319–25.

3. Schöpke K, Gomez A, Dunbar KA, Swalve HH, Döpfer D. Investigating the genetic background of bovine digital dermatitis using improved definitions of clinical status. J Dairy Sci 2015 (98): 1–11.

4. Döpfer D, Koopmans A, Meijer FA, Szakáll I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten AJ, ter Huurne AA. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Vet Rec 1997 (140): 620–23.

5. Gilmour AR, Gogel BJ, Cullis BR, Thompson R. ASREML User Guide. Third Edition. VSN International Ltd, Hemel Hempstead, HP1 1ES, UK; 2009.

Keywords: dairy cattle, digital dermatitis, M-stage, genetic parameter, breeding

71 A Genome Wide Association Study For Improved Phenotypes Of Susceptibility For Digital Dermatitis In Holstein Dairy Cattle

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Introduction

Bovine Digital Dermatitis (DD) is an infectious disease with a multifactorial aetiology, impacting negative on performance and well-being of cattle. DD is persistent, occurs in different clinical manifestations, and is difficult to manage. Identifying genes with an impact on the cow's resistance against DD, or affecting the course of disease, could contribute to a lower incidence of DD and an improved management of susceptible cows. Moderate to high heritability estimates (1) and a varying immune response (2) for different cow types regarding their susceptibility to DD support the influence of host genetic factors (3). The objective of this study was to identify chromosomal regions and candidate genes with influence on resistance or the course of DD in Holstein dairy cattle.

Material and Methods

On 7 large scale dairy farms a total of 8,148 cows were scored repeatedly for their DD-status during milking. Every cow received a score for M-stage: M0, M2 or M4 as described in Döpfer et al. (4) and one score for signs of chronicity for the hind legs. Chronicity was defined as none (healthy skin), hyperkeratotic (thickened skin) or proliferative (diffuse, filamentous or mass-like overly grown epidermal tissues). After data editing and definition of traits, a genome wide association study (GWAS) was performed for 2,520 cows with available genotype information from an associated project (Illumina BovineSNP50 Beadchip and EuroG10K Beadchip imputed to 50K) using PLINK v.1.07 (5) and SAS 9.4 (6).

Results and Discussion

For the different DD traits altogether 19 SNPs were identified as significant (Bonferroni adjusted p-value < 0.05) and 28 SNPs as suggestive (Bonferroni adjusted p-value < 0.1) on 10 different chromosomes in PLINK and SAS. Most of the SNPs were related to traits describing chronicity, like skin proliferation or the course of the disease, while only a few were linked to acute disease events, supporting our previous finding of a presumably stronger genetic background for chronic disease events. SNPs from a previous genome wide association study for DD-susceptibility (3) could not be confirmed. Intensive literature research for chromosomal regions with association to DD-traits revealed four candidate genes on BTA 11, 19 and 29. In previous studies, these genes were implicated in the regulation of inflammatory processes, immune cell differentiation and alteration of immune cell gene expression upon bacterial infection. The results of our study support a polygenetic influence on the development and progression of DD in Holstein dairy cattle. Sequencing and validation of candidate genes is underway, causal mutations have yet to be determined.

Acknowledgements

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References

1. Schöpke K, Gomez A, Dunbar KA, Swalve HH, Döpfer D. Investigating the genetic background of bovine digital dermatitis using improved definitions of clinical status. J Dairy Sci 2015 (98): 1–11.

2. Gomez A, Anklam KS, Cook NB, Rieman J, Dunbar KA, Cooley KE, Socha MT, Döpfer D. Immune response against Treponema spp. and ELISA detection of digital dermatitis. J Dairy Sci 2014 (97): 4864–75.

3. Scholey RA, Blowey RW, Murray RD, Smith RF, Cameron J, Massey JP, Ollier WE, Carter SD. Investigating host genetic factors in bovine digital dermatitis. Vet Rec 2012 (171): 624.

4. Döpfer D, Koopmans A, Meijer FA, Szakáll I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten AJ, ter Huurne AA. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Vet Rec 1997 (140): 620–23.

5. Purcell S, Neale B, Todd-Brown K, Thomas L, Ferreira, Manuel A. R., Bender D, Maller J, Sklar P, de Bakker, Paul I. W., Daly MJ, Sham PC. PLINK: A tool set for whole-genome association and population-based linkage analyses. Am J Hum Genet 2007 (81): 559–75.

6. SAS Institute Inc. SAS® 9.4 Statements: Reference, Fourth Edition: Cary, NC: SAS Institute Inc.; 2015.

Keywords: dairy cattle, digital dermatitis, M-stage, GWAS, genetic resistance

17 RECORDING/ANALYSIS

72 Data Collection In Real Life In Southern Chile. Records From A Group Of 37 Farms Give A Baseline Of Lameness Incidence, Prevalence And Lesion Distribution

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Introduction

There is very little accurate data for both incidence and prevalence of lesions causing lameness in pasture based dairy farms (1, 2). One reason is because many farmers do not routinely record lameness cases unless a treatment results in milk withholding. A second reason is that where recording is done it is usually entered onto paper records and so is almost irretrievable. A third reason is that data is often meaningless due to inadequate description of the lesions causing the lameness. The aim of this study was to document an accurate baseline of lameness treatments on pasture based dairy farms and to show the potential of good record keeping to deliver both incidence and prevalence data.

Material and Methods

Thirty seven seasonal calving, pasture based dairy farms formed the study group. The average number of cows per farm was 687 (range 367 – 1256). In preparation for the study, farm staff and veterinarians were trained in lameness prevention, treatment methods, lesion recognition and recording into a data base by the authors. Lameness treatments were documented for one full lactation (August 2015 – May 2016) and entered into the data base. Only the lameness causing lesion was recorded in each case. Nine lameness lesions were recorded: White line (WLD), Sole abscess (SA), Axial injury (AX), Digital dermatitis (DD), Overgrowth (OV), Sole bruising (SH), Solar ulcer (SU), Foot rot (PHL), Toe abscess (TA) and Chronic lameness (CHR).

Results

Table 1: lameness causing lesions incidence and prevalence for 37 study farms for the 10 months August 2015 – May 2016.

Lameness lesions	Average lameness Incidence (%)	Range	Portion of total lame (%)	Range	Average monthly prevalence(%)	Range
All lesions	21.62	4.85 – 57.03	100		3.50	0.71 – 10.19
WLD	11.33	0.23 - 29.09	51.92	3.70 – 70.33	1.78	0.23 – 29.09
SA	1.78	0.00 - 7.62	7.63	0.00 – 20.41	0.30	0.00 – 7.62
AX	1.15	0.00 - 4.39	4.84	0.00 – 10.00	0.19	0.00 – 4.39
DD	2.28	0.44 - 6.55	12.08	1.84 – 37.50	0.41	0.44 – 6.55
OV	1.33	0.00 - 3.93	5.82	0.00 – 13.44	0.26	0.00 – 3.93
SH	0.89	0.00 - 5.17	3.93	0.00 – 14.43	0.13	0.00 – 5.17
SU	1.60	0.00 - 6.70	7.02	0.00 – 17.57	0.29	0.00 – 6.70
PHL	0.41	0.00 - 1.19	1.92	0.00 – 4.81	0.06	0.00 – 1.19
TA	0.12	0.00 - 0.91	0.45	0.00 – 3.23	0.02	0.00 – 0.91
CHR	0.50	0.00 - 1.94	2.14	0.00 – 6.91	0.07	0.00 – 1.94

Key – Incidence = number of new animals listed as treated as a percent of the average number of cows in the herd. Only first events for the lactation were included. Prevalence = number of treatments per number of cows in the herd recorded monthly.

The average herd lameness incidence was 21.64% (range 4.85 – 57.03%) See Table 1. It was noted that 35% (14.29 – 74.53%) of all treatments were repeat treatments

Discussion

Often the only records a farmer has are of lesions identified on the day of routine trimming (3). Accurate recording is necessary to understand a problem, and in tracking effectiveness of treatment and onsets of new lameness (4). This data set gives a baseline for lameness-causing lesions in pastoral dairy farms in southern Chile. A similar case study of large herds in the South Island of New Zealand (5) showed similar results: average herd incidence – 26.2% (4.3 – 64.4%) with White-line accounting for 58% of the lameness treatments. This data set was only possible after both training of farm staff, and strong insistence on regular input of data to a well-constructed data base. With this lameness data it is planned to try and identify more accurately the risk factors for the different lameness lesions recorded on the 37 farms in the study, and in the future to be able to accurately measure the response to reducing the risks.

References

Ranjbar S, Rabiee AR, Gunn A, House JK. Identifying risk factors associated with lameness in pasture-based dairy herds. Journal of Dairy Science 2016 (99): 7495-7505.

Fabian J, Laven RA, Whay HR. the prevalence of lameness on New Zealand dairy farms: A comparison of farmer estimate and locomotion scoring. The Veterinary Journal 2014 (201): 31-38

Borkert JA. Prevalence of lameness in 20,958 cows and the type of claw lesion in 1929 lame cows from 47 dairy herds in Southern Chile. In: 16th Symposium and 8th Conference on lameness in Ruminants. Rotorua, New Zealand 2011; 127.
http://www.ivis.org/proceedings/rumlameness/2011/oral/cramer2.pdf

Cramer G, Guard C. Recommendations for the calculation of incidence rates for monitoring foot health. In: 16th Symposium and 8th Conference on lameness in Ruminants. Rotorua, New Zealand 2011; 41 http://www.ivis.org/proceedings/rumlameness/2011/posters/borkert5.pdf

Gibbs SJ. Dairy Lameness in the South Island. In: 4th Australasian Dairy Science Symposium. Christchurch, New Zealand. 2010; 424-427

Key words: incidence, records, white-line, prevalence, Chile

73 Assessment Of Prevalence And Economic Impact Of Three Claw Disorders In Spanish Herds With And Without Preventive Hoof Trimming

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Introduction

Claw disorders are considered to have a negative impact on milk production, fertility and longevity of animals. It is recognized that the use of preventive functional claw trimming (FT) reduce lameness incidence (Hernandez et al., 2007). The overall aim of hoof trimming is to maintain a correct weight distribution through the foot in order to minimize and prevent lesion development. The goal of this study is to assess the hoof trimming as a preventive factor of the most prevalent claw disorders and the economic costs in herds using it.

Materials and Methods

Records of claw disorders from 7,300 cows, trimmed during 2015 by two trimmers in 30 Spanish Holstein herds which practice or not FT located in Northeast regions of Spain (Navarra and Basque Country) have been used. The three most prevalent lesions collected in I-SAP (Spanish recording system for claw health) were studied: dermatitis (DE), sole ulcer (SU) and white line disease (WL). Economic and technical information for each herd have been obtained from Spanish Holstein Association (CONAFE) database. The association between FT and each lesion was estimated using a binomial distribution and a probit link function in generalized linear models (PROC GENMOD of SAS, 2003) adjusted by age, days in milk, herd, and trimmer. Odds ratios (OR) of each lesion were also estimated. Costs of claw disorders have been calculated using the tool developed by Charfeddine and Pérez-Cabal (2016). Mean comparison of costs was tested using general linear model (PROC GLM of SAS, 2003).

