

*Rip Blawie*

**The 9th International Symposium on  
Disorders of Ruminant Digit  
and  
The International Conference on  
Lameness in Cattle**



**Mitzpeh Rachel, Jerusalem  
April 14-19, 1996**



**Program and Abstracts**

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Disorders of Ruminant Digit  
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### **Local Organizing Committee:**

U. Bargai, Chairman, Koret School of Veterinary Medicine  
Y. Efron, Hachaklait Veterinary Services  
E. Mcir, Israel Association of Bovine Practitioners

### **International Organizing Committee:**

P.R. Greenough, Canada  
A.D. Weaver, U.K.

### **Key-Note Speakers**

R.W. Blowey, U.K.  
A. Brizzi, Italy  
D. Dopfer, Germany  
J.G. Ferguson, Canada  
P. Greenough, Canada  
B. Johnson, U.S.A.  
P.O. Ossent, Switzerland  
J.M. Philipot, France  
J.J. Vermunt, New Zealand  
W.R. Ward, U.K.  
A.D. Weaver, U.K.

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**Conference Secretariat  
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# PROGRAM

**Sunday, April 14, 1996**

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20:30 Get Together - Cocktail Reception ("Duvdevan" Hall)

**Monday, April 15, 1996**

08:30 - 09:00 Registration

**09:00-10:30 SESSION 1: RISK FACTORS OF LAMENESS**

Chairman: P.R. Greenough, *Canada*

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09:30-09:45	<b>The Effects of Housing and Diet on the Development of Subclinical Laminitis and Foot Lesions in Holstein Heifers During Early Lactation</b> <u>C.T. Livesey, T. Harrington and A.M. Johnston and S.A. May, UK</u>	2
09:45-10:00	<b>Effect of Feeding Higher Proportion of Carbohydrates on the Histopathology of Hooves in Cows</b> S.S. Singh, India, W.R. Ward and R.D. Murray, <i>UK</i>	3
10:00-10:30	<b>Risk Factors Associated With Digital Lameness</b> <u>J.M. Philipot and P. Pluvinage, France</u>	4
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Chairman: A.D. Weaver, *UK*

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11:30-11:45	<b>Behavioural Aspects of Bovine Lameness</b> S.J. Chaplin, <u>J.E. Offer</u> , D.N. Logue and H.E. Ternent and C.H. Knight, <i>Scotland</i>	6
11:45-12:00	<b>The Impact of Different Housing Systems and Technologies on Leg Lesions on Dairy Farms</b> <u>M. Amon, N. Mavsar, Slovenia</u>	7
12:00-12:30	<b>Observations on the Etiology of Sandcracks in Beef Cattle</b> <u>P.R. Greenough, J. Campbell, L. Petrie, Canada</u>	8-9
12:30-12:45	<b>Verticle Fissures in Beef Cattle in Western Canada</b> <u>L.Petrie, P.R. Greenough, J.Campbell, Canada</u>	10
12:45-13:30	<i>Lunch</i>	

**IMPORTANT NOTES:** All lectures will be held in the "Purple Hall" (Auditorium). Coffee breaks will be held in the foyer. Lunch will be served in "Rishonim Hall" (one floor above lobby level). The numbers listed in the right column above, refer to the page number of the abstract in the book.

Monday, April 15, 1996, (Cont'd)

13:30-15:30 **SESSION 2: LAMINITIS**

Chairman: C. Bergsten, Sweden

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*P.O. Ossent and C.J. Lischer, Switzerland*
- 14:30-14:45 **The Effect of Foot Shape on Dairy Cattle Locomotion and Lameness** 16  
*R.D. Murray, C. Preston, D.Y. Downham and J.A. Merritt, UK*
- 14:45-15:15 **Claw Conformation of Dairy Heifers in Two Management Systems** 17  
*J.J. Vermunt, New Zealand*
- 15:15-15:30 **Slats as an Etiological Agent in Laminitis** 18  
*U. Bargai, Israel* *R.B.* *slats*
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16:00-17:45 **SESSION 2: LAMINITIS (CONT'D)**

Chairman: J.G. Ferguson, Canada

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- 16:15-16:30 **Morphopathological Modifications of the Distal Phalanx in the Recurrent Aseptic Diffuse Pododermatitis** 20  
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- 16:30-16:45 **Laminitis in Dairy Calves - A Case Study** 21  
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- 17:00-17:15 **Gross-Pathological and Patho-Histological Study of Apical Pedal Bone Necrosis in Cattle** 23  
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- 17:30-17:45 **A Hind Feet Position Scoring-System to Monitor Subclinical Lameness in Dutch Holstein-Friesian Cows** 25  
*G. Bulgarelli-Jimenez, K. Dercks, J. Van Amerongen, Y. Schukken and M. Nielen, The Netherlands*
- 20:00-21:00 **The Jerusalem Story (Slide Show - Uri Bargai)**

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**Tuesday, April 16, 1996**

**08:00-10:00 SESSION 3: CLAW GROWTH, LAMENESS AND TREATMENT**

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*J.J. Vermunt, New Zealand*
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*A.B. Johnson and L. Schugel, USA*
- 09:30-10:00 **The Effect of Biotin on Sandcracks in Beef Cattle** 29  
*J. Campbell, P.R. Greenough, and L. Petrie, Canada*
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*J.E. Offer, D.N. Logue, G.E.J. Fisher and S.A. Kempson, Scotland*
- 12:30-13:30 *Lunch*
- 14:00 *Departure for Tour of the Old City of Jerusalem, to be followed by Dinner at the "David Tower Citadel" and a 'Sound and Light' Show*

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Wednesday, April 17, 1996

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- 10:00-10:30 **A Congenital Abnormality of the Navicular Bones in a Calf** 42  
M.A. Willemen, K.J. Dik, *The Netherlands*
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Chairman: Ch.J.Lischer, *Switzerland*

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J.Yde Blom, *Denmark*
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P.B. Greenough, *Canada* AB Dig. Derm.

12:45-14:00 *Lunch*

14:00-16:00 *Business Meeting on Future Research and the Next Meeting*  
Chairman: A. Brizzi, *Italy*

1600 BSE.  
Evening Free

\* Abstract not submitted

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Thursday, April 18, 1996

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- 18:30 *Conference Banquet and an Israeli Folklore Show by the "Jerusalem Folklore Ensemble"*

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# ABSTRACTS

## HOUSING AND LAMENESS

W.R. Ward, Liverpool University, Leahurst, Neston, South Wirral L64 7TE

In UK the usual indoor floor is concrete. Concrete adjacent to self-feed silage is often broken by acid and sharp aggregate damages cows' feet.

Clarkson and others (1993) associated slippery concrete with the amount of lameness. Grooving improves the cows' locomotion. The effect of poor floor surfaces is exacerbated by poor beds which encourage cows to stand longer. Clarkson and others (1993) found most cubicles too small for 600 kg cows. Only 13% were 2.3 m or more, and 2.4 m is now recommended. Only 30% had the bottom rail at the correct height of 340 - 400 mm. Only 4% had a kerb height under 160 mm. High kerb was strongly associated with lameness.

Most cubicles were poorly bedded. Examination of a bed after a cow has been lying reveals that bedding is rubbed away to concrete. Clarkson and others (1993) found that 63% of cubicles had inadequate bedding: 75% had a concrete surface, so any deficiency in bedding damaged skin on the hock.

Diamond and Ward (unpublished) studied 14 dairy farms in NW England. Housing, scored as in Clarkson and others (1993), correlated ( $P < 0.02$ ) with lameness. One farm where all cows were housed on straw had least lameness. John Hughes has evolved a simple cubicle, 2.4 m by 1.2 m with a floor of rammed clay, repaired each summer, and bedded with long straw. A brisket board 1.68 m from the kerb prevents cows lying too far forward. The lower rail is a double twisted rope. Bowling and Ward (unpublished) found a mean lying time of 9.4 hours in this type of cubicle. In a similar cubicle, the floor is of concrete with a rubber mat. In place of the brisket board a concrete wedge, rising from the floor to 380 mm prevents cows from lying or standing too far forward. We have measured a mean lying time of 11.8 hours.

Straw yards gained a bad reputation, because of hygiene problems. In straw yards designed by John Hughes two-thirds is bedded, and this area reserved for lying, and one-third, where cows eat and drink, is scraped concrete. Access to the bed is along the whole length over railway sleepers. Singh and others (1993, 1994) found lying times in straw yards to be comparable to those at pasture. Singh and other (1993b) found that cows that lay for longer had fewer foot lesions. Singh and others (1993a and b) found that cows in small cubicles lay down less than cows on pasture, particularly in first lactation and early in the housing season.

If inadequate space is available to cows, there are frequent interactions between cows, and shear forces between feet and floor may increase lameness. Wet horn is softer than dry horn. Silage fed in a building produces more moisture than hay, or than silage fed outside. A slope on a cubicle or a straw yard leading to a gully speeds up removal of moisture. San below a straw yard, or lime or large quantities of straw on cubicles reduce moisture. Mechanical scrapers are disappointing. Some cows stand in the slurry in front of the scraper, and their feet become covered in manure.

Slats had a poor reputation in some areas, because of faulty design, leading in some cases to damaged feet and to difficulty in manure disposal. Cows on slats have clean dry feet. Facilities for foot-bathing or spraying help control interdigital necrobacillosis, digital dermatitis, heel-horn erosion and interdigital dermatitis (Toussaint Raven, 1989).

Regular foot-paring reduces lameness (Manson and Leaver, 1988). A roofed area with a race to guide cows into a crush encourage stockmen to trim feet, and to treat lame cows early.

## THE EFFECTS OF HOUSING AND DIET ON THE DEVELOPMENT OF SUBCLINICAL LAMINITIS AND FOOT LESIONS IN HOLSTEIN HEIFERS DURING EARLY LACTATION

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The objectives of the study were to investigate the effects of housing and diet on the development of the subclinical laminitis syndrome, lameness, foot lesions, acute phase protein response, metabolic profiles and hoof horn amino acid content.

### Materials and Methods

Forty autumn calving pedigree Holstein heifers were allocated in blocks to 4 experimental groups in a 2 x 2 factorial design to study housing and nutrition. The heifers were housed 6 weeks before calving in straw yards or cubicle yards. The alternative complete diets used after calving differed in concentrate: forage ratio and energy density.

Locomotion scores were recorded weekly. At 1-3 weeks before calving and at 6 and 12 weeks after calving both hind feet were measured, pared and examined for abnormalities and horn samples were collected for amino acid analyses. A scoring system was developed for the foot lesions. Sole horn hardness was measured with a penetrometer 12 weeks after calving. Lesions were recorded graphically and photographically and numerically scored according to severity and extent. Blood samples were collected weekly to investigate acute phase protein response. Metabolic profiles for protein, urea, NEFA,  $\beta$ -hydroxybutyrate, GLDH, GGT and AST were estimated during the 1st, 3rd and 6th weeks after calving. Group feed intakes were recorded daily. Samples of the diets were collected weekly and the bulk sub-sampled and analysed monthly. Individual milk yield was recorded daily and milk fat, lactose and protein were estimated once a month. Live weight and body condition scores were recorded once a month.

### Results

There was no clinical lameness before calving. Locomotion scores increased in all groups after calving. The groups fed the high concentrate diet had higher locomotion scores.

White line haemorrhage scores were higher for heifers in cubicle yards. Sole haemorrhage scores were increased by the high concentrate diet and by cubicle yards but there was a significant interaction between diet and housing for the lesions seen 6 weeks after calving. Although there was a trend for higher heel erosion scores in straw yards this was not significant. There was a similar increase in heel erosion for all groups over the experimental period.

Cubicle housing was associated with a decrease in toe length over the experimental period. Sole horn was harder at the toe than at the sole-heel junction and cubicle housed heifers had harder soles.

Sole horn amino acid analysis showed a decrease in the proportion of cystine plus methionine in sole horn crude protein over the experimental period.

There was a rise in acute phase protein activity associated with calving and early lactation.

The cubicle-yarded heifers fed the high concentrate diet produced the least milk but had the lowest plasma NEFA concentrations and lowest weight loss during early lactation.

The work was funded by the UK Ministry of Agriculture, Fisheries and Food.

## Effect of feeding higher proportion of carbohydrates on the histopathology of hooves in cows

S.S. Singh<sup>1</sup>, W.R. Ward<sup>2</sup> and R.D. Murray<sup>2</sup>

Effect of feeding of higher proportion of commercial concentrates with barley and barley alone, along with silage was studied in two groups (I and II) of cows. In group I (three cows), initially 4 Kg of commercial concentrate ration was fed twice daily with silage. Concentrate ration was increased gradually to 8 Kg per day in four days and continued for 14 days. Later 4 Kg concentrate ration was replaced with 4 Kg rolled barley and fed for 14 days. In group II (four cows), cows were fed 1 Kg barley on first day and increased by 0.5 Kg daily to build upto 6 Kg per day in 12 days. Rolled barley (6 Kg) were fed once daily (09.00) along with ad-lib bale silage for 15 days and precision chopped silage for next 15 days.

Biopsies of hooves were taken for histopathology in both the groups and changes in rumen pH were recorded.

In group I, no cow became clinically lame. Rumen pH decreased after feeding concentrate ration. Histopathological study indicated diffuse pododermatitis in all cows. Densely stained material in the sole tubules, swollen endothelial cells initially and proliferative changes later in the laminae were observed.

In group II, rumen pH decreased after barley feeding but rumen pH did not differ between feeding of bale or precision chopped silage. One cow showed clinical signs of diffuse pododermatitis. An excess of densely stained material in the sole tubules, and hyperplasia of the basal epidermis of tubules was observed.

The study confirmed that carbohydrate rich diet can induce diffuse pododermatitis and it may have been due to endotoxin involvement.

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## RISK FACTORS ASSOCIATED WITH DIGITAL LAMENESS

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Lameness in cattle is due mainly to podal lesions. Two approaches have been developed in order to study this syndrome: on the one hand, clinical observation, that allowed a clear description of podal lesions; and on the other hand, experiments, that allowed to identify some factors responsible for podal lesions (notably, food intake), as well as some important physio-pathological processes leading to podal lesions.

However, these two approaches are not sufficient to study claw disorders for two major reasons: firstly, despite the clear clinical definition of podal lesions, the characterization of podal pathologies on the basis of observed lesions remains incomplete because of the complex relationships between podal lesions; and secondly, factors involved in the development of podal lesions are difficult to identify, because each risk factor has a limited effect and because risk factors are numerous, of various origins (nutrition, hygiene, housing, individuals, diseases), and often interrelated.

Epidemiology is a third approach, which is suited to study complex situations because of its concepts (idea of risk factor) and methods (observation study on farms, multifactorial statistical analysis).