Results

The prevalence rates of DE, SU and WL in herds having FT vary in the range from 0 to 35.8%, from 0 to 31.3% and from 0 to 33.3%, respectively. However, in herds without FT routines, prevalence rates range from 0 to 57.9%., from 14.1 to 46.4 and from 0 to 38.2% for DE, SU and WL, respectively. The frequency of severe lesions in herds following a FT routine varies from 0 to 20.6%, while in herd without FT routine it ranges from 0 to 31.6%. Associated risk factors analysis shows that cows in herds without FT compared to those with FT, were more likely to develop DE (OR=1.3), SU (OR=1.51), and WL (OR=2.02). Moreover, lesions tended to be more severe (OR=1.3), and costs were higher for SU and WL (Table 1.).

Table 1. Estimated cost per present cow per year of the three most prevalent lesions depending on the use of preventive trimming protocol (FT).

€/present cow/year	Herds with FT	Herds without FT
Dermatitis	16.55^{a}	14.68^{a}
Sole ulcer	43.99^{a}	66.65^{a}
White line disease	23.75^{b}	49.27^{a}
Overall cost of the three claw disorders	84.29^{b}	130.60^{a}

^{a,b} Different superscripts within a row mean statistical differences (*P*<0.05)

Discussion

The lack of FT is a risk factor associated with claw disorders, which is consistent with results shown by Hernandez et al. (2007). Despite including FT cost, herds with FT showed an overall cost of claw health 35% lower than herds without it, due to the higher costs of SU and WL.

Acknowledgements

The authors thank the Spanish Holstein Association (CONAFE) and ANKA Hoof Care for their support.

References

Hernandez, J. A., Garbarino E. J., Shearer J. K., Risco C. A., Thatcher W. W., 2007. Evaluation of the efficacy of prophylactic hoof health examination and trimming during mid lactation in reducing the incidence of lameness during late lactation in dairy cows. Journal of the American Veterinary Medical Association 230, 89–93

Charfeddine, N., and M. A. Pérez-Cabal. Effect of claw disorders on milk production, fertility, and longevity, and their economic impact in Spanish Holstein cows. J. Dairy Sci. 100:1–13 https://doi.org/10.3168/jds.2016-11434

SAS INSTITUTE (2003). User's Guide, Release 9.1. SAS Institute Inc., Cary, NC.

Keywords: preventive trimming, risk factor, costs.

74 Nationwide Improvement In Prevalence Of Lameness In Dairy Cattle In Great Britain

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Introduction

Following an assessment of 205 dairy farms in Great Britain in 2006-2007, nationwide prevalence (and between farm range) was estimated at 36.8%, (0-79.2%) (1), and was comparable to the findings of other studies globally (2,3,4). The Dairy cattle Welfare Strategy for GB was launched in 2010 and highlighted lameness as a priority. Lameness was increasing in importance to the industry. The Healthy Feet Project (2006-2010) led by the University of Bristol put the spotlight on lameness prevalence. In particular the project identified the challenge of helping farmers utilise their existing knowledge and recommended they apply their own action plans to tackle lameness. This project initiated a decade long programme of industry led initiates to control lameness. On completion of the project, its legacy was handed over to the industry to be further developed, ultimately into the AHDB Dairy Healthy Feet Programme (2011; https://dairy.ahdb.org.uk/technical-services/healthy-feet-programme/#.WG_JLk1XWCo). The industry-led Dairy Cattle Mobility Steering group (DCMSG) was established in 2013 by AHDB Dairy, the UK dairy industry levy board (https://dairy.ahdb.org.uk/about-ahdb-dairy/industry-groups/dairy-cattle-mobility-steering-group) bringing together cross industry stakeholders. Concurrently there has been active engagement by, and collaborative initiatives with, the National Association of Cattle Foot Trimmers (NACFT) including recent moves to formalise the accreditation of hoof trimmers. Underpinning this AHDB Dairy have invested in a concerted programme of lameness research (2011 -2021) and in 2009 an annual national Cattle Lameness Conference was established to disseminate recent lameness knowledge to the industry. More recently a range of private industry led initiatives have begun to emerge (e.g. the Cattle Lameness Academy http://www.cattlelamenessacademy.co.uk/) furthering the momentum and critical mass in this vital area of animal health. This study aimed to measure lameness prevalence in a random sample of dairy farms following a decade of national, industry-led efforts to control lameness.

Materials and Methods

A random sample of dairy farms in the midlands region of England were selected for assessment. The whole milking herd on each of the 42 selected farms (5620 cows) was locomotion scored by a trained observer using the four-point UK industry standard mobility scoring system. Industry-driven efforts to control lameness were collated by discussion with key opinion leaders and liaison with industry bodies.

Results

Average within herd lameness prevalence in this study was 30% (range 7-61%) with a total cow level lameness prevalence of 29%.

Discussion

Lameness prevalence appears to have reduced in Great Britain over the last decade. Whilst further validation of this finding is needed, it appears that national lameness control may have turned a corner with lameness prevalence now starting to decline. Whilst there is still some way to go, the impact of the increased coordination and attention on lameness by the industry is undeniable. The role of AHDB Dairy in overseeing and coordinating the engagement of so many stakeholders, and creating an industry led approach, appears to have been key.

Acknowledgements

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References

Barker ZE, Leach KA, Whay HR, Bell NJ and Main DCJ. Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. Journal of dairy science 2010, 93(3): 932-941.

Espejo LA, Endres MI, Salfer JA. Prevalence of lameness in high-producing holstein cows housed in freestall barns in Minnesota. Journal Dairy Science 2006, 89(8):3052-8

Dippel S, Dolezal M, Brenninkmeyer C, Brinkmann J, March S, Knierim U, Winckler C. Risk factors for lameness in freestall-housed dairy cows across two breeds, farming systems, and countries. Journal of Dairy Science 2009, 92(11):5476-86

Tadich N, Flor E, Green L. Associations between hoof lesions and locomotion score in 1098 unsound dairy cows. Veterinary Journal 2010, 184(1):60-5

75 Prevalence And Incidence Of Bovine Digital Dermatitis In Taranaki, New Zealand, 2015-2016: Descriptive Statistics Of A Longitudinal Observation

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Introduction

A recent survey identified BDD on 64% of farms in the Taranaki region of NZ. Initial analysis suggested that BDD could be seasonal, even though cattle are permanently at pasture. A longitudinal study to investigate the prevalence and incidence of BDD in Taranaki over a whole lactation was therefore undertaken.

Materials and Methods

Whole herd screening (visual observation of hind feet) was undertaken on 57 farms which had been identified as BDD positive previously, starting at 07/09/15 (~1 month after start of calving) and finishing on 04/05/16 (just prior to drying off). Farms were screened on five occasions, approximately 6 weeks apart. Cow ID and presence/absence of BDD was recorded and the herd and cow level prevalence/incidence calculated. The correlation matrix of within-herd prevalence/incidence across visits was examined as were the correlation between prevalence and incidence for individual visits and all visits (with 95% confidence interval) were also examined.

Results

The proportion of infected farms at each of the five visits, in visit order, were 33/57, 48/57, 43/57, 25/57 and 26/57, respectively. Overall 55/57 farms had cows with lesions on at least one occasion. During the study, lesions were identified on 938 occasions. Six hundred and forty-six cows were recorded as having a BDD lesion on at least one occasion. Of these, 469, 99, 51, 17 and 10 cows were recorded as having a lesion on one to five occasions, respectively. The cow level prevalence and incidence at each visit is summarised in Fig 1.

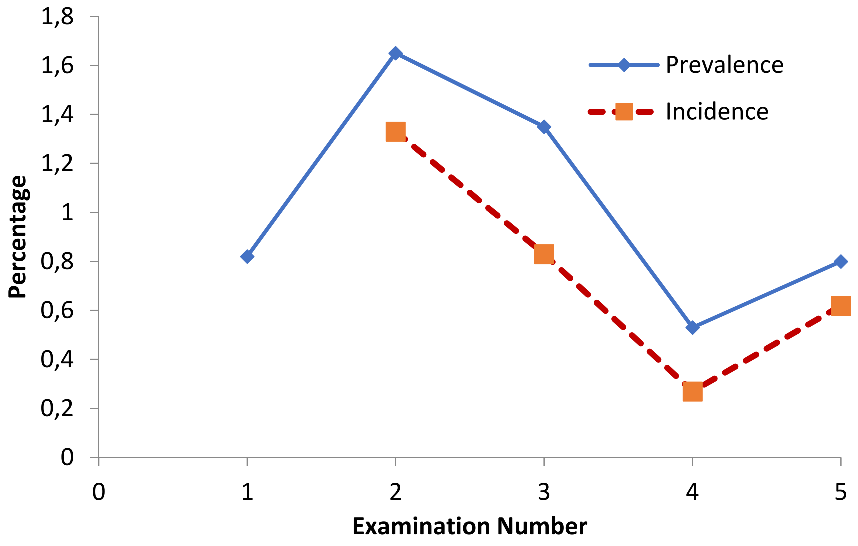

Figure 1: Prevalence/incidence of BDD at each visit on 57 farms.

The correlation analyses suggested a farm tended to have higher prevalence/incidence if it had previously had higher prevalence/incidence and prevalence was highly correlated to incidence (r= 0.94; 95%CI: 0.93 - 0.96).

Discussion

Although these herds had all been positive in the previous survey, a significant proportion of them particularly later in the year had no visible cases of BDD. Overall the proportion of infected cattle was lower than reported in the initial survey even though infected herds were specifically selected for this study. The proportion of affected cattle was very low compared to the level seen in affected herds in the northern hemisphere (1), as was the proportion of cattle which were observed as having lesions on more than one occasion. Nevertheless, herds which had higher level of BDD tended to have higher levels throughout the year, so clearly there were farm level risk factors which increased the risk of disease.

Acknowledgements

Technical support from Megan Moss and the support of the farmers are gratefully acknowledged.

References

1. Holzhauer M, Brummelman B, Frankena K, Lam T. A longitudinal study into the effect of grazing on claw disorders in female calves and young dairy cows. The Veterinary Journal. 2012; 193(3):633-8.

Keywords: Prevalence, Incidence, Correlation

P 17-1 Generalize The Recording And Valorization Of Lameness Data In Dairy Cattle.

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Introduction

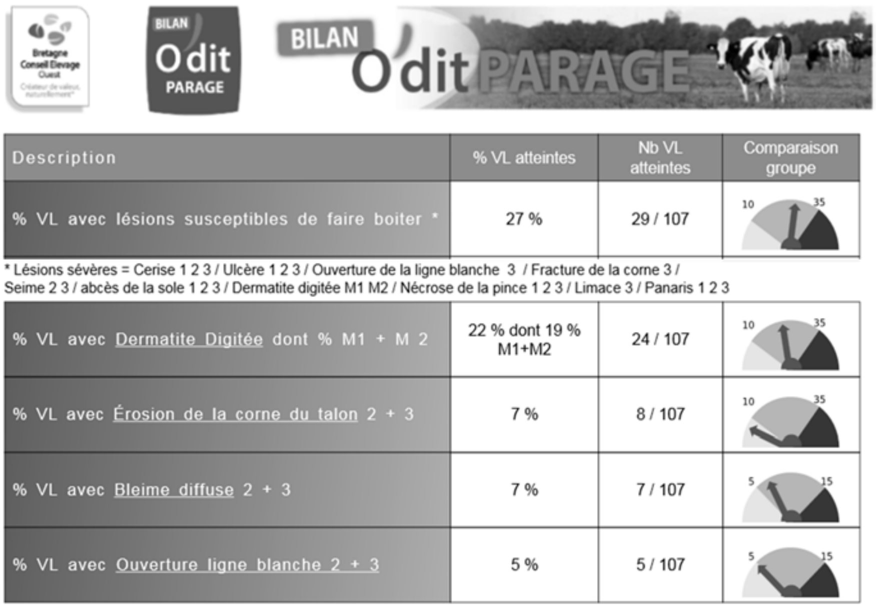
The collection of phenotypes is historically carried out by the breeding consulting companies in France. Bretagne Conseil Elevage Ouest (BCEL Ouest) wished to go further by generalizing the survey of 21 diseases since 2013. In addition, at the beginning of 2014 BCEL Ouest initiated the collection of feet and claws disorders during the hoof trimming by the creation of ACTIV PARAGE®, a software on tablet. The objective of this communication is to explain the BCEL Ouest approach, the relevance of the data collected and their valuations for the breeders.

Materials and Methods

The data recording of feet and claw disorders is defined, in France, by PARABOV and CFPPA Le Rheu (Blériot et al., 2013). The BCEL Ouest data are more than 43 000 cows and more than 100 000 hoof-trimming in 834 dairy farms which constitute the database as of 31/12/2016.

Results

Valorization for the breeder: By this method of data collection, the breeder has access to a technical valorization. The O'DIT PARAGE® document is the synthesis and the observation of the lesions present in the dairy herd during a trimming intervention. It is possible to observe the most present lesions, the most serious lesions and to prioritize the pathology present in the herd (Figure 1). The second valorization for the breeder is the individual valuation of the animals and know which animals have serious lesions as well as the animals which have particular care (bandage, heel) or a particular lesion to be managed (Digital dermatitis, M1 or M2).



Description	% VL atteintes	Nb VL atteintes	Comparaison groupe
% VL avec lésions susceptibles de faire boiter *	27 %	29 / 107	10 35

* Lésions sévères = Cerise 1 2 3 / Ulcère 1 2 3 / Ouverture de la ligne blanche 3 / Fracture de la corne 3 / Seime 2 3 / abcès de la sole 1 2 3 / Dermatite digitée M1 M2 / Nécrose de la pince 1 2 3 / Limace 3 / Panaris 1 2 3

Description	% VL atteintes	Nb VL atteintes	Comparaison groupe
% VL avec Dermatite Digitée dont % M1 + M 2	22 % dont 19 % M1+M2	24 / 107	10 35
% VL avec Érosion de la corne du talon 2 + 3	7 %	8 / 107	10 35
% VL avec Bleime diffuse 2 + 3	7 %	7 / 107	5 15
% VL avec Ouverture ligne blanche 2 + 3	5 %	5 / 107	5 15

Figure 1 : Extract from an O'DIT PARAGE® synthesis.

Advices to the breeder: Three levels of advice are purposed by BCEL Ouest, by three different interlocutors. The first one is the hoof-trimmer who provide a brief and quick report to the breeder after the trimming intervention. The second level of consulting is the breeding consultant who will analyze the data from the trimming intervention more finely, and cross the individual animal data with other dairy performance data. The breeding consultant will be able to direct the predominant pathology in the breeding and to suggest the actions to be put in place. The third level of advice is a complete audit of a breeding situation, carried out by the veterinary consultant of the company in connection with the veterinary health of the farm.

Creation Of Technical References: The database size permits to provide technical references and to increase the knowledge about the problems of lameness in dairy farms. The client's knowledge of the company BCEL Ouest also allows to cross the data of lesions of the feet with other data of breeding and data related to the animal.

Discussion and Conclusion

The implementation of the data recording of the foot and claw disorders is a major innovation in the company to improve the knowledge of lameness in breeding. This makes it possible to historicalize the data and analyze a situation at a moment. This approach permit to measure the risk of lameness in livestock and propose the good actions to be put in place.

References:

Fourichon C. et al. 1999, Renc. Rech. Rum. (6) 195-198

Bleriot G. et al. 2013, Renc. Rech. Rum. (20), 395.

Keywords : phenotype, data, collection, advice, consulting.

18 IMPACT OF LAMENESS

76 The Largest Reduction In Activity Due To Lameness Occurs During Early Lactation In Multiparous Dairy Cows

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Introduction

Stage of lactation and lameness both affect cow activities such as lying time and the number of steps. However, studies have reported somewhat inconsistent results, most likely due to too short measurement periods or grouping days in too long periods (Steensels et al 2012; Vasseur et al 2012; Westin et al 2015; Solano et al 2016), whereby important features of their activity pattern may have disappeared. A recent study of housed cows milked twice daily on four commercial farms and measured continuously demonstrated that lying time decreased to a minimum five weeks after calving and reached a peak plateau 200 days after calving (Maselyne et al 2017). This study aimed to compare the activity of multiparous cows that were lame and not lame during weekly periods throughout lactation.

Materials and Methods

Ethical approval was given by Harper Adams University Research Ethics Committee. Holstein Friesian cows at the Harper Adams University dairy unit wore IceQube® accelerometer-based sensors (IceRobotics Ltd, Edinburgh, UK). Cows were milked twice a day and grazed during daytime from spring to autumn. Two years of data from a hind leg starting November 2014 were used, which contained 237 lactations (not all were complete) from 116 multiparous cows. Primiparous cows were excluded from the analysis because of too few lame cows. Each week, cows were mobility scored on a scale from 1 (sound) to 5 (severely lame) (Chapinal et al 2009) by an experienced technician. Lameness was defined as any mobility score greater than two. Only days on which cows were mobility scored were included in the analysis. Mean daily lying time and step count for periods of one week were calculated for the lame and non-lame groups. Lame and non-lame groups were compared using t-tests on weeks 1, 5, 10, 15, 20, 25, 30, 35 and 40.

Results

In Figure 1, the lying time and number of steps are plotted relative to week in lactation for lame and non-lame groups. Lame cows would lie down significantly more than non-lame cows during week 1 and 5. Lame walked significantly less than non-lame cows during week 1, 5, 10, 15 and 20. The remaining weeks, groups did not differ significantly. The lying time of non-lame cows declined to a minimum of 554 min/d during 29 to 35 days, i.e. week 5 in lactation.

Discussion

Lameness clearly decreased the activity of multiparous cows, particularly during week 1 and 5 in lactation (Figure 1). The number of steps was lowered by lameness for a much longer period than lying time (Figure 1. Cows milked twice daily reached a lying time minimum during week 5 in lactation, which was in agreement with Maselyne and colleagues (2017). The IceQubes were capable of detecting key behavioural differences relating to lameness. Future research should seek to investigate the effect of lameness severity, movements between groups, oestrus, grazed versus housed conditions, milk yield, and number of milkings per day on cow activity further.

Acknowledgements

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References

Chapinal N, de Passillé AM, Weary DM, von Keyserlingk MAG and Rushen J 2009 Using gait score, walking speed, and lying behavior to detect hoof lesions in dairy cows. *Journal of Dairy Science 92*: 4365–4374

Maselyne J, Pastell M, Thomsen PT, Thorup VM, Hänninen L, Vangeyte J, Van Nuffel A and Munksgaard L 2017 Short communication: Daily lying time, motion index and step frequency in dairy cows change throughout lactation. *Research in Veterinary Science 110*: 1–3

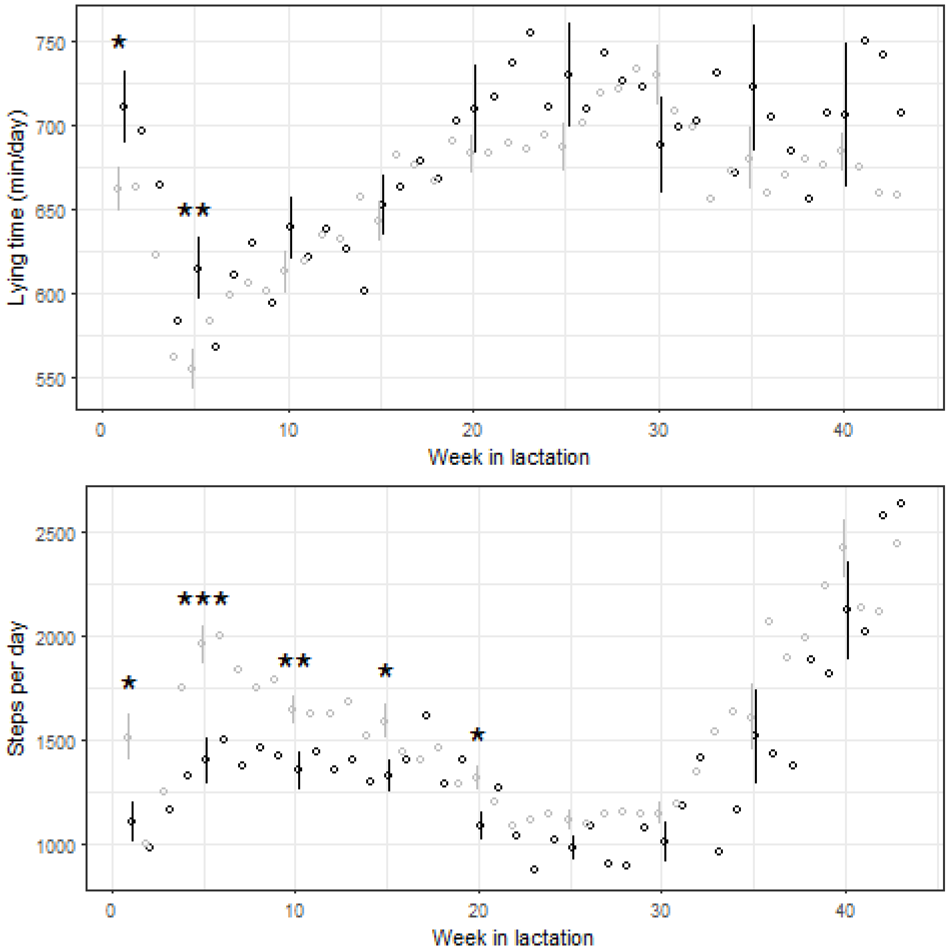
Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Nash CGR, Haley DB, Pellerin D, Rushen J, de Passillé AM, Vasseur E and Orsel K 2016 Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. *Journal of Dairy Science 99*: 2086–2101

Steensels M, Bahr C, Berckmans D, Halachmi I, Antler A and Maltz E 2012 Lying patterns of high producing healthy dairy cows after calving in commercial herds as affected by age, environmental conditions and production. *Applied Animal Behaviour Science 136*: 88–95

Vasseur E, Rushen J, Haley DB and de Passillé AM 2012 Sampling cows to assess lying time for on-farm animal welfare assessment. *Journal of Dairy Science 95*: 4968–4977

Westin R, Vaughan A, de Passillé AM, DeVries TJ, Pajor EA, Pellerin D, Siegford JM, Vasseur E and Rushen J 2015 Lying times of lactating cows on dairy farms with automatic milking systems and the relation to lameness, leg lesions, and body condition score. *Journal of Dairy Science 99*: 551–561

Figure 1: Lying time (min/day) and steps (number/day) of non-lame and lame cows relative to week in lactation, grey: non-lame, black: lame, error bars represent standard error of the mean of those weeks where groups were compared statistically. Asterisks denote significant difference between lame and non-lame groups of a week.