Results of the epidemiological studies concerning risk factors for lameness are reviewed according to their location in the causal chain leading to lameness: firstly, those podal lesions that are risk factors for lameness; next, podal pathologies characterized on the basis of the associations observed among lesions (notably, different types of laminitis, and relationships between laminitis and heelhorn erosion); lastly, risk factors for these podal pathologies, related to nutrition, comfort, hygiene, individual characteristics and diseases. In this last step, risk factors are explained and discussed according to the physio-pathological mechanism probably involved in their mode of action (for example, in nutrition: acidosis, toxins, ketosis).

The interest of combining the three approaches (clinical, experimental, and epidemiological) in order to analyse the different links of the causal chain leading to lameness, is illustrated by two means: 1. a discussion about the mode of action of the risk factors (identified by epidemiological methods) in the light of histological and epidemiological knowledge concerning claw disorders (for example: acidosis and toxins, related to inhibition of normal horn synthesis, and to reduction of digital capillary perfusion; and these physio-pathological mechanism, related to subacute, subclinical and chronic laminitis); and 2. conception of experiments designed in order to determine more precisely the effects of different risk factors (for example, nutritional supply).

Furthermore, knowledge about the risk factors for lameness can be used to build processes and tools aiming to reduce the risk of lameness in cattle farms (for example, a prevention handbook for farmers).

## RISK FACTORS ASSOCIATED WITH DIGITAL LAMENESS

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Lameness in cattle is due mainly to podal lesions. Two approaches have been developed in order to study this syndrome: on the one hand, clinical observation, that allowed a clear description of podal lesions; and on the other hand, experiments, that allowed to identify some factors responsible for podal lesions (notably, food intake), as well as some important physio-pathological processes leading to podal lesions.

However, these two approaches are not sufficient to study claw disorders for two major reasons: firstly, despite the clear clinical definition of podal lesions, the characterization of podal pathologies on the basis of observed lesions remains incomplete because of the complex relationships between podal lesions; and secondly, factors involved in the development of podal lesions are difficult to identify, because each risk factor has a limited effect and because risk factors are numerous, of various origins (nutrition, hygiene, housing, individuals, diseases), and often interrelated.

Epidemiology is a third approach, which is suited to study complex situations because of its concepts (idea of risk factor) and methods (observation study on farms, multifactorial statistical analysis).

Results of the epidemiological studies concerning risk factors for lameness are reviewed according to their location in the causal chain leading to lameness: firstly, those podal lesions that are risk factors for lameness; next, podal pathologies characterized on the basis of the associations observed among lesions (notably, different types of laminitis, and relationships between laminitis and heelhorn erosion); lastly, risk factors for these podal pathologies, related to nutrition, comfort, hygiene, individual characteristics and diseases. In this last step, risk factors are explained and discussed according to the physio-pathological mechanism probably involved in their mode of action (for example, in nutrition: acidosis, toxins, ketosis).

The interest of combining the three approaches (clinical, experimental, and epidemiological) in order to analyse the different links of the causal chain leading to lameness, is illustrated by two means: 1. a discussion about the mode of action of the risk factors (identified by epidemiological methods) in the light of histological and epidemiological knowledge concerning claw disorders (for example: acidosis and toxins, related to inhibition of normal horn synthesis, and to reduction of digital capillary perfusion; and these physio-pathological mechanism, related to subacute, subclinical and chronic laminitis); and 2. conception of experiments designed in order to determine more precisely the effects of different risk factors (for example, nutritional supply).

Furthermore, knowledge about the risk factors for lameness can be used to build processes and tools aiming to reduce the risk of lameness in cattle farms (for example, a prevention handbook for farmers).

## HUMAN BEHAVIOUR AND LAMENESS

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Stockmanship involves, first, dealing with animals on a day-to-day basis. Secondly, there are skills involved in the longer term management of a farm. On a small farm one person may perform both sets of skills.

Mill and Ward (1994) studied the person who decided whether a cow was lame, referred to as the farmer. Farmers' knowledge, training and awareness were all associated with the prevalence of lameness. Diamond and Ward (unpublished) in a similar study on 14 farms in NW England found a significant correlation ( $P < 0.01$ ) with the prevalence of lameness.

Clackson and Ward (1991) showed that the way in which stockmen herded cattle during the grazing season affected the incidence of lameness, confirming findings in New Zealand by Chesterton and others (1989). Hughes and Faull (unpublished) have shown that farmers can construct tracks and gateways so that cows walk more quickly and with less risk of lameness. Decisions on the length of the grazing season, and the distance cows have to walk, are made by the farmer.

Stockmen who make cows walk quickly across broken concrete drastically increase the amount of lameness. It is the farmer's job, however, to provide a safe non-slip surface for the cows to walk on.

A good stockman cleans the cubicle beds and passages, and provides bedding and lime, so improving hygiene. Good design of cubicles or use of straw yards increase the time that cows spend lying down (Singh and others, 1993a, 1994) and increased lying times can reduce the number of sole lesions (Singh and others, 1993b). Hughes and Faull (unpublished) showed that a change from small cubicles to larger cubicles or to a straw yard drastically reduced the prevalence of lameness.

Regular antiseptic spray or footbaths reduce infection. Hygiene can be improved by provision of buildings that encourage removal of faeces and urine from the cows, by installing slats and by provision of footbaths or equipment for spraying.

A skilled stockman introduces concentrates to freshly-calved cows gently, avoiding rumen acidosis, which could result in foot damage. Cows fed so that they calve in the correct condition consume more forage, reducing the proportion of concentrate, and the locomotion score. Long-term strategy determines the amount and quality of feed, and the facilities for feeding. A high proportion of concentrate, or a ration high in protein, can increase the locomotion score of cows (Manson and Leaver, 1988, 1989).

Selection of bulls whose daughters have a low incidence of lameness reduces the problem in the long term (Russell, 1987). Some farmers select bulls partly on the basis of foot shape (Mill and Ward, 1993; Diamond and Ward, unpublished).

Stockmen who perform preventive foot trimming improve locomotion score (Manson and Leaver, 1988b). Clarkson and others (1993) found that foot-trimming was sometimes followed by more lameness, suggesting that unskilled trimming is a risk factor. The stockman's skills improve if the farmer sends him on a suitable course.

An alert stockman notices lameness promptly, and treats the cow or calls the veterinarian early. Clarkson and others (1993) found that the duration of lameness in one area of Britain was shorter than elsewhere, and explained this as a result of enthusiastic stockmen.

Clarkson and others (1993) considered that the skill and enthusiasm of one veterinarian helped to reduce the duration of lameness in one area of Britain. A veterinarian also reduces lameness by providing good advice on prevention.

Skilled foot-trimmers reduce the amount of lameness. Clarkson and other (1993), however, found that when some foot-trimmers had been employed, there was more lameness after trimming than before.



## BEHAVIOURAL ASPECTS OF BOVINE LAMENESS

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Lameness, hoof lesion formation and behaviour were compared between a group of 10 early lactation, first calved heifers (LH) and heifers of the same age in early pregnancy (PH). Both groups were housed in cubicles under identical conditions with 4 older cows mixed with each group to provide a social stressor. The LH group had previously experienced cubicles whereas the PH group had not. Behavioural observations were made by scan sampling every 15 minutes for 24 hours, commencing at housing and continuing fortnightly thereafter for 8 weeks. Hoof examinations were performed at -4, 0, 4 and 8 weeks after housing. PH was subsequently examined again at approximately 2 months before, around the time of calving and 2 and 3 months after calving the following year. At each examination all 4 feet were photographed and the lesions were scored using image analysis techniques to estimate the size and position of the lesions and a geometric score for severity. Measurements of hoof hardness (Shore A), growth and wear and hoof conformation were made in the right hind foot at each examination. Animal were locomotion scored weekly for the first 10 weeks after housing. Significant increases in total lesion scores were associated with both housing and calving in both groups. Peak lesion scores for the white line area were observed approximately 2 months after calving whilst those for the sole occurred later at 3 months post calving. This trend was similar for both groups. Incidence of lameness and lesion scores were significantly higher for LH than for PH. Behavioural observations showed that total lying times were greater for PH than for LH (11.2 Vs. 9 hours) and that LH had more disturbed patterns of lying behaviour: lying bouts were shorter (maximum 2.1 Vs 2.9 hours) and more numerous (9.7 Vs 7.4 bouts/24 hours for LH and PH respectively). Cubicle occupation and utilisation were similar for both groups and aggressive social interactions were only present at a very low frequency. It is suggested that there is an interaction between housing and calving affecting subclinical laminitis and lesion formation and that this is mediated via metabolic, environmental and behavioural changes.

# THE IMPACT OF DIFFERENT HOUSING SYSTEMS AND TECHNOLOGIES ON LEG LESIONS ON DAIRY FARMS

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About 3.500 milch cows on 17 bigger farms in Slovenia have been examined, to establish the impact of different housing systems and technologies on leg lesions.

Especially lesions on different parts of legs (claws, carpuses, tarsuses, thighs) of cows in different housing systems have been scored and compared.

By using statistical analysis of multiple regression there have been established different influences on leg lesions, age, health, production of milk and reproduction intensity.

By this method of multiple regression analysis it has been established a range list of influences. There have been significant differences due to housing systems on lesions on different parts on the legs and body.

The herd management traits include: herd size, milk production, housing system, with tied up cows, with different dimensions of standing places, as well as cubicles with different types of construction and dimensions, feeding systems, feeding barriers and passages, fences, cubicle divisions, reproduction traits, age, on slatted floors, cow traps, indoor all year, on pasture etc.

Number and intensity of injuries are related to the housing system, technology, production of animals, reproduction intensity and age. All of these characteristics are worse in tied systems. Pasture mitigated the intensity and the frequency of lesions.

It could be concluded that housing systems in cubicles are more convenient for animal wellbeing and in general for animals welfare too.

Housing systems for milch cows are important factors which have influence on injuries and technology related diseases in intensive rearing systems, which we can improve for better wellbeing of the animals, production, reproduction and health as well.

## OBSERVATIONS ON THE ETIOLOGY OF SANDCRACKS IN BEEF CATTLE

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Sandcracks (Vertical Fissures) are commonly encountered in the claws of beef cattle in Western Canada. In one survey it was found that from 20.5% to 64.3% (average 37.2%) of the mature beef cows in 15 herds were affected with one or more cracks (Westra, 1981). In another study there was a prevalence of sandcracks of 22.7% among 1183 cows examined (Hand et al, 1992, Goonewardene and Hand, 1995).

The main economic loss associated with sandcracks and claw problems in beef cattle arise from reduced longevity of a herd. Increased levels of culling result from chronic foot problems. Some estimate of the economic effect of lameness can be extrapolated from work with dairy cattle. Reluctance to walk reduces the animals ability to walk and compete for feed. Lamé cows at summer grass lie down longer and graze less than normal cows (Hassall et al, 1993). In one study body condition score dropped by an average of 0.8 units (Weaver, 1990) Poor reproductive performance has been associated with lameness in dairy cattle (Collick et al, 1989, Lee et al, 1989). Processing and medication of lame animals is costly (Esselmont and Spincer, 1993). Lameness has also been associated with an increase in the incidence of other diseases such as mastitis (Peeler et al, 1994). Danish workers have also established that the insult associated with the etiology of laminitis affects other organs such as the liver, kidneys and adrenals. As a result it was found that production was lower than expected (Mortensen and Hesselholt, 1986).

The economic significance of sandcracks in beef cattle is unknown although ranchers claim that the condition is associated with higher than acceptable levels of lameness and a higher than normal culling rate. Pedigree breeders also claim that the unsightly appearance of claws is detrimental to the sale of breeding stock.

Little has been written about the etiology of sandcracks although various unsubstantiated hypotheses exist. No proven treatment or control measures have been established.

### Materials and Methods

Two herds of beef cattle were the subjects for this study. One herd of Polled Herefords consisted of 265 mature cows and the other of 142 mixed breed cows. The incidence of sandcracks was 37% of animals over three years of age in the first herd and 64% in the second herd.

In order to determine the rate of growth of the claw horn a 2.5 mm hole was drilled in the horn of the claw 3 cm from the distal border of the coronary band. The hole was filled with white bath caulking compound which would facilitate location later.

The claws of 2 and 3 year old animals were examined in June and October of 1994 and 1995 respectively.

### Findings

Some sandcracks are confined to the coronary band starting with a disfunction of the coronary dermis. Several sandcracks commenced as the result of trauma and other cases could be associated with an incident of foot rot.

Hypothetically other (perhaps the majority) sandcracks had a mechanical etiology. Many of these vertical fissures were associated with a horizontal fissure. The theory is that fissures are a point of weakness in the wall. As the horizontal fissure moves to the middle of the wall upwards pressure from the toe causes stress on the already weakened wall. This causes the claw to split upwards to the coronary band.

It was discovered that the rate of horn growth on the dorsal flexure of beef cattle was from 2.0 to 3.0 mm per month. Using this rate of claw growth as a guide it was found that the numerous grooves, and fissures were probably initiated as the result of an insult occurring in late May or early June. This, traditionally, is the time that these herds were turned out to pasture.

#### **The Nutritional or Grass Founder Hypothesis**

Most beef herds spend the winter on diets high in fibre and relatively low in TDN and Protein. At some time in the spring the herd encounters, often over a short period of time, pasture rich in crude protein and total digestible nutrients (TDN) but low in fibre. Crude protein levels in excess of 30% may be encountered with acid detergent fibre (ADF) falling below 20%. Excess protein (over 16%) can be converted to sugars which are rapidly metabolized. The ADF component of fibre has the function of buffering the ruminal contents. Therefore if the ADF level is low and protein level is high the environment of the rumen could mimic that following carbohydrate rich intakes. Variations in pasture quality can be influenced by the following:

- Seasonal rainfall/temperature
- Plant species
- Pasture fertilization
- Plant trace element content
- Mineral supplement formulation

Other potential risk factors may also have to be considered:

- Early calving periods
- Heavy body weights
- Claw shape and size (hereditary factors)
- High calf weaning weights
- Superimposed lesions, trauma or foot rot

#### **Acknowledgement**

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## VERTICAL FISSURES IN BEEF CATTLE IN WESTERN CANADA

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Vertical fissures (sandcracks) are commonly found in the claws of beef cattle in Western Canada. In a survey of 15 beef herds in Alberta, a mean of 37.2% of adult cows had vertical fissures of one or more claws with an individual herd range of 20.5% to 65.3% (Westra, 1981). In two more recent studies in the same province the prevalences of vertical fissures in adult beef cows were 22.7% and 24.8% (Hand *et al.*, 1992; Goonewardene and Hand, 1995).

The economic significance of vertical fissures in beef cattle is unknown, although ranchers claim that the condition is associated with a higher than acceptable level of lameness. Anecdotal evidence suggests that vertical fissures are the most common cause of sole abscesses in beef cows.