Keywords: Accelerometer, Behaviour, Dairy cattle, Lying time, Step number

77 Impacts Of Changing Freestall Area On Prevalence Of Lameness, Lying Time And Leg Injuries On Dairy Farms In Alberta

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Introduction

Cow comfort is of great importance to the dairy industry (1). However, the impact of changes made to the cows' environment by the producer on cow comfort has not been well characterized. Our objectives were to: 1) quantify impact of freestall area changes on prevalence of lameness and leg injuries, and average lying time; and 2) compare cow comfort outcomes on farms that have never had an assessment of cow comfort to farms that had a previous assessment of cow comfort.

Materials and Methods

A total of 44 freestall dairy farms in Alberta were visited in 2015. Participating farms included 30 farms that had been previously assessed for cow comfort. Fifteen of these farms had made changes to the freestall area (CHANGE farms), while the other 15 farms did not (NOCHANGE farms). An additional 14 farms that had no previous cow comfort assessment also participated (NEW farms). To facilitate comparison, methodology to assess cow comfort was consistent with previous studies (6,7). Methods included evaluations of animal-based measures, environmental measures, as well as management factors (8). The project was approved by the University of Calgary's Animal Care Committee (AC14-0216).

Results

Cows on NOCHANGE and NEW farms were 1.50 (1.17-2.12) and 1.71 (1.23-2.35) times more likely to be lame when compared to cows in the CHANGE farms, respectively. Average daily lying time was 0.33 and 0.62 h/d lower in the NOCHANGE and the NEW farms, respectively, compared to CHANGE farms. Prevalence of hock injuries was not different among the 3 groups of farms, but CHANGE farms had significant less knee injuries. No differences were detected when comparing NEW farms with the NOCHANGE farms; therefore, we concluded that the NOCHANGE group had not been biased by a previous assessment of cow comfort, and comparable over time. With farms in the CHANGE group having a lower prevalence of lame cows and greater lying time, it indicates that changes in free-stall design and management improved important measures of cow comfort.

Discussion

Cows on CHANGE farms had a lower prevalence of lameness when compared to NOCHANGE farms and NEW farms, as the CHANGE farms made changes to known risk factors associated with lameness (2,3,6). Due to similar risk factors impacting average daily lying time (7), the result of CHANGE farms having a higher average daily lying was in line with our hypothesis. However, there were no differences among study groups in terms of hock injuries. This study did not quantify the impact of specific changes. Additionally, certain known risk factors for injuries, e.g. stall base (4,5), were underrepresented in our study.

Acknowledgements

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References

Barkema, H. W., M. A. G. von Keyserlingk, J. P. Kastelic, T.J.G.M. Lam, C. Luby, J.-P. Roy, S. J. LeBlanc, G. P. Keefe, and D. F. Kelton. 2015. Invited review: Changes in the dairy industry affecting dairy health and welfare. J. Dairy Sci. 98:7426-7445.

Chapinal N., A. M. de Passillé, D. M. Weary, M. A. G. von Keyserlingk, and J. Rushen. 2009. Using gait score, walking speed, and lying behavior to detect hoof lesions in dairy cows. J. Dairy Sci. 92.4365-4374.

Cook, N. B. and K. V. Nordlund. 2009. The influence of the environment on dairy cow behavior, claw health and herd lameness dynamics. Vet J. 179:360-369.

Huxley, J. N. and H. R. Whay. 2006. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. Vet. Rec. 159:662-668.

Kielland, C., L. E. Ruud, A. J. Zanella, and O. Osteras. 2009. Prevalence and risk factors for skin lesions on legs of dairy cattle housed in freestalls in Norway. J. Dairy Sci. 92:5487-5496.

Solano, L., H. W. Barkema, E. A. Pajor, S. Mason, S. J. LeBlanc, J. C. Zaffino Heyerhoff, and K. Orsel. 2015. Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. J. Dairy Sci. 98:6978-6991.

Solano, L., H. W. Barkema, E. A. Pajor, S. Mason, S. J. LeBlanc, C. G. R. Nash, and K. Orsel. 2016. Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. J. Dairy Sci. 99:2086-2101.

Zaffino Heyerhoff, J. C., S. J. LeBlanc, T. J. DeVries, C. G. R. Nash, J. Gibbons, K. Orsel, H. W. Barkema, L. Solano, J. Rushen, A. M. de Passillé, and D. B. Haley. 2014. Prevalence of and factors associated with hock, knee, and neck injuries on dairy cows in freestall housing in Canada. J. Dairy Sci. 97:173-184.

Table 1. Cow-level prevalence (%) of lameness, hock, and knee injuries and average lying time in farms that did and did not make changes to the freestall area as well as new farms.

	Freestall change farms (n=15)	No freestall change farms (n=15)	New farms (n=14)
Lameness			
Not lame	747 (89)^a	660 (81)^b	560 (78)^b
Lame	92 (11)	158 (19)	160 (22)
Hock injuries			
Not injured	788 (94)	775 (95)	677 (93)
Injured	51 (6)	43 (5)	51 (7)
Knee injuries			
Not injured	814 (97)^a	769 (94)^b	662 (91)^b
Injured	25 (3)	49 (6)	66 (9)
Average hours lying per day (mean ± SD)	12.6 ± 2.3^a	10.7 ±2.2^b	10.2 ± 3.1^b

^{a,b}Within a row, percentages or estimates without a common superscript differed ($P < 0.05$)

Keywords (3-5): dairy cattle, animal welfare, lying time, leg injury, hock injury

78 The Influence Of Lameness And Claw Disorders On Fertility Parameters In Austrian Dairy Cows

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Introduction

The aim of this study was to analyse the influence of lameness and claw disorders on fertility parameters in Austrian dairy cows. Data on lameness, claw health and fertility were collected in regards to the "Efficient cow" project during the years 2013 to 2015.

Material and Methods

Data of 5392 Braunvieh, Fleckvieh and Holstein-Friesian cows from 166 Austrian dairy herds were used for evaluation. The cows were scored every 60 days during the lactation period for locomotion (*Sprecher et al. 1997),* and were grouped regarding their observed lameness episodes into five locomotion groups (L-groups; group 1: never lame; L-group 2: only two observations with locomotion score (LSC) 2; L-group 3: more than two observations with LSC 2 & one LSC 3 observation; L-group 4: two & more observations of LSC 3; L-group 5: one or more observations of LSC 4 and 5). Assessed claw lesions were documented during the 12 month observation period. The relationship between lameness & claw disorders and on fertility parameters such as calving to conception interval, calving interval, first service conception rate and non-return rate was calculated. The Chi-square test was used for evaluation of the frequency distribution of fertility parameters. The Bonferroni-Holm-test was applied for paired comparison analysis of non-lame and lame cows for each of the fertility parameters.

Results

Assessed differences regarding the fertility parameters examined between never lame cows of all the three breeds and the other locomotion groups were statistically significant for each breed. The mean calving to conception interval for never lame Fleckvieh cows was 97.5 days compared to 112.9 days for the L-group 5. The mean calving interval for never lame Holstein cows was 392.5 days compared to 425.3 days for L-group 5. The mean calving to conception interval, the mean calving interval and the non-return rate 50 were significantly lower in cows which showed no lameness within the first 100 DIM compared to cows which showed any lameness score in the same time frame. First service conception rate was assessed to be the highest for never lame cows (50%), the poorest results with 35.4% were observed for cows of L-group 4. Comparable results were seen for the non-return rate for 56 days for all breeds, whereas never lame cows performed best with 61.1% and moderate lame cows worst with 55.2 % respectively. Related to the documented claw disorders the calving interval for Fleckvieh cows was significantly shorter in cows without painful claw lesions compared to cows affected by painful claw horn lesions (mean 374.4 vs. 384.6 days).

Discussion

This is the first study that evaluated the relationship between lameness & claw disorders during lactation and selected fertility parameters in Austria. The results indicated that fertility parameters are significantly negatively influenced in cows being moderately and severely lame on repeated observation dates compared to never lame cows. Comparable results were reported from other countries *(Wiedenhöft 2005; Bicalho et al. 2007; Somers et al. 2015).*

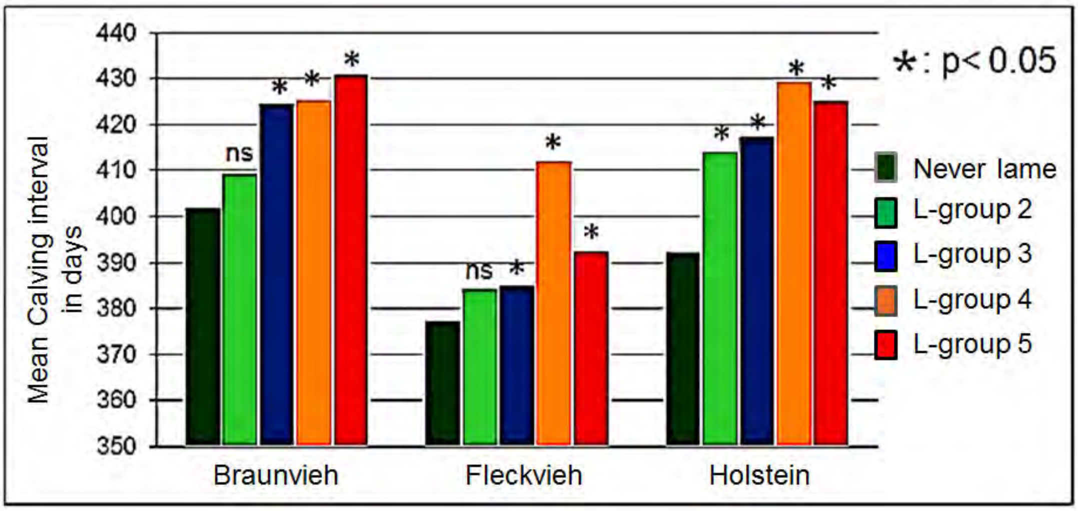

Fig. 1: Mean calving interval (in days) for never lame cows compared with cow groups showing different lameness observations in regard to the locomotion score (increasing with the number) and in regards to the lameness episode observations (increasing with the number) within one-year period; *: significant vs. non-significant (ns) difference to the group of never lame cows.

References

Bicalho RC, Vokey F, Erb HN, Guard C 2007 Visual locomotion scoring in the first seventy days in milk: Impact on pregnancy and survival. J. Dairy Sci., 90 (10): 4586 4591.

Somers JR, Huxley J, Lorenz I, Doherty ML, O'Grady L 2015 The effect of lameness before and during the breeding season on fertility in 10 pasture-based Irish dairy herds. Irish Vet. J., 68 (1):14. DOI 10.1186/s13620-015-0043-4; accessed December 20, 2016.

Sprecher DJ, Hosteler DE, Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenol., 47 (6): 1179-1187.

Wiedenhöft D 2005 Einfluss von Lahmheiten auf die Fruchtbarkeitsleistung von Milchkühen. Dissertation, Tierärztliche Hochschule Hannover.

Key Words: Lame dairy cows, claw lesions, fertility parameters, Efficient Cow Project

79 Lameness In Dairy Heifers: Long-Term Impacts Of Hoof Lesions

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Introduction

Whilst it has been demonstrated that a lameness event in dairy cows increases future lameness risk, the impact of hoof lesions in heifers on long-term lameness risk is less clear (Green, et al. 2014, Hirst, et al. 2002, Randall, et al. 2015). Similarly, impacts on milk yield and culling have been widely reported, but have not yet been fully explored in heifers (Amory, et al. 2008, Booth, et al. 2004). Considering the high prevalence of lesions in heifers, impacts on long-term health, productivity and welfare of the dairy herd could be significant (Capion, et al. 2009, Maxwell, et al. 2015). This study aimed to investigate long-term impacts of hoof lesions, occurring around the time of first calving, on future lameness, milk yield and culling risk. (Randall, et al. 2016).

Materials and Methods

Data were obtained from 158 heifers calving between 2003 and 2006 into Scotland's Rural College (SRUC) Dairy Research and Innovation Centre. Heifers were examined from 2 months pre-calving to 4 months post-calving (2 month blocks); sole lesions (SL) and white line lesions (WLL) were scored on a zero to 10 scale and digital dermatitis (DD) zero to 3. Data for outcome measures, including lameness (weekly locomotion scores), average daily milk yield and culling, were obtained from 2003 to 2011. Regression models were used to investigate associations between maximum lesion scores and outcomes.

Results

Sole lesions were the most common lesion and cumulative incidence increased after calving; 2-4 months post-calving 97% of heifers had some degree of SL. WLL ≥3 and SL ≥4 2-4 months post-calving were associated with an increased risk of future lameness (Table 1). Predicted increased relative risk was 1.6 for WLL and 2.6 for SL. Mild WLL (score 2 – 4) pre-calving were associated with a decreased lameness risk, likewise SL (score 2) 2-4 months post-calving were associated with a decreased risk. SL ≥4 and DD ≥1 2-4 months post-calving were associated with a milk yield reduction when adjusted for time within the herd; 9,928 kg and 3,513 kg respectively over the animals' productive lifespan. Mild SL (score 1) pre-calving were associated with a reduced culling risk.

Table 3 Summary of key results from binomial models for the outcomes lameness and culling in 158 heifers calving during the time period August 2003 to March 2006, with herd lifetime data recorded from September 2003 to August 2011 at the SRUC Dairy Research and Innovation Centre.[1]

Outcome: Lameness (locomotion score ≥3 on a 1 to 5 scale)			
Variable	Odds ratio	Lower 95% CrI[2]	Upper 95% CrI
WLL score 0-2 months pre-calving			
0 to 1	Baseline		
2 to 4	0.34	0.13	0.86
WLL score 2-4 months post-calving			
0 to 1	Baseline		
2	1.48	0.70	3.12
3 to 4	3.48	1.34	9.07
SL score 2-4 months post-calving			
2	Baseline		
0 to 1	2.28	1.16	4.48
3	1.53	0.87	2.67
4 to 8	2.90	1.54	5.46
Outcome: Culling			
Variable	Odds ratio	Lower 95% CrI	Upper 95% CrI
Sole lesion 0-2 months post-calving			
0	Baseline		
1	0.52	0.32	0.84
2 to 10	0.70	0.31	1.61

[1]Limited results from the models are included in this table as a summary. For full results table please refer to Randall et al 2016.
[2]CrI = credible interval.

Discussion

Novel findings demonstrate that mild SL were associated with reduced risk of culling and future lameness risk. We hypothesise that a mild insult, resulting in adaptive changes and increased resilience, may be beneficial to claw health. High WLL and SL scores 2-4 months post-calving were associated with an increased risk of lameness. High SL scores and DD were associated with an overall reduction in milk yield. Whilst the quantitative impacts are specific to this one study herd, the qualitative impacts are likely to be relevant across similar dairy herds. Managing heifers to reduce more severe lesions is likely to have major benefits over their productive lifetime. Furthermore, recent work suggests that the majority of lameness events are attributable to previous lameness highlighting heifer management as key to lameness control.

Acknowledgments

Funding from the Biotechnology and Biological Sciences Research Council (BBSRC) and Boehringer Ingelheim is gratefully acknowledged.

Referenes

Amory JR, Barker ZE, Wright JL, Mason SA, Blowey RW, and Green LE 2008 Associations between sole ulcer, white line disease and digital dermatitis and the milk yield of 1824 dairy cows on 30 dairy cow farms in England and Wales from February 2003–November 2004. Preventive Veterinary Medicine 83: 381-391.

Booth CJ, Warnick LD, Grohn YT, Maizon DO, Guard CL, and Janssen D 2004 Effect of lameness on culling in dairy cows. J. Dairy Sci. 87: 4115-4122.

Capion N, Thamsborg SM, and Enevoldsen C 2009 Prevalence and severity of foot lesions in Danish Holstein heifers through first lactation. Veterinary Journal 182: 50-58.

Green LE, Huxley JN, Banks C, and Green MJ 2014 Temporal associations between low body condition, lameness and milk yield in a UK dairy herd. Preventive Veterinary Medicine 113: 63-71.

Hirst WM, Murray RD, Ward WR, and French NP 2002 A mixed-effects time-to-event analysis of the relationship between first-lactation lameness and subsequent lameness in dairy cows in the UK. Preventive Veterinary Medicine 54: 191-201.

Maxwell OJ, Hudson CD, and Huxley JN 2015 Effect of early lactation foot trimming in lame and non-lame dairy heifers: a randomised controlled trial. Veterinary Record 177: 100.

Randall LV, Green MJ, Chagunda MG, Mason C, Green LE, and Huxley JN 2016 Lameness in dairy heifers; impacts of hoof lesions present around first calving on future lameness, milk yield and culling risk. Prev Vet Med 133: 52-63.

Randall LV, Green MJ, Chagunda MGG, Mason C, Archer SC, Green LE, and Huxley JN 2015 Low body condition predisposes cattle to lameness: An 8-year study of one dairy herd. J. Dairy Sci. 98: 3766–3777.

Key words: heifers, hoof lesions, milk yield, culling

80 The DD Check App To Monitor Digital Dermatitis In Cattle

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Introduction

Digital dermatitis (DD) in cattle is the major causes of lameness, production and welfare losses that compromise claw health under intensive cattle husbandry systems, both dairy and beef. Collecting records of DD lesions using the M-stage system is a tedious activity, particularly if repeated records are required for prediction modeling. Therefore, the DD Check App was developed that uses a standardized interface for recording of M-stages and signs of chronicity associated with an automated prediction models that allows to predict outbreaks of DD before they happen (Tremblay et al 2016).

Materials and Methods

The mobile part of the App was programed for Apple users on iPhone, iPad mini and other iPads, while the automated predictive model was programed using the shiny library in R 3.1. The predictive model is a class-structured population model resulting in a transition matrix (Tremblay et al 2016).

Results

Cows can be scored in the milking parlor, in the pens while in head gates or in the restraint chute at different levels of detail, with and without cow identification. The prediction model will work only if cows are identified and the same cows are scored at least three times, preferably at 1 week and up to monthly time intervals.

Discussion

The DD Check App simplifies collection of DD lesion data in large populations of cattle and has been used on ten thousands of cows for scoring DD lesions since it was developed. Standardized records and signs of chronicity can be used to predict the relative frequencies of M-stages over time based on the transition between M-stages. Comparison of interventions, choice of different time intervals for analysis, analysis of data stratified by user chosen variables and development of treatment lists to share with herdsmen all contribute to early detection, prompt treatment and observation of trends in herds endemically affected by DD. According to our current knowledge, it is the only App using an automated prediction model in agriculture.

Acknowledgements

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References available upon request

1. Döpfer D, Huurne AA ter, Cornelisse JL, Asten AJ van, Koopmans A, Meijer FA, Schukken YH, Szakáll I, Klee W, Bosma RB. Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. Vet. Rec. 1997 (140): 620–623.

2. Berry SL, Read DH, Famula TR, Mongini A, Döpfer D. Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. Vet J. 2012 Sep;193(3):654-83.

3. Tremblay M, Bennett T, Döpfer D. The DD Check App for prevention and control of digital dermatitis in dairy herds. Prev Vet Med. 2016 Sep 15;132:1-13.

Keywords: digital dermatitis, DD Check App, cattle

P 18-1 Effect Of Parity On Claw Horn Lesions In Holstein Dairy Cows: Clinical And Radiological Study

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Introduction

Feet and leg diseases are a persistent but not decreasing problem in modern intensive dairy production (Schöpke et al., 2013). In the pathogenesis of claw lesions are involved herd-level factors including housing environment, management practices, season of claw trimming and nutrition, as well as cow-level factors including parity, milk yield, lactation stage, body condition score (BCS), breed and genetics (Katsoulos and Christodoulopoulos, 2009; Olechnowicz et al., 2010). The aim of this study was to estimate the effect of parity on the incidence of claw lesions in Holstein dairy cows through clinical and radiological observations.

Materials and Methods

Ninety-seven cows were enrolled in a farm of North-East Italy. Locomotion score, BCS, X-rays of the feet, hoof trimming and clinical evaluation were recorded two months after calving in all animals. According to the stage of lactation, the cows were divided into three groups: first lactation (Group 1, n=40), second lactation (Group 2, n= 29) and third or more lactations (Group 3, n=28). Statistical analysis was performed using the STATISTICA 7 Stat Software. Data were normally distributed with Shapiro and Wilk test. One-way analysis of variance (ANOVA) was applied to assess the statistical significance among the three groups on BCS, locomotion score, medial and lateral X-rays of the feet, and foot lesions (white line lesion, sole ulcer, sole haemorrhage, toe ulcer, corkscrew claw, foot fissures, interdigital hyperplasia, thin sole, digital dermatitis, heel erosion, interdigital dermatitis and foot rot, phlegmon). Bonferroni's multiple comparison test was used for post hoc comparison test. Pearson's correlations were determined to assess the relationship between locomotion score and other variables.

Results

Significant effects of the three groups were evidenced on BCS and radiographic images. In particular, statistically higher BCS values were found in Group 1 compared to Group 3. The radiographic images showed a significant increase of osteolysis from Group 1 to Group 3. The application of Pearson's correlation coefficient showed a significantly negative correlation between locomotion score and BCS in Group 2. A significantly positive correlation was found between locomotion score and some claw lesions in all groups.

Discussion

Locomotion score slightly increased from Group 1 to Group 3, indicating an obvious tendency towards a higher possibility of lameness in older cows. The negative correlation found between locomotion score and BCS found in Group 2 is supported by Lim et al., (2015) who demonstrated that low BCS was associated with an increased risk of treatment for lameness. In our study, in both hind limbs the lateral phalanx showed from Group 1 to Group 3 a progressive statistical prevalence of radiographic changes, respect to the medial one. These results are in agreement with the finding of El-Shafaey et al., (2013), who described that the lateral digits were more affected than the medial ones. In conclusion, this study provides an overview of claw lesions in dairy cow through clinical and radiological observations. Using locomotion score to screen herds can be helpful when evaluating claw health and need for intervention. Radiographic changes in our study were remarkable.

Key words: dairy cow, parity, locomotion score, radiology, claw lesions.

References

El-Shafaey, el-S.A.A., Aoki, T., Ishii, M. and Yamada, K. (2013): Pilot study of bovine interdigital cassetteless computed radiography. J Vet. Med. Sci. 75, 1503-1506.

Katsoulos, P.D. and Christodoulopoulos G. (2009): Prevalence of lameness and of associated claw disorders in Greek dairy cattle industry. Livest. Sci. 122, 354-358.