Two beef herds with an apparently high incidence of vertical fissures were examined in 1994. In herd 1, an overall prevalence of 27.5% was found; 38.2% of cows 3 or more years old had vertical fissures, but only 2.5% of two-year-old cows were affected. In herd 2, 52.8% of cows had vertical fissures; none of the 29 2-year-old cows was affected, but 22%, 65% and 86% of cows aged 3, 4 and greater than 4-years-old, respectively, had vertical fissures. Lesions predominated in the lateral claws of the fore feet, with 48% and 54% of animals having the lateral claws of the left fore and right fore feet affected respectively. The corresponding values for medial claws of the fore feet were 5% and 20%. The prevalence of lesions in the hind feet was considerably lower, with 10.6%, 2.6%, 10.6% and 16% of the left hind lateral and medial and right hind lateral and medial claws, respectively, having lesions. The prevalence of affected claws in herd 2 was 18%. The clinical findings and significance of these lesions will be discussed.

### Acknowledgements

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## LAMINITIS IN CATTLE: WHAT DO WE KNOW OR ASSUME TODAY?

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Laminitis is an important predisposing factor of lameness due to claw disorders. The subclinical laminitis syndrome, including white zone (white line) lesions and sole ulcer, is regarded to be the most important condition affecting the claws of dairy cattle today. However, there is still much speculation on most aspects of the aetiology and pathogenesis of (subclinical) laminitis.

### **Different forms of laminitis**

Bovine laminitis results in morphological and(or) functional changes within the claw. It presents itself in various forms depending on the severity and duration of the condition. The terms "acute", "subacute", "chronic", and "subclinical" are used (although arbitrarily) to classify the various stages of laminitis.

*(Sub)acute laminitis* -- In the acute stage of the disease, an aseptic inflammation of the dermis coincides with a systemically sick animal. It is often caused by a single factor such as ruminal acidosis, severe mastitis or metritis. Clinically, aberrations in posture and gait, in response to pain resulting from a disease process within the claw, can be observed. At this stage, the claw horn shows few, if any, visible changes. However, historic evidence of the insult may be observed in the claw some time after the laminitic episode has resolved.

Subacute laminitis is a milder degree of acute laminitis. Both forms of laminitis are prone to recurrence at varying intervals and often progress to the chronic form.

*Chronic laminitis* -- This form has no systemic signs and changes are localised to the claw. A disturbed horn growth pattern and an alteration in the shape of the claw, i.e. an elongated and concave dorsal border, and a flattened, broadened sole, are characteristic. Sole ulcers and a widened white zone are also a common feature. Grooves and ridges, caused by irregular episodes of horn growth, may be present in the claw wall.

*Subclinical laminitis* -- Subclinical laminitis represents a multifactorial disease, involving many factors such as nutrition, management, environment, conformation, genetic predisposition, behaviour and exercise. Changes in posture or locomotion are usually not observed. However, historic evidence that an insult occurred some time ago may be present in the claw horn. Particularly, the horn of the sole becomes physically softer, discoloured and rather waxy in appearance, and is often stained yellow. Haemorrhages can be seen in the weight-bearing surface of the claw, in particular the white zone, apex of the sole and axial side of the sole-bulb junction. These haemorrhagic lesions appear to be distributed over all claws in a rather symmetrical fashion, but are localised to the sole without involvement of the laminae. Subclinical laminitis also gradually progresses into chronic laminitis.

### **Histological features of the dermis**

The dermis is "sandwiched" between the distal phalanx and the horny capsule. The dermal micro-circulation supplies the horn-producing cells with oxygen and nutrients. To relieve pressure within the delicate vessels, some mechanism is required to accommodate temporarily the retrograde flow of venous blood which occurs during weight bearing. Several such mechanisms exist within the bovine claw:

*Arteriovenous anastomoses (AVAs)* -- These form direct connections between the arterial and venous divisions of the dermal circulation and occur throughout the entire dermis of the bovine claw. The functioning of the AVAs is controlled by smooth muscle cells present in the wall of

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these structures. AVAs provide a route to bypass the papillar and lamellar capillaries.

*Glomus bodies* -- These are expandable vessels which form "bridges" between arterioles and venules. Blood is diverted into these structures if the pressure within the claw increases. Blood is returned into the general circulation when smooth muscle cells in the wall of the glomus bodies contract.

*Capillary enlargements* -- In the interior half of the dermal lamellae, focal enlargements and distentions of the capillary plexus can be found at the transition into the venous bed. Again, smooth muscle cells are present around these enlargements.

*The coronary cushion* -- This spongy network of venous plexuses lies immediately beneath the coronary margin of the claw. Blood is squeezed into the larger veins of these plexuses during weight bearing.

Most, if not all of these structures appear to play a crucial role in the pathogenesis of bovine laminitis.

#### **Theories on the aetiology and pathogenesis of laminitis**

Despite intensive study, knowledge of the precise aetiology and pathogenesis of laminitis is still incomplete.

##### *The theory of insult to the vascular system of the dermis*

For many years, vasoconstriction and ischaemia of the peripheral, dermal micro-circulation have been incriminated in the pathophysiology of laminitis. The commonly accepted theory hypothesizes that toxic, vaso-active substances, such as histamine, lactic acid, endotoxin and possibly nitrite are formed or released in the digestive tract or are produced during post-partum diseases. The vaso-active components, together with a coagulopathy, severely disturb the haemodynamics in the dermis. This results in tissue hypoxia and nutrient starvation, and is followed by ischaemic necrosis and degeneration of the horn-producing structures.

The true nature of these processes has not been established yet and there is much speculation on how the toxic substances employ their vaso-active effect.

Recent research on equine laminitis suggests that the inciting haemodynamic cause of acute laminitis may be digital venoconstriction caused by an unknown vaso-active mediator. This would reduce the afflux of blood from the lamellar and papillar capillaries, resulting in increased capillary pressure and hydrostatic movement of fluid from the vasculature into the interstitial tissue of the dermis. The increase in interstitial pressure further impedes capillary blood flow and also leads to ischaemia.

Both increased shunting and venoconstriction cause a rise in local venous pressure which spreads to the capillary bed, thereby raising the capillary pressure. As a consequence, a reduction in digital capillary perfusion occurs, particularly through the lamellae and papillae. The blood flow stagnates, causing increased pressure and pain. The capillaries become congested, which can lead to oedema and focal haemorrhages in the capillary beds of the affected tissues. Such haemorrhages are then incorporated into the horn. As new horn is produced, these haemorrhages move towards the surface of the claw and become visible in the tubular horn of the wall and sole and lamellar horn of the white zone. Haemorrhages in the horn, particularly of the sole and white zone, are dominating features of bovine laminitis.

Besides injury to the vascular wall, a prolonged decrease in perfusion rate also damages the keratin-producing cells of the epidermis, particularly in areas of high cell proliferation, i.e. the coronary margin, white zone and sole. Irreversible damage may result, leading to the production of poor quality horn (softer and more easily damaged), which is also characteristic for laminitis.

Vascular disruptions in the claw may occasionally be caused by direct trauma to the dermis, such

as excessive concussion or bruising of the sole after improper trimming. Congestion, exudation and haemorrhages normally follow.

#### *The theory of altered keratin metabolism*

A second theory contends that laminitis is the result of altered keratin metabolism in the horny capsule of the digit. In this situation, the horn-producing cells are the first line of attack for the toxic factors involved in laminitis and the vascular changes in the dermis are secondary.

#### *The theory of Epidermal Growth Factor involvement*

Epidermal Growth Factor (EPG) released from the gastro-intestinal tract and(or) uterus, would bind to the membranes of cells in the horn matrix. EPG possesses both a mitogenic effect and an inhibiting effect upon the differentiation of keratinocytes.

#### **Lesions associated with laminitis**

These can be broadly classified in primary and secondary lesions.

*Primary lesions* -- These occur as a direct result of the histopathological changes in the dermis:

1. *Sole haemorrhages* -- A disturbance of the micro-vasculature of the dermis results in the escape of blood components into the tubules of the horn of the sole and bulb (see above).

2. *Poor quality horn* -- Diffuse lesions lead to the production of inferior horn, which then appears some time later on the external surface of the claw capsule (see above).

*Secondary lesions* -- Reportedly, these lesions are observed more commonly in cattle that are or have been affected by laminitis, and include:

1. *Sole ulcer* -- During laminitis, an inadequate supply of oxygen and nutrients to the multiplying basal cells at the dermal-epidermal junction causes the inter-digitating laminae and lamellae to separate at that point. Biomechanical forces imposed on the compromised bond securing the distal phalanx to the claw wall causes the distal phalanx to drop slightly within the horny capsule, thereby compressing the underlying dermis. The resulting haemorrhage and necrotic debris, situated directly beneath the process of the deep flexor tendon insertion onto the distal phalanx, will then be either incorporated into new horn or hinder the production of new horn. If the insult is severe enough, the latter will lead to the formation of a classic sole ulcer.

Similar lesions may develop at the toe or along the abaxial white zone of the sole, depending on whether the dermis is compressed by the apex or the lateral border of the distal phalanx, respectively.

2. *White zone disease* -- At the relatively soft white zone, horn of the claw wall merges into horn of the sole. Extensive exudation, haemorrhages and a decline in horn quality (associated with a laminitic insult) all reduce the strength and integrity of the white zone. As a result, the white zone becomes wider and softer, and eventually disintegrates.

3. *Double sole* -- This occurs when a large amount of serous or haemorrhagic fluid escapes from the dermal circulation and temporarily hinders the production of new horn by the basal cells at the dermal-epidermal junction.

4. *Heel horn erosion* -- Layers of haemorrhages in the sole horn, produced during episodes of laminitis, often terminate at the heel as tiny grooves. Bacteria invade these grooves, causing disintegration of the heel horn. Also, heel horn erosion and underrunning of horn is more likely to occur if abnormal keratinisation occurs, as is the case in laminitis.

#### **Predisposing factors of laminitis**

Most laminitis problems in cattle are thought to be associated with type of feed. However, the hypothesis of a multifactorial aetiology extends beyond nutritional factors and current concepts



suggest that a combination of mainly interdependent factors influence the occurrence and severity of laminitis. Numerous factors, acting either directly or indirectly (through vaso-active substances) on the dermal micro-circulation, have been cited as predispositions to laminitis in cattle. They include individual cow factors such as systemic disease, age or parity, stage of lactation, conformation and genetics as well as herd-level factors such as nutrition, housing and flooring, level of exercise, behaviour and environment.

To isolate one possible predisposing factor from another is difficult, if not impossible. However, it is the total effect of all factors combined on the occurrence of laminitis which is important. The many changes in feeding, management, environment and social grouping, to which heifers in particular are subjected around the calving period, likely cause considerable stress at a time when their body metabolism is also changing rapidly. Furthermore, it has been demonstrated that the toxic, vaso-active substances, which affect the claws of cattle experiencing episodes of laminitis, also affect other tissues and organ systems. Therefore, such animals are unlikely to produce to their full potential.

## THEORIES ON THE PATHOGENESIS OF BOVINE LAMINITIS

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Laminitis is a disease condition of the claw of manifold etiology and uncertain pathogenesis. The condition, arising from a systemic disorder due to a wide spectrum of interdependent aetiological factors, is due to a disturbance in the microcirculation of the corium with ensuing degenerative and possibly inflammatory changes at the dermal-epidermal junction. The aetiological influences range from metabolic and digestive disorders, parturition or severe inflammatory processes (e.g. metritis or mastitis) to influences localized within the hoof such as trauma, claw or limb configuration (overload), lack or excess of movement, and "inherent" deficiencies in the keratinizing epidermis itself. Some factors have been known for thousands of years, others have only been discovered recently. All have something in common. Sequelae range from impaired horn production with diffuse softening and discolouration (sub clinical laminitis), hemorrhages in the sole and heel, double soles, heels and walls, ulcers in the sole and heel, to white line lesions (separation) and in chronic cases, deformation of the whole claw. The changes may be grouped into a sub clinical, acute, sub acute and chronic form.

In the first phase, predominantly vasoactive substances which have been released into the system, trigger degenerative and or inflammatory changes, centred around the blood vessels. Exudation and swelling of the adjacent dermal tissues follow, further aggravating the situation. Vasodilation and erythema persist for the duration of the inflammatory process. Oedema in the corium develops after the vessel walls become permeable to fluid and the vascular pressure increases. Thrombi may supervene.

For anatomical reasons the soft tissues in the hoof are in a unique predicament which renders them vulnerable to this cascade of adverse events. The corium (dermis) is sandwiched within the inflexible narrow space between the pedal bone and the horn shoe. Any increase in the volume of the corium will aggravate the situation by further amplifying tissue pressure and inducing pain and soon a vicious circle analogous to the compartment syndrome in muscle develops. By this stage all or some of the following have occurred; vessel wall damage, oedema, sludging, unphysiological arterio-venous shunting, hypoxaemia, tissue hypoxia, haemorrhage and thrombosis. In the bovine, it is not clear to what extent and at which stage inflammatory cell components contribute to these events or even whether their presence is obligatory.

Further special anatomical features of the hoof are the interdigitating dermal and epidermal laminae. A greater part of the body weight bearing on the limb is suspended from the dorsal and side walls by this structure whose integrity is imperative for the normal function of the foot. The basal epidermal cells, supplied from the underlying corium, require more nutrients and oxygen than any other tissues in the vicinity. Thus any deficiency in the supply of essential substances resulting from the changes in the corium mentioned above will affect the tissues of the laminar dermal-epidermal junction first, both for metabolic and then for mechanical reasons. The laminae will begin to separate by sliding past each other like fingers being drawn from a glove. The pedal bone, i.e. the digit, sinks within the horn shoe and compresses the thin layer of soft tissues of the sole and bulb. The next phase of events is initiated.

Capillary damage and ischaemia lead to a second interreacting network of phenomena. Haemorrhage, necrosis, oedema, thrombosis and cellular inflammatory reaction develop under the pedal bone and present more reason for lameness and are a greater threat to the animal. Should the adverse influences continue they will eventually become clinically apparent.

Serous fluid, haemorrhages and necrotic debris either hinder the production of horn altogether or they will be incorporated within the new horn layers being produced by the basal cells of the volar surface. They will emerge as double sole or heel, red patches (hemorrhages) or cause perforations (ulcers). More diffuse lesions will lead to the production of inferior horn which appears some time later as flakey, yellow, friable, soft masses.

The site of necrosis and haemorrhage is determined by the angle at which the pedal bone sinks and also depends on the bone's surface configuration. If the tuberositas flexoria, the most distal point of the pedal bone compresses the tissues the lesion, be it haemorrhage or necrosis, will be located adjacent to the "typical site". Correspondingly, toe lesions occur when the tip of the pedal bone sinks first. Necrosis in the solar corium is practically always focal and often protuberances or the sharp abaxial edge of the pedal bone are palpable underneath. Sufficiently severe and persistent lesions will eventually cause a sole ulcer.