Lim, P.Y., Huxleya, J.N., Willshirec, J.A., Greena, M.J., Othmanb, A.R. and Kaler J. (2015): Unravelling the temporal association between lameness and body condition score in dairy cattle using a multistate modelling approach. Prev. Vet. Med. 118, 370-377.

Olechnowicz, J., Jaśkowski, J.M., Antosik, P., Bukowska, D. and Urbaniak, K. (2010): Claw diseases and lameness in Polish Holstein-Friesian dairy cows. Bull. Vet. I. Pulawy 54, 93-99.

Schöpke, K., Weidling, S., Pijl, R. and Swalve H.H. (2013): Relationships between bovine hoof disorders, body condition traits, and test-day yields. J. Dairy Sci. 96, 679–689.

P 18-2 Effect Of Locomotion Score On The Chance Of Pregnancy IN Grazing Dairy Cows

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Introduction

Lameness is one of the most important diseases in dairy cattle worldwide associated frequently with long-lasting pain and always with deterioration of the animal's welfare that decreases productivity (1-3). Many studies have found reduced intensity of estrus, lower conception rates and extended calving to conception interval in lame cows (1-3). A locomotion scoring system has been developed to assess lameness, and its negative association with reproductive outcomes has been proposed (2). As cows diagnosed lame before the end of the voluntary waiting period had impaired reproductive performance when compared with normal cows, this could be one mechanism by which lameness decreases fertility (2, 3). Finally, it has been proposed that lameness can affect fertility at all stages of the reproductive cycle. The objective of the present study was to assess the effect of locomotion score (LS) on the chance of pregnancy in grazing dairy cows.

Materials and Methods

A prospective observational cohort study was conducted in one commercial dairy farm in Argentina (35°37' S, 61°22' W) from January to July 2015. Locomotion score was evaluated every 14 days by using a 5-point scale (2). Data records from 955 dairy cows were included in the study. A proportional hazard model was run with the Proc PHREG (4) to test the fixed effect of LS as categorical time dependent variable (LS-1 vs. LS-2 and 3 vs. LS-4 and 5) and parity (1 through 8+) on the chance of pregnancy during a given 14-day period of risk.

Results

The LS had an effect on the chance of pregnancy ($P = 0.008$) in cows having LS-1 with greater daily risk of pregnancy than those with LS-2 and 3 [HR (95%CI) 1.198 (1.027-1.395)], and also than those with LS-4 and 5 [1.482 (1.165-1.903)]. In addition, the chance of pregnancy was also affected by parity ($P < 0.001$) with the risk decreasing with successive parturitions.

Discussion and Conclusions

Cows with LS-2 and 3 had a 20% lower chance of pregnancy than cows with LS-1, and cows with LS-4 and 5 had a 48% lower chance of pregnancy than cows with LS-1. In conclusion, grazing dairy cows with LS >1 are associated with poorer fertility parameters than healthy cows. Similar negative effects on fertility were reported in pasture-based dairy cows that were lame before and during the breeding season in New Zealand and Ireland (1, 3).

References

Alawneh JI, Laven RA, Stevenson MA. The effect of lameness on the fertility of dairy cattle in a seasonally breeding pasture-based system. Journal of Dairy Science2011; 94(11):5487–93.

Sprecher DJ, Hostetler DE, Kaneene JB. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 1997; 47(6):1179–87.

Somers JR, Huxley J, Lorenz I, Doherty ML, O'Grady L. The effect of Lameness before and during the breeding season on fertility in 10 pasture-based Irish dairy herds. Irish Veterinary Journal 2015; 68:14. DOI 10.1186/s13620-015-0043-4

SAS University Edition. 2014. SAS Institute Inc., Cary, NC, USA.

P 18-3 Lameness Affects Lying Time But Does Lying Time Affect Lameness? A Review Of Our Current Understanding Of The Lying Behaviour Of Housed Dairy Cattle

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Introduction

Most dairy cattle are housed for some of their lives, with an increasing number housed all year round. With raised public awareness of the wellbeing of housed cattle a greater understanding of the impact of housing on cattle is becoming increasingly important. Given a suitable environment, housed cows will lie down for >12 hours per day (h/d) (Ito et al 2009) and lying time is widely accepted as a measure of cow comfort (Haley et al 2001). Reduced lying time is widely reported as a risk factor for lameness (Cook 2006). This review aims to summarise current understanding of the factors influencing lying time in housed cows with a focus on the consequences of changes in lying behaviour on lameness.

Materials and Methods

A detailed CAB Abstract and Medline keyword search was undertaken. Resulting papers were amalgamated into a reference database, manually reviewed for relevance and critically appraised. Key themes were mapped and gaps in the evidence base were identified.

Results

In the largest study of lying behaviour to date (5135 cows across 141 herds) Solano et al (2016) reported an average lying time of 10.6 h/d. Ito et al (2009) reported a large variation between herds (range 9.5-12.9 h/d) but even greater variation between individuals within herds (4.2 -19.5h/d). In the first study to follow cows throughout lactation Maselyne et al (2017) demonstrated that lying time inversely tracks yield, decreasing to a nadir at four weeks into lactation before steadily increasing. Cubicle design (Tucker et al 2004), bedding material (Ito et al 2014) and stocking density (Charlton et al 2014) have all been shown to influence lying behaviour. However due to limitations in direct observation much of the early work has relied on small sample sizes and short term study designs. On average, lame cows lie for longer, in fewer, longer bouts compared with non-lame cows (Solano et al 2016). Cook et al (2004) demonstrated a reduction in lying time in lame cows housed on mattresses but not on sand. Ito et al (2010) showed that while severely lame cows on deep sand beds increased their lying time in comparison to non-lame counterparts, severely lame cows on mattresses did not.

Discussion

It is clear that the within herd variation in lying time reported by Ito et al (2009) can be, in part, accounted for by our improved understanding of the influence of stage of lactation. However, we do not yet understand the influence of herd level lying behaviour on incidence and prevalence of lameness. Whilst differences in lying behaviour between lame and non-lame counterparts have been described, no papers have definitively demonstrated that reduced lying time causes lameness. Future work which documents lying behaviour in large numbers of cows, across herds, for long periods of time are now feasible due to the increasingly ubiquitous and reduced cost availability of data loggers. Studies of this type are urgently required to understand the direction of causality in the relationship between lying time and lameness.

Acknowledgements

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References

Cook, N.B., Bennett, T.B., Nordlund, K.V. Effect of free stall surface on daily activity patterns in dairy cows with relevance to lameness prevalence. Journal of Dairy Science 2004 (87):2912-2922

Cook, N.B.The dual roles of cow comfort in dairy herd lameness dynamics. In: Proceedings of the Annual American Association of Bovine Practitioners Conference, St. Paul, Minnesota. 2006 150–157.

Charlton, G. L., Haley, D.B., Rushen, J., de Passille, A.M. Stocking density, milking duration, and lying times of lactating cows on Canadian freestall dairy farms.Journal of Dairy Science 2014 (97): 2694-2700.

Haley, D. B., de Passille, A.M., Rushen, J. Assessing cow comfort: effects of two floor types and two tie stall designs on the behaviour of lactating dairy cows. Applied Animal Behaviour Science 2001 (71): 105-117.

Ito, K., Weary, D.M., von Keyserlingk, M.A.G. Lying behavior: assessing within- and between-herd variation in free-stall-housed dairy cows. Journal of Dairy Science 2009 (92): 4412-4420

Ito, K., von Keyserlingk, M.A.G., Le Blanc, S.J., Weary, D. Lying behaviour as an indicator of lameness in dairy cows. Journal of Dairy Science. 2010 (93): 3553-3560

Ito, K., Chapinal, N., Weary, D.M., von Keyserlingk, M.A.G. Associations between herd-level factors and lying behavior of freestall-housed dairy cows. Journal of Dairy Science 2014 (97): 2081-2089.

Maselyne, J., Pastell, M., Thomsen, P.T., Thorup, V.M., Hanninen, L., Vangeyte, J., van Nuffel, A., Munksgaard, L. Daily lying time, motion index and step frequency in dairy cows change throughout lactation. Research in Veterinary Science 2017 (110): 1-3.

Solano, L., Barkema, H.W., Pajor, E.A., Mason, S., Le Blanc, S.J., Nash, C.G.R., Haley, D., Pellerin, D., Rushen, J., de Passille, A.M., Vasseur, E., Orsel, K. Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. Journal of Dairy Science 2016 (99): 2086-2101.

Tucker C.B, Weary, D.M, Fraser, D. Freestall dimensions: effects on preference and stall usage. Journal of Dairy Science 2004 (87): 1208-1216

Key Words (3-5) Lying behaviour, housing, DIM

P 18-4 Relations Of Milk Fat Percentage And Fat-To-Protein Ratio Within 60 Days In Milk To Selected Claw Disorders In Holstein Cows

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Introduction

Increased milk fat content and fat-to-protein ratio (FPR) in early lactation are markers of pronounced negative energy balance (1). High FPR is a risk factor for many diseases including lameness (2). The aim of the study was to evaluate the relations of these milk parameters to a later occurrence of certain claw disorders.

Materials and Methods

In a high yielding herd (11,000 kg milk per lactation) of 400 loose-housed Holstein cows (concrete floors, straw bedded cubicles) all the cows were subjected to regular claw trimmings supervised by a veterinarian. The data from the two trimming sessions (January and June) were used; the cows that had been treated for lameness before the claw trimming were excluded. The occurrence of sole hemorrhages, white line disease, sole and toe ulcer was related to the results of preceding milk tests, performed on monthly basis. For the study, results of one milk test in pluriparous cows till 60 days in milk (DIM) were used. Required intervals between milk recording and claw trimming were 45±15 (group A, n=66; 38 DIM on milk test day); 75±15 (group B, n=69; 33 DIM) and 105±15 (group C, n=62; 35 DIM) days. Number of claw disorders affected cows versus number of non-affected cows was evaluated by χ^2 test (KyPlot 2.0), involving the with FPR lower (and equal) or higher than 1.4. These three groups were also tested by the Spearmann Correlation Test (KyPlot 2.0) for correlations between milk fat or FPR and the number of affected limbs.

Results

The three groups showed average values of milk fat 3.58, 3.89 and 3.45%, and FPR 1.19, 1.33 and 1.16, respectively. Both milk fat and FPR were significantly higher ($p<0.01$) in the group B as compared to the other groups. The claw disorders were found in 61, 62 and 60% cows of the groups A, B, C, respectively, with average numbers of affected limbs per cow of 0.97, 1.16 and 1.08. For the groups B and C the χ2 test documented a significantly higher ($p<0.05$) occurrence of claw disorders in the cows with FPR >1.4 (significantly different ratio affected versus unaffected cows). In the group B, this relation was also confirmed by the Spearmann Correlation Test, showing that both milk fat ($\rho=0.26$; $p<0.05$) and FPR ($\rho=0.39$; $p<0.01$) correlated with the number of affected limbs.

Discussion

Obviously, an interval of more than 2 months is necessary for the development of visible lesions in most cases. The correlation was probably supported by significantly higher milk fat and FPR in the group B as compared to the other groups. The ascertained relations should be tested in larger studies. These relations suggest that marked negative energy balance in early lactation period contributes to the development of claw disorders.

Acknowledgements

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References

1. Duffield TF, Kelton, DF, Leslie KE, Lissemore K, Lumsden JH. Use of test day milk fat and milk protein to predict subclinical ketosis in Ontario dairy cattle. Can Vet Journal 1997 (38): 713-718.