Changes to the wall horn develop during the first phase of laminitic insult. The horizontal parallel grooves seen in chronically laminitic animals are due to successive bouts of disease injuring the horn producing cells in the coronary region. Extensive exudation in the acute phase and, or reactive hyperplasia in the chronic stage of laminitis will lead to a widening of the laminar zone eventually allowing white line disease to develop.

Careful examination and interpretation of the necropsy findings helps to throw light on the pathogenesis of foot lesions, may give insight into the order of events and may help to explain the nature of disorders in the horn capsule. A spectrum of lesions which may be encountered within the foot at post mortem examination will be demonstrated. Emphasis will be put on cases which presented with severe clinical signs leading to slaughter but where no external changes were seen.

## THE EFFECT OF FOOT SHAPE ON DAIRY CATTLE LOCOMOTION AND LAMENESS

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A method of assessing cattle foot shape was devised which allowed large numbers of observations to be made whilst dairy cows were milked (Res. Vet. Sci 1994, **56** 265-269). Using this, approximately 25,250 observations of hind foot shape were recorded from 23 dairy farms located in three different areas of the United Kingdom over a two years period. From these observations, 11% of cows had moderate, or severe, overgrowth of the toe, 12% had a heel height >4.5 cm and 9% had moderate to severe "corkscrew claw" conformation. Generally, toe length and axial wall conformation were best in late summer (August - October). Claw shape was found to deteriorate most for toe length and "corkscrew claw" in late winter and early summer (February - June). A combination of high heels and excessive toe length was found to increase locomotion scores by 0.6 of affected cattle; this was highly significant ( $p < 0.001$ ). Approximately 2,000 records were obtained of cows' feet trimmed not lame, where records of foot shape existed both before and after trimming.

Whilst foot shape could be consistently improved, locomotion scores were worse after trimming than before in some herds. A similar study of foot shape was carried out on lame cows before and after treatment, and a proportion of cows were more lame after treatment and corrective claw trimming than before. The welfare issues that these results raise will be discussed.

## CLAW CONFORMATION OF DAIRY HEIFERS IN TWO MANAGEMENT SYSTEMS

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A computerized conformation determination system was used to objectively evaluate claw conformation of dairy heifers in two management systems, i.e housed indoors on concrete slats or out of doors on a drylot. Examinations were made at four-week intervals from 12-13 months of age until calving at 24-26 months. Overall, angle of the dorsal border did not differ between front and hind claws. Length of the dorsal border, heel height, and toe:heel ratio were greater for front claws ( $P<0.001$ ). Hind claws were longer than front claws ( $P<0.001$ ), but front claws were wider ( $P<0.001$ ). On both front and hind limbs, lateral claws were wider than medial claws ( $P<0.001$ ). Claw angles decreased and lengths of the dorsal border, and heel heights increased over time ( $P<0.05$ ). Significant differences in claw conformation were found between the two management groups. Heifers maintained out of doors had longer toes and wider lateral claws than heifers housed indoors ( $P<0.05$ ). At time of entry into the respective management group, no significant differences in claw traits were found between the two groups. At calving, however, outdoor-housed heifers had hind claws with smaller toe angles and longer dorsal borders ( $P<0.05$ ).

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Slates as an etiological agent in Laminitis

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Housing has been incriminated as a risk factor in Laminitis in cattle. Several specific causes related to housing were reported, among which the size and structure of the loose box , the free space allowed to each cow, the floor shape and other.

This report will describe a severe problem of lameness in a dairy herd. The lameness originated in the hooves of cows from second lactation onward. Investigation in the herd revealed that the lameness were typical of sequelae of laminitis, such as double sole, solar abscesses, white line abscesses and wall separation.

The herd consisted of 300 milking cows, among which there were 78 1st lactation cows. none of the 1st lactating cows showed lameness. All heifers are moved to the lactating cows shades and diet immediately after parturition. The diet of all the lactating cows groups was the same and included 17% digestible protein and 1.72 megacalories in a Kg. of food.

During the last 2 years there were 3-4 new lame cows every week, and 30% of the herd was culled annually, of which 70% were because of foot lameness.

hematology and biochemical studies done on 9 severe clinical cases of foot lesions revealed normal findings in most cows and minor changes in few cows but no universal abnormality.

Investigation into the housing system showed that the cows were housed all winter and most of the time in the summer in a closed

space with slates floor. These slates were very irregular, rough and tall because of dry manure adheres to them. the slates were never scraped due to technical difficulties.

Due to the unique lameness in this herd - only from second lactation on- and the lack of faults in the nutrition- as could be judged from the normal blood finding- it was concluded that the laminitis developed in the cows because they walk on the very rough slates. Since 1st lactation cows do not have large heavy udder, they are less affected by the slates. The cows with large heavy udder, namely cows from 2nd lactation on, developed laminitis and its sequelae which were so apparent in this herd.

INCIDENCE OF ACUTE DIFFUSE ASEPTIC INFLAMMATION OF THE CORIUM OF THE CLAW IN  
DAIRY COWS

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Herd health and production - related problems were monitored for the period of one year on a large farm with 385 Holstein-Friesian cows nearby Ljubljana. An incidence of acute aseptic inflammation of the corium of the claw (n=33) and urovagine (n= 37) was detected and treated at the end of August 1993, especially in cows on pasture. The incidence of the disease was during the summer (pasture) statistically significantly ( $P<0,01$ ) greater than during the winter (stalls). The analyses of the intake revealed that it was markedly richer in proteins during the summer months and that it contained less energy and roughage. A statistically significant ( $P<0,001$ ) difference was revealed between fat, protein and urea bulk milk contents. Therefore we may associate the appearance of acute aseptic inflammation of the corium (Sole haemorrhages) and urovagine with too rich supplement of animals with proteins (lush pasture ) and/or an increased urea content and some other toxic substances in the organism of dairy cows.

MORPHOPATHOLOGICAL MODIFICATIONS OF THE DISTAL PHALANX IN  
THE RECURRENT ASEPTIC DIFFUSE PODODERMATITIS

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In previous researches, the authors demonstrate that within permanent stabulation conditions and the lack of trimming, the abnormal growth of claws is the main risk factor or the digit disease. The correlative knowledge of pathological modifications of the hoof wall and of the phalanx is considered to be useful.

In the paper, there are presented the results of the research made on 80 digits provided from cattle between 5-6 years old, at which there were diagnosed recurrent aseptic diffuse pododermatitis circumscripta (sole ulcer). Through usual techniques, distal phalanx and hoof walls were examined macroscopically and pathological modifications of the phalanx induced by the abnormality of the hoof walls present in recurrent PAD and PC of the sole were established.

The obtained results reveal a positive correlation between the type of the abnormality of the hoof wall and the type of pathological modifications found in the phalanx. Thus, in recurrent PAD the narrowing, lengthening and bending of the hoof wall induce the same deformation tendencies of the phalanx. In the chronic forms, one can notice modifications of the vascular bone holes, osteoporosis alternated with osteophytosis processes, reflecting the consequences of circulatory disturbances, of the abnormal position of the claws, of the inequity of the leaning and of the excess of the horn tissue in the abaxial wall and in the central area of the sole.

In all the cases of pathological abnormality, the hoof wall preceded the pathological modifications of the phalanx.

Modalities of trimming and treatment are presented in the paper.

## LAMINITIS IN DAIRY CALVES - A CASE STUDY

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In dairy cattle, laminitis is generally considered to be a disease of adult animals, but there have been a few reports of it affecting calves. This paper describes an outbreak of clinical laminitis with a chronic course in young Swedish Red and White calves in a commercial herd in western Sweden.

The herd consisted of 50 dairy cows and their offspring. The calves were kept in individual pens for their first week of life, and were then housed in groups of eight to 10 until they were weaned at 10 weeks. They were fed milk replacement from a computerized calf feeder, hay, and pelleted calf feed, and from six weeks of age they also received crushed grain consisting of 60% of oats and 40% rye wheat. They were kept on straw litter and the floor was crude concrete in the calf feeder. After weaning, the bulls and heifers were separated and housed in groups on deep litter with a concreted feeding alley. They all had free access to silage, and for each nine calves 8 kg crushed oats and rye wheat, and 6 kg of a commercial protein feed for cows were allocated daily.

Between November 1994 and January 1995 clinical laminitis was diagnosed in six of the heifer calves, when they were between six weeks and 12 weeks of age. They had difficulty in rising and rested on their carpi for up to 20 minutes before finally standing up. They moved stiffly with their backs arched and with little flexing of the carpal joints; when standing they often extended their forelegs. Their hooves became overgrown. Two of the calves were examined by the authors shortly after their clinical signs began and the digital arteries could be felt pulsating and the hooves were hot. No clinical signs of laminitis were observed in the bull calves kept in the same pens.

Blood samples were taken from four of the affected calves and the serum concentrations of calcium, phosphorus, vitamin D (25-OH-D<sub>3</sub>), albumin and globulin, and the activities of glutathione peroxidase and aspartate aminotransferase were within their normal ranges. The four calves were slaughtered and their claws examined for pathological changes: they all had sole haemorrhages and ventral rotation and atrophy of the distal phalanx. A histological examination of material from one of the calves revealed abundant haemorrhages, areas of necrosis, thrombosis and vasculitis in the corium, and pronounced destruction of the bone adjacent to the affected corium.

Rye wheat, is not normally fed to Swedish dairy calves, and its high starch content may have been one factor in the development of the laminitis, Another factor may have been infection with bovine viral diarrhoea virus (BVDV), because four of the calves were chronically infected with the virus and one had had a primary infection; the BVDV status of the sixth calf is unknown. However, chronic BVDV infection was also diagnosed in seven of the bull calves of a similar age. None of them developed clinical signs of laminitis but some of their claws were slightly affected by laminitis at post mortem examination.



## CLINICAL STUDY ON TOE ABSCESS AND NECROSIS OF THE APEX OF THE DISTAL PHALANX IN CATTLE

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### **Introduction**

Disorders of the apical area of the bovine hoof ("toe abscess" and osteolysis of the apical pedal bone) have not been widely reported. The diagnosis is based on clinical examination, in particular on accurate visual examination of the horn shoes, which is facilitated by a thorough washing of the claws and a "diagnostic trimming" of the sole. Radiographs document the extent of osteolysis of the apex of the distal phalanx. The purpose of this study was to describe the clinical and radiographic findings of "toe abscess" (= necrosis of the pododerm of the toe area) and apical pedal bone necrosis in 42 cattle and their treatment.

### **Material and Methods**

42 cattle suffering from "toe abscess" and / or apical pedal bone necrosis (January 1985 - September 1995) were selected for this study. Their clinical reports were evaluated regarding the causative factors, clinical symptoms, topical lesions, radiographic findings and type, duration and success of treatment or cause of slaughtering. The cattle from various breeds showed a mean age of 5.2 years. Clinical examination was based on observation and classification of lameness and detailed investigation of the hoof. Radiographs were taken in dorso-palmar/plantar and latero-medial directions or using interdigital plates. The clinical and radio-graphic findings of 42 cattle were classified, depending from the extent and severity of the observed signs.

### **Results**

A total of 64 claws in 42 cattle showed disorders of the toe region: in 27 cattle the distal phalanx of only one claw showed osteolysis, in 6 cattle the distal phalanx of 2 claws, and in 5 cattle the distal phalanx of 3 claws was affected, 4 cattle suffered from a "toe abscess" in one claw only. Only claws of the hindlimbs were involved in cases with multiple apical pedal bone necrosis. The toe disorders were localized on lateral respective medial claws of hindlimbs in 39 respective 20 cases, in 5 cases the claws of forelimbs were affected. The lameness degree ranged from grade 2 to grade 4 (out of 4), and some cattle were reluctant to move, showed severe stilted or a spasmodic gait or were mainly recumbent. As causative factors overtrimming and perforation of the sole during claw trimming with the disk could be determined. Less frequent causes were traumatic injuries and laminitis. Thin soles, very small to large separations of the sole from the wall, circumscribed horn defects, under-run soles of various extent, discharge of exudate or even the uncovered and discolored apex of the distal phalanx could be assessed. Radiographic changes ranged from a slight osteolysis of the apical margin of the tip of the distal phalanx to osteolytic changes of a quarter to a half of the pedal bone with pathological fracture. Sixteen cattle were euthanized or slaughtered after the diagnosis was stated: they showed multiple digital diseases or in addition mastitis or bronchopneumonia. In 19 cattle the necrotized apex of the distal phalanx was resected under regional intravenous anaesthesia and antibiotics, but 2 out of 19 cattle were dismissed later to slaughter. In one out of this 19 an amputation of the digit was necessary later. In 4 cattle with severe osteolytic changes an amputation of the digit was performed. In 3 cases with "toe abscess" the claws were trimmed, the lesion opened and drained. Wooden blocks were fixed under the sound adjoining claw in all cases of apical pedal bone resection and in cases of opening and draining the "toe abscesses". Bandages were applied in all surgically treated cases, antibiotics administered parenterally in cases of bone resection. The duration of treatment ranged from 16-60 days in cases of resection of the tip of the distal phalanx and from 13-26 days in cases of "toe abscess".

### **Conclusions**

The clinical image and the prognosis of apical pedal bone necrosis varies widely, depending on the severity of the lesions, the number of claws involved and the causative factors; these animals show a marked supporting limb lameness or, if claws of more than one limb are affected, a severe stilted gait. In some cases a "neurological" disease could be assumed due to spasmodic limb movements observed in the standing cow and the severe spasmodic gait. But by an accurate examination of the thoroughly cleaned, and if necessary "diagnostically trimmed" claws, the lesions of the toe region can be detected. By means of radiography the accurate degree of involvement of the distal phalanx can be imaged, which facilitates the choice of adequate surgical treatment. The importance of accurate claw trimming is confirmed again.

## GROSS-PATHOLOGICAL AND PATHO-HISTOLOGICAL STUDY OF APICAL PEDAL BONE NECROSIS IN CATTLE

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### Introduction

The primary lesions of apical pedal bone necrosis can be diagnosed by visual examination of the horn shoes after "diagnostic trimming" of the sole. In cases of "toe abscess" and the subsequent necrosis of the apex of the distal phalanx overworn or overtrimmed soles, separation of the sole from the wall in the white line, circumscribed horn defects in the toe area, discharge of exudate or even the uncovered and discolored apex of the pedal bone can be diagnosed, but in many cases of apical pedal bone necrosis the visible changes are moderate and seem to be without correlation to the observed severe lameness or stilted gait. By means of radiography the degree of osteolysis of the pedal bone can be imaged. The purpose of this study was to describe the gross-pathological, patho-histological and microbiological findings of apical pedal bone necrosis in 10 cattle.

### Material and Methods

The distal limbs of 7 euthanized cows, 2 slaughtered cows and one amputated digit of another cow (n: 10 cows) with apical pedal bone necrosis, revealed by clinical examination and radiography, were examined during the period October 1994 - September 1995. All claws underwent a thorough gross-pathological examination for assessment of visible lesions on the horny sole and horny wall. Then the feet were immersed in hot water of 65° Celsius for 30 minutes, and thereafter the horn shoes were removed in whole using the procedure described by *Ossent (Schweiz. Arch. Tierheilk. 132, 1990, 451)*. Then the complete inner surface of the horn shoes was inspected and the entire extent of the inflammatory alterations of the corium of the sole and the wall of the hoof was studied. A sample was taken from the necrotized apex of the pedal bone for microbiological examination. Afterwards the exungulated claws, showing a pedal bone necrosis were transected sagittally with a band saw to assess the extent of osteolysis and osteomyelitis. From the border area of the bone necrosis to the vital bone, specimens were gathered for the patho-histological examination.

### Results

Apical necrosis of the distal phalanx was assessed in 23 claws, in 3 other claws a "toe abscess" (= necrosis of the pododerm of the toe area) was found. By visual examination of the entire claws, extensive lesions of the horny sole at the toe were found in 13 claws, in 13 other claws the lesions were represented only by separations between the sole and the wall within the white line at the toe of the claws. In all cases a more or less extensive under-run sole was assessed using a metal probe. Thirteen lateral claws and 10 medial claws of hindlimbs showed an apical pedal bone necrosis, and 2 lateral claws of hindlimbs and one lateral claw of a forelimb showed a "toe abscess". In 5 cows three claws per cow were affected by apical pedal bone necrosis, in 3 cows two claws per cow and in 2 cows only one claw were affected.

The gross-pathological alterations of the exungulated claws were severe inflammatory signs of the corium at the toe of the claw or of the corium of the complete sole and wall with reddening and necrosis of the corium and slight topical or extensive bone necrosis and osteomyelitis of the pedal bone. Microbiological examinations revealed predominantly mixed infections with  $\alpha$ -haemolytic Streptococci, *Actinomyces pyogenes*, *E. coli* and *Staphylococcus* sp.. Nonuniform patho-histological results were assessed regarding the demarcation of the osteolytic bone from the vital bony tissue: a purulent demarcation, a demarcation by granulation tissue and no signs of demarcation were found histologically.

### Conclusions

The visualization of the pathological changes of the complete surface of the corium, using the described technique aimed to a better understanding of the severe clinical signs observed in cows with apical pedal bone necrosis. This was true, especially in such cases where the topical changes of the horn shoes appeared to be moderate. The knowledge and study of these gross-pathological findings should lead to a comprehensive interpretation of the clinical and radiographic signs in apical pedal bone necrosis, which is important for the veterinarian evaluating the prognosis and the success of treatment.

OSTEOMYELITIS OF THE DISTAL PHALANX AS COMPLICATION OF SEPTIC  
PODODERMATITIS AND WHITE LINE DISEASE IN THE CATTLE

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Fifteen cases of distal phalanx osteomyelitis are described in this paper. Most of the bone lesions represented a secondary complication of septic pododermatitis of the sole (Punctured sole), of the wall and of white line disease; the apex or the solar surface of the phalanx were frequently involved.

The acute phase of this serious condition was characterized by an extended necrosis of solar pododerma and partially of the abaxial wall pododerma, that caused the exposure of the third phalanx surface .

In acute phases there was usually an obvious lameness with extreme difficulty in rising and walking; sometimes the affected limbs escaped from weight bearing.

Clinical exam in some cases revealed a slight swelling of the coronet and localized pain. A sudden drop of milk production, fever, anorexia, together with a generalized stiffness, were frequently observed in cattles. The latter clinical signs usually allowed to differentiate the distal phalanx osteomyelitis from not complicated cases of septic pododermatitis and white line disease.

The treatment, just of the early diagnosed cases, included the curettage of the exposed bone. In more advanced cases of bone involvement, due to delayed diagnosis, the surgical approach consisted on removal of all necrotic tissue and, almost constantly, of the bone sequestrae. In both cases we followed the treatment with an antibiotic or sulphonamide powder dressing; a wooden block was applied to the other hoof to protect the affected claw.

The progression of the disease and the outcome of the therapy was periodically observed ( 7-10 days ) for each individual case.

## A HIND FEET POSITION SCORING-SYSTEM TO MONITOR SUBCLINICAL LAMENESS IN DUTCH HOLSTEIN-FRIESIAN COWS.

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A cross-sectional study design was used to assess the reliability of a feet position scoring method, to quantify the degrees of external rotation of the hind feet and to create a descriptive chart for evaluation of the hind feet position.

The data were collected weekly, from January until June 1995, at the dairy farm of the Faculty of Veterinary Medicine at the University of Utrecht. A total of 41 Holstein Friesian lactating cows were included in the study.

The position of the hind feet was classified according to visual appreciation of the external rotation. None to slight (Feet Position Score 1), moderate (Feet Position Score 2) and severe (Feet Position Score 3) rotation were considered. If there were differences in the position of the feet, the most rotated foot was used to score the cow.

The degrees of external rotation of left and right foot were measured for every cow after scoring the feet position. A set of instruments specifically for this purpose was used. The basic instrument was a modified protractor.

Assessment of the feet position scoring method reliability was done through an agreement test. Individual and overall Kappa values for the comparisons between and within investigators showed moderate to good agreement.

The degree ranges of external rotation of the hind feet for each feet position score were suggested based on 95% confidence intervals estimates. Values under 17 degrees for a feet position score of 1, between 17 to 24 degrees for score 2 and higher than 24 degrees for score 3 were suggested ( $P < 0.05$ ).

The descriptive chart for the hind feet position (Feet Position Scoring-system) combines the feet position scoring method, the ranges of degrees of external rotation associated with each score and the position of the hocks and base of the legs.

We propose that the hind Feet Position Scoring-system can be used as a helpful tool in the evaluation of subclinical lameness and the prevention of clinical lameness at an early stage. Evaluation of the hind feet position as part of regular herd health programs should give an idea of the health status of the claws without the need to lift the legs. Thus, based on this knowledge it should be possible to advise the optimum moment for functional trimming of the claws.

## GROWTH, WEAR AND HARDNESS OF CLAW HORN OF DAIRY HEIFERS IN TWO MANGEMENT SYSTEMS

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Data on horn growth, wear and hardness were collected on 30 Holstein heifers in one herd housed either indoors on concrete slats or out of doors on a drylot. Examinations were carried out at four-week intervals from approximately 13 months of age until calving and measurements were made on left hind lateral claws. Growth and wear were recorded at the toe and abaxial wall; hardness was measured at the apex of the sole and abaxial wall. Horn growth did not differ between groups. In both groups, there was more growth than wear at both sites ( $P < 0.001$ ). Horn growth was greater on the abaxial wall than on the toe, but the difference was significant in outdoor-housed heifers only ( $P < 0.05$ ). Horn wear did not differ between sites. Rates of horn growth and wear tended to be less during the winter than in the summer. Overall, horn at the apex of the sole was softer than at the abaxial wall ( $P < 0.001$ ). At both measuring sites, claw horn was softer in outdoor-housed heifers ( $P < 0.001$ ).

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## FACTORS AFFECTING THE GROWTH RATE OF CLAW HORN IN CATTLE

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It is generally accepted that many of the clinical lesions of the bovine claw are the result of poor claw quality. Although claw quality is defined as the product of horn characteristics, claw shape and anatomy and physiology of the inner structure, it is largely determined by the production of good calibre horn of adequate resistance.

Claw horn is in a state of continuous turnover. Rates of formation and loss of horn tissue as well as variation in horn quality are important issues in animal production systems where confinement is increased (North America and Europe) or walking distances are excessively long (Australasia). The various factors reported to influence horn growth include physiological, seasonal, nutritional, environmental, management and anatomical aspects.

Sex and breed of cattle have no significant effect on the rate of horn growth, but horn appears to grow faster in younger animals than in mature cattle.

A seasonal variation in horn growth has been observed; it appears to be a cyclic process with maximum growth occurring during either warmer parts of the year and(or) increasing daily photoperiod. Also, it is suggested that horn growth may be negatively affected by changes to the blood supply of horn-producing tissues during extreme cold weather that involve constriction of arterioles and dilation of arteriovenous anastomoses. As a consequence, the horn-producing cells are inadequately supplied with oxygen and nutrients.

In general, reports on the influence of nutrition (protein and energy) or dietary supplementation (methionine and biotin) on horn growth rates have been contradictory or inconclusive. Clearly, further studies are required to determine if nutritional factors affect claw horn growth in cattle.

The rate of horn growth is greater in confinement-housing on concrete than on pasture, but it is not enough to compensate for the greater horn wear which also occurs in housed cattle. Therefore, regardless of the season, cows on concrete while milking need a dry period on dirt or pasture for claws to recover length. Horn growth is also increased by claw trimming. It is suggested that, under such conditions, some compensatory mechanism stimulates the growth of claw horn.

Rates of horn growth for front and hind claws appear to be similar, but lateral claws tend to grow faster than medial claws. Horn growth at the abaxial wall and heel regions of the claw (which are also the areas of greatest wear) is greater than at the dorsal border (toe).

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## STRATEGIC USE OF SUPPLEMENTS IN CATTLE FOR REDUCTION OF BOVINE LAMENESS

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The term "strategic nutrient supplementation" is rapidly becoming a term that needs definition. Currently it may convey different ideas to different people leading to confusion. Because this is a relatively new concept, it should be up to this group to define the term and offer parameters for its use.

Strategic nutrient supplementation should be divided into two different programs. A complete program would encompass total nutritional management. This would consist of all areas of supplementation feeding programs (i.e. protein supplementation, mineral supplementation, etc.) and it would encompass all areas of pasture and range management (i.e. improved forage type, grazing systems, etc.).

The second program would be an incomplete program. This would encompass only one such area of supplementation feeding programs (i.e. mineral supplementation, creep feeding, etc.).

In defining and implementation of a strategic nutrient supplementation plan one must always keep the goals of the producer as the major focus. Geographic area may be a driving force behind strategic nutrient supplementation. Another variable that will determine the use of strategic nutrient supplementation will be stage of production of a group of animals in a herd or the entire herd itself. Always rely on history - the history of a group within the herd, historical analysis and past problems of the herd and the area as an index of possible needs to strategically supply nutrients.

Practical considerations for feed manufacturers should include inventory control, minimum order amount, and liability for formulations.

## THE EFFECT OF BIOTIN ON SANDCRACKS IN BEEF CATTLE

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The B vitamin biotin (Vitamin H) is an essential co-enzyme that takes part in biological carboxylation reactions. It is involved in the tricarboxyl acid cycle, gluconeogenesis, and fat synthesis. Dietary supplementation of biotin has been shown to increase the hoof horn strength and reduce the frequency of foot lesions in pigs (Simmins & Brooks; Webb *et al*). Dietary supplementation of biotin has also been used as a treatment for horses with weak hoof horn (Comben *et al*). In ruminants, a requirement for supplemental biotin has not been established, and ruminal and intestinal synthesis of this vitamin is often considered to be sufficient. However, daily supplementation of the diet with biotin in dairy cows has been shown to increase the plasma concentration of biotin for several months and to reduce lameness problems (Cooke & Brumby). Studies have also demonstrated that the plasma concentration of biotin is lower in cows with a history of lameness when compared to cows with no lameness (Roberts & Baggott).

Sandcracks or vertical fissures are a common claw lesion in beef cattle in Western Canada. In a survey of 15 Alberta beef cow herds 37.2% of the cows were affected with one or more cracks (Westra). Another Canadian study demonstrated that cows with sandcracks tended to be older and heavier than cows without sandcracks (Goonewardene & Hund). In affected herds, sandcracks will often result in increased levels of culling due to chronic lameness problems.

The objective of this study was to determine the effects of supplemental dietary biotin on the prevalence of sandcracks in beef cows. The study herd consisted of 265 mature Pollad Hereford cows. This herd had a history of being severely affected with sandcracks with a prevalence of 37% in animals over three years of age. A complete examination of the claws of all the mature female cattle in the herd was made on June 1, 1994. An age cohort of the herd, those cows born in 1992 were separated from the main herd and randomized in two groups. One group received a 10 mg/day dietary supplement of biotin in their grain ration while on pasture, while the other group received an identical grain ration without the biotin supplementation. The claws of the cattle in these groups were reevaluated after the grazing season, in October 1994 and significant lesions were categorized and described. In June of 1995 a second age cohort was also separated from the main herd and randomized into the same two groups. This age cohort consisted of those cows born in 1993. In June of 1995, the claws of all the animals in both groups were evaluated, categorized and described. In total, there were 138 cows randomized into a biotin-supplementation group and a control group. In October 1995, the claws of each animal was evaluated, categorized and described once again. At this evaluation, the investigators were blinded as to which animal were receiving biotin and which animals were in the control group.

The prevalence on sandcracks in the Biotin supplemented group was 10/70 (14.3%) compared to 20/68 (29.4%) in the control group. This difference is statistically significant when compared using the Chi-square Statistic ( $p < 0.05$ ). Overall, cows that received dietary biotin supplementation were 2.5 times less likely to have sandcracks than cows that did not receive dietary biotin supplementation. The animals in the biotin supplemented group also had significantly lower numbers of broken toes and coronary band lesions ( $p < 0.05$ ).

It is clear that biotin supplementation alone did not completely prevent sandcracks. However, it did dramatically reduce the proportion of animals affected in this study. It would appear from this preliminary trial that biotin supplementation in beef cows helps to improve the claw quality in such a manner that it lowers the prevalence of sandcracks. It would also appear to lower the prevalence of other lesions such as broken toes and roughened or enlarged coronary bands.



## THE EFFECT OF BIOTIN IN THE TREATMENT OF UNCOMPLICATED CLAW LESIONS WITH EXPOSED CORIUM IN DAIRY COWS. PART I: THE NORMAL HEALING PROCESS.

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Claw lesions like ulcers in the sole and in the white line are common diseases in dairy cows. They have a substantial impact on the welfare of the affected cows and the economic return to the farmer. A controlled double blind trial to test the effects of biotin on the healing process of claw lesions with exposed corium was conducted. This paper describes the first part; the healing process without the use of biotin.

A total of 160 dairy cows from 82 tied-stall herds from eastern Switzerland with lameness due to an uncomplicated claw lesion with exposed corium were included in this study. Between January 1993 and August 1994 (20 months) 236 separate lesions were treated and the healing process was observed for half a year. Treatment consisted of functional trimming, removing of loose horn and thinning of horny edges. The exposed corium was disinfected with Hibitane® and covered by a bandage (n=146). In cases of severe lameness or extensive exposure of the corium a wooden block was attached to the sound claw (n=13). On days 3, 10, 20 and 30 the bandage was changed and lameness and new horn formation was recorded. Further changes of the bandage were performed in 10 day intervals if required.