2. Heuer C, Schukken H, Dobbelaar P. Postpartum body condition score and results from the first test day milk as predictors of diseases, fertility, yield, and culling in commercial dairy herds. J Dairy Sci 1999 (82): 295-304.

Keywords: Dairy cattle, Test-day milk components, Sole hemorrhages, White line disease, Ulcer

P 18-5 Effect Of Parity On Recovery Of Lameness, With Or Without Early Treatment

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Introduction

Early treatment of lame cows is one of the most important features of any lameness reduction plan in a herd (Bell et al., 2009) as early treatment results in better recovery rates (Groenevelt et al., 2014; Thomas et al., 2016). However, it is not yet clear whether or not parity has an effect on the recovery rate of early treated lame cows. Data from a randomised controlled treatment trial was analysed to see the effect of parity on both the treatment and control groups.

Materials and methods

Four dairy farms in the South West of England were lameness scored every two weeks for three years during the winter housing period. They had been allocated previously to either the treatment (TX) or control (CX) group after randomising and pairing based on parity and stage of lactation. A four point scoring system was used, 0 and 1 being sound scores and 2 and 3 being lame scores (Groenevelt et al., 2014). Cows that had been sound for at least two consecutive scores were enrolled into the study. The TX group received treatment within 48 hours of scoring while the CX group were to be treated according to the farmers own treatment protocol. The treatment consisted of hoof trimming of both hind legs, carried out by a veterinarian trained in the Dutch Five Step method. Recovery rates were based on a score 0 or 1 at fortnightly intervals following initial treatment or enrolment at a lame score event.

Results

A total of 171 TX cows and 256 CX cows were enrolled in the study. Due to drying off and culling, the number of animals with consecutive scores decreased every scoring. The percentage of TX parity 1 and 4+ cows that 'stay sound' at consecutive scoring events was higher at every time point compared with CX parity 1 and 4+ cows. However, the percentage of TX parity 4+ cows that 'stay sound' was low throughout, around 30 per cent from 10 week onwards. As seen in Figure 1, the percentage of animals that 'stay lame' in parity 4+ for both TX and CX groups is. Compared to the other parities, parity 4+ have consistently higher 'stay lame' rates than other parities, both in TX and CX groups. At the moment of writing, no statistical analyse had been done.

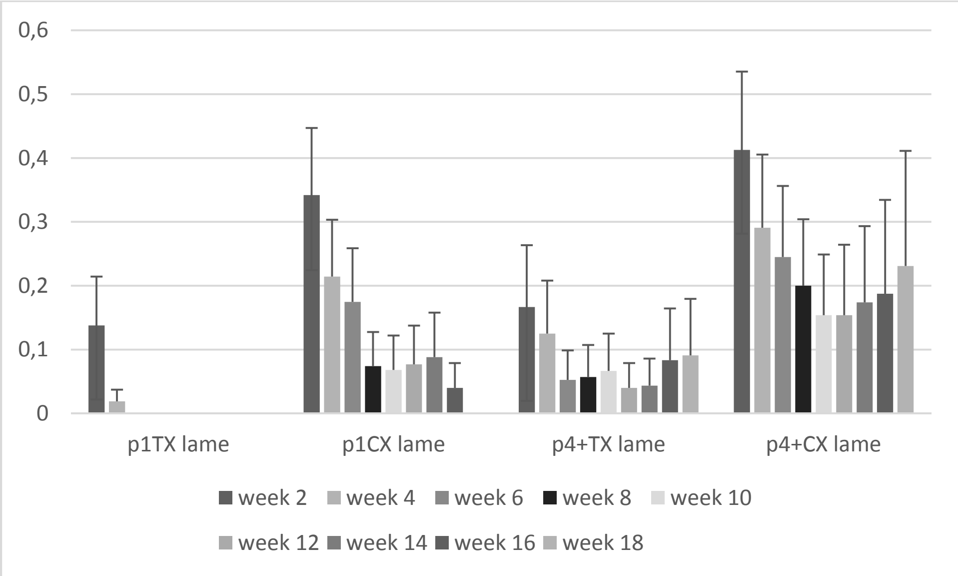

Figure 1 Percentage of 'stay lame' animals after treatment (TX) or enrolment (CX), error bars represent a confidence interval of 95%

Discussion

The percentage of cows that 'stay sound' in parity 4+ groups is low for both TX and CX, illustrating that parity 4+ animals do not recover from lameness as well as younger parities. This is particularly the case for the animals in the CX group that are not promptly treated. Compared to parity 1 animals from the TX group this difference is obvious with no animals that 'stay lame' after week 4. The history of the animals in parity 4+ is not known in this study, it could be that these animals had already been lame the year before and a lame event in the past is known to increase the risk of a lame event in the future (Reader et al., 2011). However, this data does accentuate the need to focus on the heifers in order to keep them sound as their chances of long term recovery later in life decreases over time, regardless of prompt treatment.

References

BELL, N. J., BELL, M. J., KNOWLES, T. G., WHAY, H. R., MAIN, D. J. & WEBSTER, A. J. F. (2009) The development, implementation and testing of a lameness control programme based on HACCP principles and designed for heifers on dairy farms. Veterinary Journal 180, 178-188

GROENEVELT, M., MAIN, D. C., TISDALL, D., KNOWLES, T. G. & BELL, N. J. (2014) Measuring the response to therapeutic foot trimming in dairy cows with fortnightly lameness scoring. Veterinary Journal 201, 283-288

READER, J. D., GREEN, M. J., KALER, J., MASON, S. A. & GREEN, L. E. (2011) Effect of mobility score on milk yield and activity in dairy cattle. Journal of Dairy Science 94, 5045-5052

THOMAS, H. J., REMNANT, J. G., BOLLARD, N. J., BURROWS, A., WHAY, H. R., BELL, N. J., MASON, C. & HUXLEY, J. N. (2016) Recovery of chronically lame dairy cows following treatment for claw horn lesions: a randomised controlled trial. Veterinary Record 178, 116

Keywords: mobility scoring, early detection,

P 18-6 The Effect Of Lameness In Pregnant Heifers On First Lactation Performance

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Introduction

Lameness is an economically significant disease in dairy cows (1). Depending on the type of lesion the costs range from 120 US dollars to 489 Euro (2-4). Parts of these costs are secondary and due to a decrease in performance of the affected cows. The painful nature of the claw lesions influences feed intake and metabolic health: The risk for ketosis is increased (5) and milk yield and fertility are decreased (6, 7). There is a growing awareness of the economic impact of lameness in cows but there are few studies investigating the effects in heifers. Lameness during gestation will give them a poor start to their productive life (8). Risk factors for lameness and prevalence of specific claw lesions in heifers have been reported (8-10) but unlike in multiparous cows, there are no studies reporting the consequences of claw lesions during the last trimester of gestation in heifers on their performance regarding milk yield, fertility and health during the first lactation. Therefore the goal of this study was to investigate the effects of claw lesions in heifers in late gestation on health and productivity in the following lactation. These effects might differ significantly from cows because primiparous cows face other challenges and conditions than multiparous animals. They are still growing, have a flat lactation curve and are usually more fertile.

Materials and Methods

The data was collected retrospectively. Heifers with a claw lesion in the last trimester of gestation (n=43) were matched with heifers without claw lesion on the same farm for calving date. All data including BHB concentrations in blood *post partum*, 305 day milk yield, fertility parameters (insemination index, days open) and body condition score during the first lactation had been recorded using the herd management program DairyComp 305. The data is analysed statistically using descriptive methods and generalized models.

Results

The data is currently being analysed and therefore no results are available yet. However, first analyses suggest that there might not be significant differences between heifers with and without claw lesions in the parameters assessed, for example BHB concentrations in blood post partum (Fig. 1).

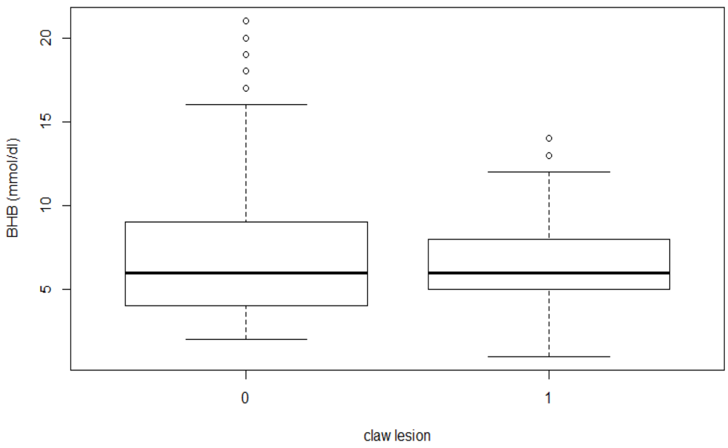

Figure 4: Post-partum BHB levels of primiparous cows who had claw lesions (1) or not (0) in the last trimester of gestation

Discussion

Even though it has been shown that lameness in heifers, like in cows, has long term consequences for hoof health once they are lactating (8) no studies have shown the extent of these consequences to date. In this present study the data analysis has not been fully carried out but first results suggest that there might not be any differences that can be shown. This could be due to lower milk yield of primiparous compared to multiparous cows and the difference in metabolic challenges they face, the long duration between lesion and effect or lack of power of the study. Therefore the hypotheses should be investigated further at a larger scale.

References

1. Huxley JN. Impact of lameness and claw lesions in cows on health and production. Livestock Science. 2013;156(1-3):64-70.

2. Häggman J, Junni R, Simojoki H, Juga J, Soveri T. The costs of interdigital phlegmon in four loose-housed Finnish dairy herds. Acta Veterinaria Scandinavica. 2015;57(1):90.

3. Kofler J, Gasteiner J. Klauenrehe. Die wichtigste Klauenerkrankung unserer Milchrinder. Der fortschrittliche Landwirt. 2002;Heft 8:27-37.

4. Cha E, Hertl JA, Bar D, Gröhn YT. The cost of different types of lameness in dairy cows calculated by dynamic programming. Preventive Veterinary Medicine. 2010;97(1):1-8.

5. Rajala-Schultz PJ, Gröhn YT, McCulloch CE. Effects of Milk Fever, Ketosis, and Lameness on Milk Yield in Dairy Cows. Journal of Dairy Science. 1999;82(2):288-94.

6. Green LE, Hedges VJ, Schukken YH, Blowey RW, Packington AJ. The Impact of Clinical Lameness on the Milk Yield of Dairy Cows. Journal of Dairy Science. 2002;85(9):2250-6.

7. Hernandez J, Shearer JK, Webb DW. Effect of lameness on the calving-to-conception interval in dairy cows. Journal of the American Veterinary Medical Association. 2001;218(10):1611-4.

8. Capion N, Thamsborg SM, Enevoldsen C. Prevalence and severity of foot lesions in Danish Holstein heifers through first lactation. The Veterinary Journal. 2009;182(1):50-8.

9. Webster AJ. Effects of housing practices on the development of foot lesions in dairy heifers in early lactation. Vet Rec. 2002;151(1):9-12.

10. Kofler J, Hangl A, Pesenhofer R, Landl G. Evaluation of claw health in heifers in seven dairy farms using a digital claw trimming protocol and claw data analysis system. Berliner und Munchener tierarztliche Wochenschrift. 2011;124(7-8):272-81.