- The cows, aged from 2.5 to 16 years ( $\bar{x}$  7.4  $\pm$  2.6) had an average milk yield of 6188  $\pm$  1174 litres (data from previous lactation). Cows with the same or a higher milk yield than their herd average were over-represented (72 %). Almost half (45 %) of the cows were in the second half of their lactation when treatment commenced.
- A total of 52 % of the cows had been lame for less than 10 days prior to treatment, 24 % for 10 days to 6 weeks and 24 % longer than 6 weeks. Seventy-two of the 160 cows (45 %) in the observed period had been treated for lameness by either the farmer or a professional hoof-trimmer. In respect to claw lesions in previous lactations 91 cows (59 %) had no history of lameness; twelve cows (8 %) were treated for the second time and 33 % (51/160) had a history of three or more claw lesions. Changes attributed to laminitis were observed in two thirds of all animals (subclinical 36 %; clinical 30 %).
- During the study 12 (7.5 %) of the 160 cows had been treated for 3 or more lesions, 49 (30.6 %) cows for 2 lesions and 99 (61.9 %) cows for one lesion. The most common sites of ulceration were at the outer hindclaw at the typical places in the sole (62 %) and in the wall (17 %). The alterations of the exposed corium were either classified as slight (63 %), moderate (22 %) or severe (15 %).

Healing of claw lesions: The healing of claw lesions in the control group (74 cows with 105 lesions) was evaluated as a reference for the biotin supplemented group. The evaluation of the healing process was based on quality and rate of the new horn formation, recovery from lameness and sensitivity to hoof testers.

- Overall healing: During the half year period 58 % of the 74 cows of the control group recovered uneventfully from their claw lesions. 39 % healed but had one (25 %) or more (14 %) relapses at the same or at another location. In 3 % of all cows the claw lesions did not heal in the first half-year.
- Rate of new horn formation: Twenty days after initial treatment 54 % of all lesions were completely covered by a solid layer of new horn. After 30 days 68 % and after 50 days 89 % of all lesions were completely covered. In 5 lesions the exposed corium was never covered by new horn during the half-year. The mean time for the formation of a closed layer of horn was 25 days for lesions with slight corium alterations, 33 days for moderate and 42 days for severe alterations.
- Short term healing: As a parameter for the healing potential of exposed corium the healing process was judged one month after treatment and was evaluated with a scoring system ranking from score 1 (very rapid) to score 6 (very slow). The short term healing was considered to be fast (score 1 or 2) in 25 % of the lesions, normal (score 3 or 4) in 46 % or slow (score 5 or 6) in 29 %.
- Factors influencing the healing process of lesions: Severity of corium alteration, duration of lameness, history of former claw lesions and laminitis were statistically related to the healing of claw lesions. No significant relationships were found for age, stage of lactation and milk yield in this investigation with a total of 160 cases. Lesions with a rapid healing rate, had a highly significantly less relapses than those with normal or slow short term healing.

The corium seems to play an important role in the pathogenesis and the healing of claw lesions such as ulcers in the sole and in the white line. The fact that a history of former claw disease, laminitis and severity of alteration of the exposed corium prolong the healing ulcers indicates that already irreversible changes in the vascularization of the corium may be present in these animals.

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THE EFFECT OF BIOTIN IN THE TREATMENT OF UNCOMPLICATED CLAW LESIONS WITH EXPOSED CORIUM IN DAIRY COWS. PART II: THE HEALING PROCESS IN SUPPLEMENTED ANIMALS.

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A controlled double blind trial was conducted on 160 dairy cows from 82 tied stall herds from eastern Switzerland. Only cows with an uncomplicated claw lesion with exposed corium were selected for this study. During half a year, the test group (n=80) was treated with biotin at a dosage of 20 mg/day, whereas a placebo was applied to the control group (n=80). The reliability of the oral administration of the biotin or placebo was assessed by measuring the plasma biotin concentration in each cow 5 times during the trial. Treatment of the claw lesions and follow up of the healing process are described in part I of this paper.

Twenty-two of the 160 cows were slaughtered during the trial. Four groups were established after evaluation of the plasma biotin assays (plasma levels greater than 1000 ng/l were considered positive). Depending on the biotin assay results 21 of the biotin supplemented animals fulfilled all theoretical requirements (Initial value negative and 4 following values positive). In the placebo group 62 were selected with 5 negative plasma biotin values. To achieve larger numbers for statistical evaluation 2 further groups were established in which one value abberating from those defined above was tolerated (Extended groups).

	<u>All theoretical requirements fulfilled</u>		<u>Extended group: one value abberating</u>	
Biotin supplemented animals (n=80)	BIOTIN GROUP	n=21	Extended biotin group	n=62
Placebo supplemented animals (n=80)	PLACEBO GROUP	n=54	Extended placebo group	n=74

Extended biotin group vs extended placebo group

Although, no statistically significant differences in healing parameters (see part I) could be found between these two groups, the mean scoring for the short-term-healing was slightly improved (0.7 score value) in the extended biotin group. The mean time required for the lesions to be covered by a solid layer of new horn was 2 days shorter in the extended biotin group (supplemented 28 and placebo 30 days).

Biotin group vs placebo group

The short term healing rate differed significantly ( $p=0.02$ ): In the biotin group the short term healing was considered to be fast (score 1 or 2) in 50 % of the lesion, whereas in the placebo group 23 % of all lesions healed fast. In the biotin group the mean time required for the lesions to be covered by a solid layer of new horn was 26 days (placebo group: 30 days).

The results of this field study showed that the precise application of an oral drug by the owner over a period of half a year is difficult. The selection criteria in this study were: Dairy cows, tied stall and the evidence of an uncomplicated claw lesion with exposed corium.

Although it is well known that the healing of a claw lesion is dependent on multiple factors, the effect of biotin on the new horn formation were evident. Horn production in the biotin group, where precise supplementation of biotin by the owner had yielded constant assay results, was significantly better than in the control group in the first month of treatment.

Further studies under controlled conditions including light and electronmicroscopical examination of horn biopsies at the site of ulceration are necessary to verify the effect of biotin on the formation of new horn following surgical treatment.

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## **SURGICAL PROCEDURES IN THE BOVINE LEG**

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### **SURGICAL MANAGEMENT OF BONE SEQUESTRAE**

Sequestration of bone in cattle is a relatively common occurrence and when the sequestrum involves other than small bony fragments the condition is best treated with surgery.

The terminology associated with sequestration is related to: sequestrum which is the specific piece of necrotic bone that is isolated from the surrounding healthy bone. The involucrum is the area of new bone formation surrounding the necrotic bone and is laid down in response to the inflammatory process associated with the devitalized tissue. The new bone is laid down as membranous bone and is initially associated with a fibrous tissue response which may palpate as a very hard tissue and cannot be distinguished by physical examination from the bony reactive tissue. The cloaca is the opening or drainage tract (also called a sinus) which connects the area of purulent fluid surrounding the sequestered bone to the outside and functions to allow drainage. This tract may be followed from the skin and used to find the sequestrum which may be difficult to localize clinically. The tract may also be identified and characterized using contrast medium as a fistulogram. When sequestrae are initially diagnosed using radiography in their early stages there is no evidence of the formation of a bony envelope nor the presence of a radiolucent "lake" surrounding the isolated fragment. However within approximately two weeks the inflammatory process results in the development of purulent debris surrounding the dead bone and the formation of the fistulous tract allowing drainage to the outside.

Sequestra in cattle may be grouped into two separate categories which appear to be related to both age and etiology. Adult cattle frequently have sequestra located in distal extremities which are considered to have developed from a traumatic incident and results in the necrosis of bone presumably from interference with vascularity and/or infection. These lesions are classically located on the distal limbs particularly the greater metacarpal and greater metatarsal bones. They are characterized by pain and swelling of the region, frequent evidence of the initiating trauma, and in chronic cases, a fistulous tract. Younger animals frequently have sequestra in the long bones of the upper limb such as the radius, humerus, or femur. These bones are relatively protected from direct insult and trauma does not appear to be a prominent factor in the history or development of the condition. The author believes that the etiology of bone sequestrum in young animals is related to the competency of the immune system and the relatively high incidence of infectious disease in the young. It is considered likely that the bone is infected via an embolic process and dies as a result of the infection. The dead bone then initiates the inflammatory process which produces thrombosis of the region causing the local bone to die and a sequestrum to result. The dead bone is then separated from the living bone by purulent material.

Diagnosis is based on lameness, swelling of the region, and the presence of a draining tract in advanced cases. The presence of a sequestrum is confirmed by plain radiographs and sinography when indicated.

Prior to surgical treatment, the animal may be anesthetized using local intravenous methods or general anesthesia if the lesion is located in the proximal forelimb, if the proximal hindlimb is involved, epidural anesthesia may be utilized. It is imperative to thoroughly examine the limb with the objective of establishing physical landmarks, and determining the extent of the surgical excision required. When a fistulous tract is present, it is recommended that the tract be resected along with some of the tissue overlying the involucrum. Care should be taken to conserve enough tissue to allow the incision to be covered. The physical examination should be made in addition to radiographic examination which may include the placement and documentation of radiopaque markers for surgical reference. The location of the sequestrum is frequently obscured due to the extensive nature of the fibrous and periosteal bone response over the site and variable course of the draining tract. Simple, early, and small sequestra may be removed by sedating the animal, providing a local intravenous anesthesia to the limb and resecting the offending

necrotic bone through an elliptical incision. However when there is extensive periosteal new bone production over the necrotic bone and prolonged immobilization is required, it is recommended that the animal be treated under general anesthesia. A tourniquet should be utilized when the lesion is distal to the hock or elbow to control hemorrhage which may obscure the operative field. An elliptical skin incision is made over the sequestrum and sharp dissection is utilized to remove all soft tissue over the site. Bone gouges, chisels, and currettes are then used to remove the new bone over the sequestrum which is differentiated from healthy cortex by its typically yellow colour and the presence of purulent and / or granulation type tissue separating it from the surrounding healthy cortex and overlying new bone production. The dead bone is removed and its necrotic tissue bed curetted down to healthy, bleeding bone before closure of the site is accomplished. Placement of a drain is frequently utilized and the defect is closed and bandaged in a routine manner.

The prognosis for successful treatment of a bone sequestrum is good to excellent depending on the size of the necrotic portion, the duration of its existence, and the degree to which other nearby structures such as joints are affected by the involucrum and fibrous swelling. When the sequestrum involves the full cortical thickness and substantial longitudinal or circumferential dimensions, the removal may jeopardize the ability of the long bone to resist normal forces and result in a pathological fracture due to the defects effect on inherent bone strength. In most cases the developing involucrum has a callus-like effect which contributes strength to the bone enabling it to resist normal forces in the post operative period. Whenever significant bone is removed, it is recommended that some form of external support be provided for the recovery period and the first few weeks of ambulation. In select cases it may be indicated to support the limb using internal fixation devices.

#### **SURGICAL MANAGEMENT OF FRACTURES OF THE DISTAL PHALANX:**

Fractures of the distal phalanx are not uncommon in cattle and are seen to primarily affect one digit only although numerous cases of bilateral fractures have been reported. Fractures of both distal phalangeal bones of the same limb are rare. The forelimbs are affected most commonly with the medial claw being the one usually involved. This is probably due to the increased proportion of weight born by that digit. Fractures are usually articular and extend to the solear surface. Initially there is minimal displacement but distraction of fracture fragments increases with time, presumably as a result of tensile forces exerted by the deep digital flexor tendon and bone resorption at the fracture site.

The etiology of this fracture has been associated with trauma, osteomyelitis, flourosis, heavy body type, and low copper levels. Problems with slippery flooring, and / or hard walking surfaces are also thought to predispose to this condition. In most cases, the animal is found to have a fracture of the distal phalanx without an obvious cause evident.

Animals with this fracture are observed to be acutely painful and are reluctant to bear weight on the affected digit. Those with bilateral fractures on contralateral limbs frequently assume a cross-legged stance in response to pain originating from both medial claws of the forelimb. When pain is severe, such animals may also prefer to kneel and crawl to alleviate weight bearing pain. With time, regardless of treatment, there is gradual improvement in stance and gait. The problem may be identified in the distal phalanx during examination by compression with hoof testers and percussion. There is little swelling due to restriction of the hoof wall but heat may be detected.

Treatment regimens are aimed at relieving pain and minimizing distractive forces of the flexor tendons by elevation of affected digits by means of a wooden block affixed to the sound digit. The fractured phalanx is thus allowed to heal without additional fixation, a process which takes several months to complete but which occurs clinically much sooner. When the rare double fracture occurs on the same limb, the distal limb is completely enclosed in a short fiberglass cast to the level of the proximal metacarpal bone. The use of a metal walking bar and fixing the distal limb in partial flexion facilitates ambulation and minimizes distractive forces acting across the fracture site. Clinical healing will occur within four to eight weeks with gradual improvement in weight bearing and gait. Radiographic changes occur slowly and may

fail to demonstrate boney union for several months. The animal should be confined to a small box stall for one to two months for best results. A short-term, and simplistic approach to treatment is to amputate the digit above the level of the fracture site. The animal will thus become weight bearing on the limb within a few days and sound within a few weeks which may facilitate fattening and finishing the animal for purposes of slaughter faster than is possible if the fracture undergoes the normal healing process. Amputation is thus a radical form of treatment and should be reserved only for a very limited number of cases such as pathological fractures which occur as a result of, or in association with infection of the distal phalanx.

In cases such as flourosis where the inciting cause is identified, preventive measures may be taken to reduce intake in the herd, however most animals are affected sporadically and the initiating cause of the fracture remain unconfirmed.

### **SURGICAL TREATMENT OF SEPTIC ARTHRITIS OF THE FETLOCK**

Infectious arthritis is of appreciable economic importance to the cattle industry. Economic losses in affected cattle arise from reduced weight gains, lower carcass values, diminished milk production and reduced breeding function.

In the past, calves with septic arthritis of the fetlock were treated medically using antibiotics when the condition was diagnosed early in the course of the disease. Occasionally joint lavage was performed particularly when the condition was more advanced. The success rate in such procedures is sub-optimal and the utilization of surgical intervention to remove infected and devitalized tissues should be considered when medical treatment alone proves to be inadequate.

Preliminary procedures on a limited number of calves with severe clinical infection of the metacarpophalangeal joint has shown that a simple, "field quality" surgical procedure can be effective clinically and yet be economical. Surgical curettage of septic bovine metacarpophalangeal joints yields good results with return to milk production, weight gain and efficient breeding function. The curettage results in a clinically movable joint or pseudo-arthritis of the joint. The term "pseudo-arthritis" has been described in different ways by various authors and needs to be clarified for purposes of this report. In the classification of Jubb and Kennedy, the simplest form of pseudoarthritis occurs when a fibrous union between the two bones exists as a result of any cause, an extension of this case is the stage at which either fibrous or hyaline cartilage develops within the uniting fibrous tissue. In the highest stage of refinement of a pseudoarthritis, clefts form in the cartilagenous interface and a synovial-like tissue forms and lines the "new" joint, this final form of pseudoarthritis may then be termed a neoarthritis. The above sequence of events, if surgically designed to occur, would not have the same pathological connotation which has frequently been associated with a pseudoarthritis.

The majority of animals are presented within the first few months of life, all breeds appear to be susceptible to the condition. Young animals are usually presented with severe lameness and swelling of the affected fetlock joint. The skin over the swelling is warm and very sensitive to pressure. Older animals may not show the severe extent of soft tissue swelling seen in younger animals but the lameness is just as marked. Radiographic examination reveals an obvious soft tissue swelling. In early cases, the joint space may not be grossly enlarged but in more advanced cases the distance becomes increased and bony involvement may be apparent. The presence of gas and fluid lines may be observed.

Affected animals are placed on appropriate systemic antibiotics before surgery. Anesthesia is accomplished by either general anesthetic or heavy sedation with xylazine in combination with a local intravenous anesthetic of lidocaine applied distal to a tourniquet.

The metacarpophalangeal area of the affected limb is clipped and prepared for aseptic surgery in a routine manner. A lateral metacarpophalangeal arthrotomy is performed by making a 5 cm incision through the skin, subcutaneous tissue and the joint capsule at right angles to the axis of the limb. The articular

cartilage and all affected subchondral bone on the distal third metacarpal and proximal first phalangeal condyles are removed using a number four curette (approximately 3 cm wide) and the joint is then lavaged with normal saline to remove all cartilage and bone fragments. The joint capsule and the subcutaneous tissue is sutured in one layer using number zero polyglycolic acid suture material in a simple continuous pattern followed by skin closure with number one nylon suture material in a cruciate pattern. After the closure of arthrotomy incision, a non-adhesive pad is placed over the suture line and a light bandage extending from the carpus down to the hoof was applied on operated legs. Swelling around the fetlock is usually reduced within 24 - 48 hours at which time the affected limb is cast from the level of the proximal metacarpus or metatarsus to the hoof. Standard cast management protocol is followed for the next 21 days following which the cast is removed and a light bandage applied.

The removal of the articular cartilage and the subchondral bone of the bovine metacarpophalangeal joint of control calves with subsequent immobilization of the operated limbs with casts for three weeks followed by bandaging of the limbs is well tolerated and does not impair the general well-being of the animal. Surgical curettage of the infected metacarpo-phalangeal joint in calves when used in conjunction with local and systemic antibiotic therapy plus lavage, results in control of septic antibiotics and osteomyelitis in this particular joint. The surgical creation of a pseudo arthrosis in one half of the metacarpophalangeal joint in control calves and those affected by septic arthritis results in a clinically sound animal.

#### **EMERGENCY MANAGEMENT OF FRACTURES**

While the emergency management of fractures in some species, notably the horse, is thought of as being potentially critical to the outcome of the surgical procedure, this same concern is not commonly held by most veterinarians who deal with lameness problems in cattle. Although the temperament of cattle is generally not a problem, the circumstances surrounding the initiation of the fracture may involve excitement of the animal and the potential for significant self inflicted damage. Stoic attempts to ambulate by the animal runs a great risk in compounding the damage to the affected area and should be minimized by the application of some form of external support. The process of loading, transportation, and unloading an animal with a fracture runs a significant risk of reducing the surgical prognosis and increasing the complication rate. The presence of an external supportive device is also advocated on humane grounds since minimal pressure over the site of the wound and control of a flailing limb is considered to reduce the suffering already present as the result of the fracture. Open wounds associated with fractures are also maintained in a more clean condition than if allowed to be exposed to the contaminated environment usually associated with stables, trailers, and holding facilities. Regardless of the location of the fracture, every attempt to provided stabilization and support should be made. The carefully applied fixation prior to transportation or treatment is in general, a good investment in time and effort. Fractures and dislocations of the limb distal to the mid metatarsal or metacarpal bones respond well to casting using plaster or fiberglass. A less effective although helpful alternative is the modified Sir Robert Jones bandage. Polyvinylchloride pipes cut in half longitudinally and applied to the dorsal or plantar surface of these bones provide and excellent temporary support. Fractures of the radius and ulna or tibia are well protected by either a modified plaster spica or Thomas Schroder splint. It is important to note that when splints are applied over the distal limb, adequate padding must be present over pressure sites between the limb and the splint surface.

#### **COMMON ERRORS IN HANDLING FRACTURES**

1. Failure to understand the importance of emergency immobilization.
2. Inadequate advice given to the owner regarding restraint until veterinary assistance arrives, and failure to emphasize its importance.
3. Lack of materials to construct external support devices at the site where the injury occurred.

4. Failure to select and apply an appropriate form of support to the fractured limb. This usually means failure to apply a cast before referring or moving the animal to another facility.
5. Failure to begin antibiotic treatment in the early post-trauma period when it is indicated. This is of particular importance when the fracture is open.
6. Administration of drugs for restraint or control of infection when economics and the nature of the fracture dictate or strongly suggest slaughter as the route of choice.
8. Failure to radiograph proximal limb problems before transport or referral.
9. Failure to describe the cost of treatment, the immediate post-operative care required, and the long-term prognosis to the owner in each case

#### CLAW TRIMMING: WHAT FARMERS THINK!

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A postal questionnaire sent to 55 dairy farmers in Somerset, south west England, was designed to elicit information about digital lameness and claw trimming practices in the calendar year 1995. Average herd size was 140 cows (range 34-440), being predominantly Friesian or Friesian-Holstein type. The average annual lameness incidence was 30.3% (range 5-100%). 65% of farmers considered lameness to be an important problem, and major forms included sole ulcer (75% of farms), digital dermatitis (53%), interdigital disease (15%), and laminitis (13%). With one exception all farms practised routine claw trimming, usually done by farm personnel, performed at any convenient time (54% of farms) or when being dried off (44%). Conventional tools were used, and a rotary sander or grinder was only used by 7% of farms. The veterinarian had assisted in instruction in 62% of farms, though this was supplemented by self-teaching (59%). Formal courses had been little utilised, as had books, videos and lay press articles. Most farmers (91%) found routine trimming to be very useful, and were satisfied with the results. Many had suggestions for further investigations, thought likely to benefit them. These varied from aspects of breeding for digit conformation through the prevention of digital dermatitis and "superfoul" to improvements in farm tracks and investigation of specific diets.



## OBSERVATIONS OF SOLE LESIONS, HOOF MEASUREMENTS AND LAMENESS DURING FIRST LACTATION OF HEIFERS FED DIFFERENT DIETS IN EARLY PREGNANCY

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Two groups of ten uncalved British Friesian/Holstein heifers in early pregnancy were fed either grass silage (S) or chopped meadow hay with a barley based supplement (H) in a continuous design experiment over 98 days. At the beginning of the experiment mean ( $\pm$  SE) liveweights were 357 ( $\pm$ 12.3) 357 ( $\pm$ 11.6) kg and ages were 462 ( $\pm$ 16.7) 465 ( $\pm$ 12.1) days for H and S respectively. The amount of supplement fed to group H was reduced from 3 to 1.5 kg/day FW on day 42 of the experiment to give similar daily liveweight (LW) gains (617 ( $\pm$ 52.3) and 694 ( $\pm$ 41.3) g/day for H and S respectively). After the experimental feeding period all animals were turned out to grass where they remained until calving in August/September. Eight animals from each treatment group were paired according to calving date. Condition scores at calving were significantly higher in S than in H (2.5  $\pm$  0.09 Vs. 2.1  $\pm$ 0.09). No significant effect of treatment was observed on milk or milk constituent yield, liveweight or condition score after calving. Locomotion was scored weekly and all feet were routinely examined for sole lesions approximately one month before and 1, 10, and 20 weeks after calving, and when clinically lame. Lesions were mapped and scored by severity. Measurements of hardness (Shore A meter), growth and wear of the wall, and hoof conformation were made on the right hind foot. Additionally a sliver of horn was taken from the white line area of the outer claw for ultrastructural examination using transmission electron microscopy and scored according to hoof horn integrity. No significant differences were observed in any hoof measurement due to previous diet, however there were significant correlations between heel erosion, hoof conformation and rates of wear. Significant (negative) correlations were also observed between hoof hardness and sole lesion formation. Blood samples were taken at all but the precalving observation and were analysed for calcium, magnesium, phosphorus, urea, copper, aspartate transaminase (AST), alanine transaminase (ALT),  $\beta$ - hydroxybutyrate, gamma-glutamyl transferase, haptoglobin and non-esterified fatty acids (NEFA). Levels of AST, NEFA and haptoglobin in the blood were significantly higher for H immediately after calving but there were no significant differences due to treatment for locomotion, total lesion or ultrastructural scores. It is concluded that diet in early pregnancy does not affect subsequent lameness and sole lesion formation despite some evidence of increased metabolic stress.

MAMBO DAIRY COW  
A MULTI MEDIA SOFTWARE FOR PREVENTING LAMENESS IN DAIRY COWS.

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In 1987 the Ecopathology Centre made a study in 160 dairy farms to reveal the risk factors of laminitis and interdigital dermatitis in dairy cow.

The results of this study enabled to characterize more precisely the foot diseases and define better the risk factors regarding the shape of the foot, hygiene, comfort and feeding.

Thanks to its communication of knowledge and savoir - faire, the Ecopathology Center elaborated and approved a handbook for preventing lameness, already distributed to over 1500 farmers. (confer to Philippe Sulpice's article).

Based on this work, the Bio Informatic Unit of National Vet. sch. of LYON developed a multimedia software dealing with lameness in dairy cows : " Mambo DC"

People likely to be concerned with this means of study are the veterinarians and foot trimmers to use it on the very farm where the lameness problem exists, or students from veterinary colleges and agricultural secondary schools as well as apprentice trimmers.

The software developed with the Toolbook (r) tech generator, works on a PC computer. It is divided in 4 parts called "books" :

- 1) The farmer's book is meant to enounce the lameness risk factors existing on the farm;
- 2) The veterinarian's book is meant to refer to the present knowledge of the main podal diseases.
- 3) The technical book proposes information on foot trimming (material, principles) as well as some aspects of feeding and housing related to lameness .
- 4) The Illustration Book, an indispensable supplement of the first three books, illustrates the fixing of the leg, the principles of trimming, the foot lesion and several risk factors.

Those 4 books are complementary and can be consulted simultaneously. The vet can propose the farmer images illustrating his sayings, and meanwhile identify the risk factors on the farm.

We were able to notice the farmer' s interest for this multimedia instrument in our own practice.

Using this software as an educational tool is also very promising, either with students ( simulation is possible) or with professionnals.

Lastly reactualising its contents can easily be done as well as improving the illustration stock.

## DIAMETER MEASUREMENT OF DIGITAL ARTERIES AND VEINS IN CATTLE USING B-MODE ULTRASONOGRAPHY

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### Introduction

Most of the publications regarding disorders of the digital vessels in cattle describe the angiographic imaging of alterations of arteries and veins in bovine digits. Only *Steiner et al.* (*Schweiz. Arch. Tierheilk.* 132, 1990, 227) reported clinical and pathomorphological findings of a complete thrombosis of the digital veins after a repeated application of intravenous regional antibiotics. Anatomical descriptions of the vessels can serve only as guideline for the clinician. Contrast angiography, however, found little acceptance as routinely applicable technique in the bovine patient due to the rather difficult invasive technique. In the last years diagnostic ultrasound has been established as a valuable method in diagnosis of bovine musculoskeletal disorders (*Kofler and Edinger, Vet. Radiol. & Ultrasound*, 36, 1995, 246). For the investigation of digital vessels in cattle ultrasonography remains to be evaluated. The objective of the study is the ultrasonographic imaging and measurement of the large digital vessels in the bovine hindlimb, in particular of the digital veins used for intravenous regional anesthesia and the establishment of basic data for the vascular sonoanatomy of the digit in healthy cattle.

### Material and Methods

The large digital vessels of 28 hindlimbs of 14 healthy, non pregnant cows (mean age:  $6.1 \pm 1.7$  years) were examined using a Real-time B-mode system with a 7.5 MHz linear-transducer (Sonoscope 3®, Kranzbuehler, Germany) and a stand-off pad. The limbs were shaved, cleaned and a coupling gel was applied. The sedated cows were investigated in standing position. The ultrasonic system applied has a measurement accuracy of 1 mm. VHS-videotapes served for documentation. Using electronic calipers, measurements of the large digital vessels were performed weekly for 3 weeks on defined anatomical locations in the distal bovine hindlimb. The following vessels were investigated at the level of the fetlock joint respective directly dorsal or proximal of the accessory digits: A. and V. digitalis dorsalis communis III, A. and V. digitalis plantaris communis II, IV and A. and V. digitalis plantaris communis III. The vessel diameter was measured from the inner wall to the inner wall, in transverse and in longitudinal planes. The mean value of the 3 measurements was determined, and established as the diameter of each vessel. After the study was terminated the cows were slaughtered, the hindlimbs were prepared half for gross pathologic section and half for freezing. The sonographic results were compared with gross anatomical findings and with transverse anatomical sections of the frozen specimens.

### Results

The vessels appeared as tubular (in transverse planes) or bandshaped (in longitudinal planes), anechoic structures, which were distinctly demarcated from the surrounding hypoechoic and echogenic soft tissue. Arteries showed pulsations and veins were completely compressible. The mean luminal diameters of those vessels that could be measured all three times within three weeks were: A. and V. digitalis dorsalis communis III (3.9 / 2.7 mm, SD: 0.4), V. digitalis communis plantaris II and IV (2.1 / 2.1 mm, SD: 0.35). Due to the small size, superficial location and following compression of the A. and V. digitalis plantaris communis III and the A. digitalis plantaris communis II and IV these vessels could not always be imaged and measured: diameters of 1 or 2 mm could be assessed, but in some cases they were below the smallest unit measurable. The vessels within the hoof capsule could not be imaged. Except for V. digitalis dorsalis communis III, statistical analysis of the mean diameters of the examined vessels of the right and the left distal hindlimb in 14 cows revealed no significant differences ( $p=0.05$ ).