Keywords: heifers, milk yield, fertility, BCS

P 18-7 Association Of Lying Behavior During The Transition Period With Claw Lesions In Primiparous Grazing Dairy Cows

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Introduction

Recent work has provided evidence that behavioral changes during transition period can increase the risk of lameness later in lactation. However, the majority of work to date on transition cow behavior has focused on multiparous cows in freestall housing (Chapinal et al., 2009; Proudfoot et al., 2010), with little research in first lactation dairy cows on pasture-based systems. Therefore, the aim of our study was to determine changes in lying behavior during the transition period in primiparous grazing dairy cows before the diagnosis of claw lesions mid in lactation.

Materials and Methods

The study was conducted on three commercial dairy farms in southern Chile. A total of 103 first lactation Holstein Friesian cows were monitored for lying behavior 21 d before calving until 21 d after calving. Lying behavior was recorded daily using an automated monitoring system. The claws of cows were scored for lesions one month after calving (between week 3 and 4) and every month thereafter until four months after calving. Lesions were classify according to Shearer et al. (2004), as normal (no significant lesion), hemorrhage (presence of hemorrhage in the sole or white line of at least one foot), claw lesion (sole defect or ulcer, or a white line fissure or abscess), and infectious lesion (presence of interdigital phlegmon or digital dermatitis). Due to standing behavior is directly affected by lameness, only cows with no significant lesion during first month after calving were selected for the analyses (n=46). Cows were retrospectively categorized into two groups based on the lesion on the sole: no lesion group (n=30), that had no significant lesion during the study period and lesion group (n=16), that had at least one claw lesion diagnosed between second and fourth month after calving. Cows with and without lesions were compared for lying time, lying bouts and lying bouts duration. For statistical analysis, all behaviors were summarized by week relative to calving. Analyses were performed using the PROC MIXED procedure in SAS.

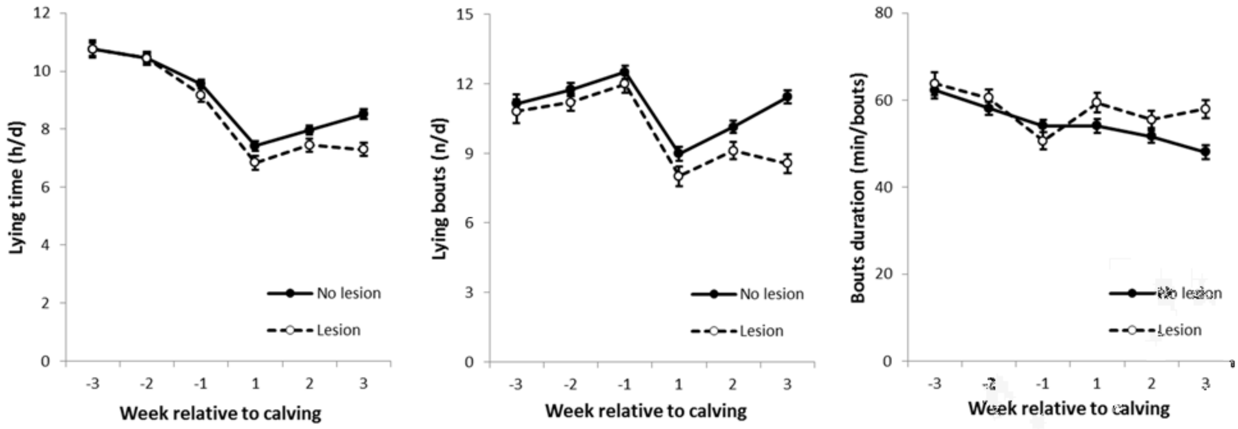
Results

As shown in figure 1, the largest differences in lying time between lesion and no lesion cows were seen only during wk +3 after calving, when cows diagnosed with lesions in mid lactation lied down 1,22 h/d less than cows without lesions (P=0.007). During the prepartum period there was no difference in number of lying bouts among lesion and no lesion cows in their first lactation. However, cows diagnosed with lesions in mid lactation had fewer lying bouts per day than cows without lesions during wk 1, 2 and 3 after calving (P<0,05), and these bouts were approximately 10 min longer in wk+3 (P=0.005) for cows that were diagnosed with lesions.

Discussion

We found a significant relationship between lying behavior during the transition period and claw health status in the first third of lactation in primiparous cows under pasture-based system. This agrees with Proudfoot et al. (2009) who suggested that high standing times (i.e. decreased lying times) during transition likely increase the risk for lesions in cows housed indoors. We conclude that primiparous cows may benefit from closer observation during the transition period, including information on lying behavior that could be used by farmers in some form of an alert system of lesions that can be diagnosed later in lactation.

Figure 1. Pattern of daily lying time, number of lying bouts, and lying bouts duration during the transition period in primiparous grazing dairy cows categorized according claw lesions observed between 2 and 4 months of lactation. Values are LSM ± SEM.



Acknowledgements

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References

Proudfoot K, Weary D, and von Keyserlingk M A G 2010 Behavior during transition differs for cows diagnosed with claw horn lesions in mid lactation. *Journal of Dairy Science* 93:3970–3978.

Chapinal N, de Passillé A, Weary D, von Keyserlingk M A G, and Rushen J 2009. Using gait score, walking speed, and lying behavior to detect claw horn lesions in dairy cows. *Journal of Dairy Science* 92:4365–4374.

Shearer J, Anderson D, Ayars W, Belknap E, Berry S, Guard C, Hoblet K, Hovingh E, Kirksey G, Langhill A, Mills A, Miskimins D, Osterstock J, Price R, Prigel D, Roussel A, van Amstel S, Wallace R, Wasson J, Cook N, Garrett E, Hostetler D, and Shugel L 2004 A record-keeping system for capture of lameness and foot-care information in cattle. *Bovine Practitioner* 38:83–92.

Keywords: lying behavior, primiparous, pasture-based system

P 18-8 Relationships Between Claw Lesions And Metabolic State During The Transition Period In Pasture-Grazed Primiparous Dairy Cows

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Introduction

During the transition period many cows experience a negative energy balance (NEB), leading to lipid mobilization of fat from stores around the body including the digital cushion (Bicalho et al., 2009). This could reduce the effectiveness of protection to the corium, explaining the increased risk of claw lesion formation in thin cows (Hoedemaker et al., 2008). Non-esterified fatty acids (NEFA), β-hydroxybutyrate (BHBA) and cholesterol serum concentrations have been used as markers of NEB. Therefore, the aim of our study was to investigate the relationships between metabolic indicators of NEB during the transition period and the occurrence of claw lesion mid in lactation.

Materials and Methods

Three Holstein pasture-grazed dairy herds located in southern Chile were visited weekly for blood sample collection from 103 primiparous cows. Blood samples were taken from week −1 through week 3 relative to calving to determine NEFA, BHBA and cholesterol serum concentrations. The claws of cows were scored for lesions one month after calving (between week 3 and 4) and every month thereafter until four months after calving. Lesions were classify according to Shearer et al. (2004), as normal (no significant lesion), hemorrhage (presence of hemorrhage in the sole or white line of at least one foot), claw lesion (sole defect or ulcer, or a white line fissure or abscess), and infectious lesion (presence of interdigital phlegmon or digital dermatitis). Only cows with no significant lesion during first month after calving were selected for the analyses (n=46). Cows were retrospectively categorized into two groups based on the lesion on the sole: no lesion group (n=30), that had no significant lesion during the study period and lesion group (n=16), that had at least one claw lesion diagnosed between second and fourth month after calving. Cows with and without lesions were compared for NEFA, BHBA and cholesterol concentrations across the transition period. Statistical analysis were performed using the PROC MIXED procedure in SAS (SAS Institute Inc., 2002 – 2012).

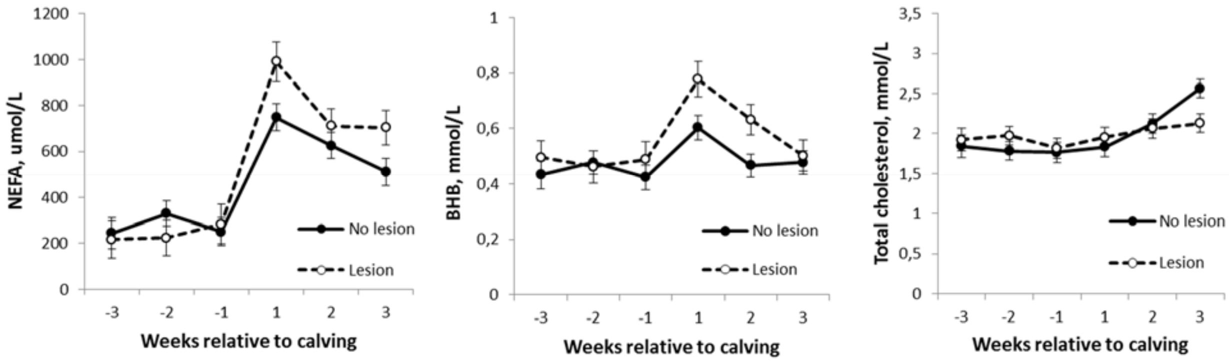
Results

Figure 1 shows analyte concentrations in serum during the transition period by claw lesion status. NEFA concentration tended to be greater in cows with lesions relative to cows that had no lesions during week 1 and week 3 after calving (p=0.09 and p=0.10, respectively). Similarly, there was a tendency for cows that were diagnosed with lesions to have greater concentrations of BHBA during week 1 and week 2 (p=0.09 and p=0.05, respectively). There was no difference in the pattern of cholesterol during transition period between cows with and without lesions (P = 0.92).

Discussion

The results of the current study showed that high concentrations of NEFA and BHBA after calving are associated with claw health status in mid lactation primiparous cows under pasture-based system. Physiological changes during transition that predispose cows to claw horn lesions include a decrease in the thickness of the digital cushion (Bicalho et al., 2009) and these changes could be related with the metabolism of adipose tissue (Raber et al., 2006). We suggest that metabolic imbalances during the transition period of primiparous dairy cows, specifically those related with energy status, could have an effect on the health of the hoof predisposing them to present claw lesions during their first lactation.

Figure 1. Serum concentrations of NEFA, BHBA and cholesterol during the transition period in primiparous grazing dairy cows categorized according claw lesions observed between 2 and 4 months of lactation. Values are LSM ± SEM.



Acknowledgements
This project was funded by FONDECYT 1150692.

References

Bicalho R, Machado C, and Caixeta L 2009 Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. *Journal of Dairy Science* 92:3175–3184.

Hoedemaker M, Prange D, and Gundelach Y 2008 Body condition change ante- and postpartum, health and reproductive performance in German Holstein cows. *Reproduction Domestic Animals* 44:167–173.

Räber M, Scheeder M, Ossent P, Lischer C, and Geyer H 2006 The content and composition of lipids in the digital cushion of the bovine claw with respect to age and location–A preliminary report. *Veterinary Journal* 172:173–177.

Shearer J, Anderson D, Ayars W, Belknap E, Berry S, Guard C, Hoblet K, Hovingh E, Kirksey G, Langhill A, Mills A, Miskimins D, Osterstock J, Price R, Prigel D, Roussel A, van Amstel S, Wallace R, Wasson J, Cook N, Garrett E, Hostetler D, and Shugel L 2004 A record-keeping system for capture of lameness and foot-care information in cattle. *Bovine Practitioner* 38:83–92.

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