### Conclusions

B-Mode ultrasonography has proved a suitable method for imaging and measurement of the digital vessels larger than 1 mm. Established basic data are needed as reference data for investigation of blood vessels in cases of septic digital disorders and disorders of the vessels itself. In previous studies we could ascertain that the lumina of digital arteries in cases of severe septic digital disorders were distended to 3 to 5 mm in diameter (*Kofler and Edinger, 1995*). Recently, the thrombosis of three tarsal veins and the increased luminal diameters of the distal metatarsal and digital veins have been described in a case report (*Kofler et al., Vet. Rec., in press*). Real-time B-mode ultrasonography can be recommended as the non-invasive method of choice for the examination of the larger digital vessels in cattle.

COMPARATIVE STUDIES OF TWO FUSOBACTERIUM NECROPHORUM SUBSPECIES FROM OVINE FOOTROT AND OVINE INFECTIVE BULBAR NECROSIS

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The roles of Fusobacterium necrophorum subspecies necrophorum (FNN) and F. necrophorum subspecies funduliforme (FNF) in ovine footrot (OFR) and ovine infective bulbar necrosis (OIBN) have been well documented; however, the constitutive bacteriologic properties of the FNN and FNF strains from these diseases have not been compared. In this study, the enzyme activities of 14 strains (10 FNN and 4 FNF) from OFR and 20 strains (18 FNN and 2 FNF) from OIBN, and the outer membrane protein (OMP) profiles of 4 strains (2 FNN and 2 FNF) from OFR and 8 strains (6 FNN and 2 FNF) from OIBN were determined.

The commercial API ZYM semiquantitative enzyme system provided a rapid and reproducible method for determining the preformed enzyme levels of the 34 F. necrophorum strains. Enzyme levels from 0 to  $\leq 5$  nanomoles (nmol) were scored as negative reactions; 5 nmol, as weak positive reactions; and 10 to  $\geq 40$  nmol, as strong positive reactions. The 28 FNN strains had strong positive acid phosphatase and alkaline phosphatase reactions, distinguishing them from 6 FNF strains that had either negative or weak positive acid phosphatase and alkaline phosphatase reactions (Table 1). All 34 strains had either negative or weak positive reactions for esterase (C4) and esterase lipase (C8), and negative reactions for alpha-galactosidase, alpha-glucosidase, alpha-fucosidase, alpha-mannosidase, beta-galactosidase, beta-glucosidase, beta-glucuronidase, chymotrypsin, cystine aminopeptidase, leucine aminopeptidase, lipase (C14), N-acetyl-beta-glucosaminidase, phospholipase, trypsin, and valine aminopeptidase.

Table 1. Acid phosphatase and alkaline phosphatase reactions

28 FNN STRAINS				
FNN4180 5/4*	FNN4383 3/3	FNN4732 4/4	FNN4733 4/4	FNN4756 5/3
FNN4758 3/3	FNN4789 4/4	FNN4793 4/5	FNN4794 4/4	FNN4795 3/4
FNN6001 3/3	FNN6002 4/4	FNN6003 3/3	FNN6004 4/3	FNN6005 4/4
FNN6006 3/3	FNN6007 3/3	FNN6008 3/3	FNN6009 3/3	FNN6010 3/3
FNN6011 3/3	FNN6012 3/4	FNN6013 4/3	FNN6014 3/4	FNN6014 3/5
FNN6016 3/4	FNN6017 4/3	FNN6018 3/4		
6 FNF STRAINS				
FNF4101 1/0	FNF4209 0/1	FNF4387 1/0	FNF4393 1/1	FNF6019 1/0
FNF6020 1/0				

\*0 = 0 to  $\leq 5$ nmols; 1 = 5 nmols; 2 = 10 nmols; 3 = 20 nmols; 4 = 30 nmols; 5 =  $\geq 40$  nmols.

The OMP profiles from each F. necrophorum subspecies were similar, if not identical. The major OMP of the 2 pathogenic F. necrophorum subspecies, however, were markedly different. No differences were noted between strains of the same F. necrophorum subspecies isolated from these two disease conditions.

Data from these studies demonstrated that the 2 pathogenic F. necrophorum subspecies had markedly different preformed levels of acid phosphatase and alkaline phosphatase and very distinct OMP profiles. The significant differences in these constitutive properties conform with the taxonomic classification of FNN and FNF, which was established in 1991.

## A CONGENITAL ABNORMALITY OF THE NAVICULAR BONES IN A CALF

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A six-months-old Holstein-Friesian heifer calf was referred for an evaluation of lameness of the left forelimb. At rest the calf tended not to bear weight on the left forelimb. When walking, its gait was short and stiff in both forelimbs, with no clear difference between left and right. Paring of the claws did not reveal bruises, sole ulcers or any other problems. Dorsopalmar survey radiographs of both forelimbs showed normal lateral navicular bones and bipartite medial navicular bones. To evaluate these abnormalities, CT-scans of both front feet were obtained. Both medial navicular bones consisted of two completely separate parts of approximately the same size. The axial part of this bipartite navicular bone was clearly defined and had smooth bone edges and a normal articular surface. The abaxial part was completely fused to the second phalanx. The appearance of the abaxial part of the distal interphalangeal joint indicated an additional incomplete fusion between second and third phalanx. These findings were identical in left- and right forelimb. It was decided that a reduction of the weight borne by the medial claws might reduce pain. The lameness was markedly reduced after the attachment of claw blocks. When, after one month, the blocks were removed, the lameness appeared to have improved. A radiological examination of the medial digits revealed that no substantial differences could be demonstrated, compared with the initial examination. Seven months later the animal was again examined clinically and radiologically. The lameness had improved but the appearance of a survey radiograph remained almost unchanged.

EFFECTS OF ELEVATED ADMINISTRATION OF ZINC (Zn) TO DAIRY COWS ON SOLE HAEMORRHAGES (*Pododermatis aseptica diffusa*)

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Zinc is an important micro mineral in the formation of hair, horn and epidermal layers. It is also included in many wound ointments to promote healing. Zinc has been reported to be one of the factors to control claw health.

Twenty-two cows were randomly allotted to different treatments of zinc supplementation for a 24 week experimental period. Cows were in lactation week 6 - 8 at the start of the experiment. Experimental groups were control (C, 7 cows), normal (N, 225 mg Zn day, 7 cows) and high (H, 450 mg per day, 8 cows) zinc supplementation (Bioplex-Zn, NutriScan A/S). This zinc preparation was claimed to have a high bioavailability. The zinc supplement was mixed with beet pulp and fed individually once daily. Feeding regimes and housing conditions were the same for all cows. The cows were kept in cubicles with slatted floor in the same group. The slatted floor had 40 mm slots and the cubicles were 2.2\*1.3 m and had rubber mats. Sawdust (about 1 kg per occasion) was provided twice weekly to the cubicles. Cows were kept on grass for 6 hours a day during a 12 week period in the summer (during the second half of the experiment).

Claws were trimmed and photographed at the beginning (T1) and at the end (T2) of the experiment. Evaluation of haemorrhages (*Pododermatis aseptica diffusa*) in the sole was evaluated at a single slide session. The values were summarised into the white line (Zone 1, 2 and 3) and the sole (Zone 4 and 5) of the fore and hind feet. Contrasts between the two evaluations (T1 - T2) were calculated.

The preliminary evaluation shows that haemorrhage score in the white line of the hind feet decreased (at T2) in one cow in the control group, in 4 cows in group N and in 5 cows in group H compared with the initial (T1) score. In the sole of hind feet, scores decreased in 3, 4 and 5 cows in group C, N and H respectively. There was no change in haemorrhage score in the fore feet in 7 cows (2C+2N+3H) for white line lesion and in 8 cows (2C+2N+4H) for sole lesions. More details of the experiment and the data will be presented and discussed.

## Digital Dermatitis - a major problem in dairy cattle

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During a longitudinal descriptive study about digital dermatitis (DD) the course of disease has been described and a qualitative and quantitative classification system developed to study the dynamics of DD within a herd. A discussion file can be found in the Internet under „<http://www.tiho-hannover.de>“. It should be used to join documentation material from different sources to standardise the classification of DD and other bovine digital diseases internationally.

A transition matrix showing the movement of animals through the disease classes over time is used to discuss the clinical changes of two herds. The quantitative classification system is compared to a statistically generated classification system and a second scoring system developed for the clinical evaluation of a vaccination trial against DD.

The classification systems have been applied to clinical settings in terms of a follow-up study on the effect of parenteral penicillin treatment for the control of DD and a clinical pilote trial for the effect of a vaccination against DD using species of anaerobic bacteria.

An epidemiological field study in northern Germany revealed DD to be the most prevalent cause of lameness in the area of a claw trimming practice. During a period of one year records of about 10.000 animals were gathered and analysed for risk indicators with regard to DD. DD was found to have a two waved incidence pattern with maxima between February and April and June until August. Owners considered DD to be a herd problem only if herd prevalence exceeded 30%. The pilote vaccination trial (n=120 dairy cows) resulted in less „classical ulcerations“ due to DD (11.7% in the vaccinated versus 22% in the control group,  $p < 5\%$ ) with lower scores for the severity of digital lesions (9.5 in the vaccinated group versus 15.6 in the control group,  $p < 5\%$ ) in the vaccinated versus the control group after three vaccinations (day: 0, 21, and 180).

Epidemiological methods for documenting clinical and especially subclinical disease, analysing the economical impact of DD on dairy cattle and the effect of therapeutic measures, and planning future management strategies and their evaluation should be combined with clinical experience to yield a control strategy realised in a herd health program. Future investigations should optimise cost-benefit margins between diseases like DD and management efforts.

## PREVALENCE OF DIGITAL DERMATITIS IN DANISH DAIRY HERDS

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From being largely unobserved in Denmark until recently, reports from practising veterinarians have revealed Digital Dermatitis prevalent in a considerable number of Danish dairy herds. In order to assess the magnitude of the problem in Denmark, a survey was performed based on claw trimming reports collected among skilled claw trimmers, all members of the Danish Association of Examined Claw Trimmers.

The survey was performed during the late autumn of 1994. Reports were received from 556 herds (4.6 % of milk recorded herds), comprising 25.453 examined cows. The average prevalences of Digital Dermatitis in the examined herds are shown in table 1. The within herd prevalences showed large differences as shown in table 2.

*Table 1. Prevalence of Digital Dermatitis as related to type of housing.*

	Total	Tie-stall housing	Cubicle housing	Deep bedded housing
No of cows examined	25.453	16.234	7.860	1.359
Prevalence of Digital Dermatitis, %	2.0	1.0	4.3	2.2

*Table 2. Prevalence of Digital Dermatitis within type of housing. Per cent cows.*

	Tie-stall housing	Cubicle housing	Deep bedded housing
No signs	84	77	80
1-10 %	13	16	10
>10 %	3	7	10

The prevalence of Digital Dermatitis was further examined in a cubicle housed dairy herd with a prevalence of more than 60 % among the milking cows. All animals in the herd were thoroughly examined. Typical lesions were observed in young bulls on slatted floors and in young calves from the age of four months, the latter being housed on slatted floors, unsuitable for calves of that age. Dairy heifers on grass were unaffected.

It is concluded that Digital Dermatitis is a common disease in Danish dairy herds, especially in loose housing, and that the disease may occur in young calves housed in unfavourable conditions in affected herds.



## CLAW TRIMMING AND CLAW CARE IN LAMINITIS

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Diffuse aseptic pododermatitis (laminitis) is a complex disease whose onset and evolution are influenced by many different factors.

Vascular alterations, occurring mostly in the first phase of the disease, cause trophic difficulties of the horn forming epithelium which result in alterations of horn production.

Initially horn forming rate can be increased, later vascular damage will become evident in the form of pathologic horn discolourations, and will eventually impair horn production.

Horn defects caused by aseptic pododermatitis are normally consequent to haemorrhagic infiltrations in horn, the most common ones are: sole ulcer and white line lesion, the latter can be accompanied by undermining of the wall or of the nearby bulbar horn.

One of the critical factors influencing the extent of damage suffered by the quick, and the consequent horn defects, is the amount and distribution of load burdening the inner soft tissues of the claw and directly influencing blood circulation. If the amount of weight resting on the claw is excessive or ill distributed, the peculiar anatomical situation of the deep digital structures will predispose the inner tissues to necrosis. Most claw lesions develop and are maintained because of functional overload.

Removing load from a diseased claw and minimizing pressure exerted by loose horn on the underlying inflamed tissues, normally leads to prompt healing. This is the function of therapeutic claw trimming. Functional claw trimming, as developed by drs. Toussaint Raven in The Netherlands, is an efficient way to manage load distribution in healthy and diseased claws. Functional claw trimming is normally used to shift weight from a diseased claw to the omolateral healthy one, in this way it is also used to release dangerous strain on overgrown claws and for the treatment of closed horn defects.

Therapeutic trimming is a step further on the way of functional trimming. Height differences are enhanced, possibly with the use of orthopedic soles, loose horn is carefully removed and hard ridges surrounding the exposed quick are thinned out.

The aim of the procedure is to maximize blood flow, which is essential for all healing processes, in the corium. If functional trimming is performed on claws which show signs of laminitis, particular attention should be paid to the overall conditions of both claws. Aseptic pododermatitis determines vascular alterations in both of them and shifting the weight on a damaged inner claw could possibly trigger the development of subclinical defects into more serious lesions. This is particularly true if the application of an orthopedic sole is required.

Aseptic pododermatitis can alter the normal relationships existing between the horny capsule and the internal structures. The most common change being a certain degree of "sinking" of the third phalanx into the claw. Particularly in older animals suffering from chronic laminitis, the internal form of the claw can be changed and sometimes an important thinning of the sole can be observed. So, even when trimming clinically sound feet in presence of chronic laminitis, great attention should be paid to the thickness of the sole. Overtrimming in these conditions can lead to unpleasant situations since horn formation in old laminitic claws can be very slow. Particular attention must be paid to white line defects, which are normally present; cutting away the bearing margin of the wall near them will prevent penetration of foreign objects into the defect and subsequent worsening of the condition. Signs of chronic laminitis are normally associated with difficulties in healing horn defects. The prognosis in those cases is worse and longer recovery times must be expected, in some cases the use of orthopedic shoeing or separation from the herd should be considered.

Abnormal claw conformations, thought to be at least partly inherited, have an influence on those lesions commonly associated with laminitis. Corkscrew claws are typically prone to white line lesions and have difficulties in healing, they also frequently show extensive haemorrhages in solear horn.

The results which can be achieved by the use of functional trimming, as a curative and preventive measure against horn defects, depend on different factors. The proficiency of the claw trimmer is important but, in case of high prevalence of laminitis in a herd, great attention should be paid to other concurrent factors like housing and feeding practices. In the worst Italian conditions more than 70% of the clinical cases treated once, with or without the use of an orthopedic sole, did not require any further intervention within two months. The overall reduction in prevalence of horn defects was 40% for sole ulcers and 20% for white line defects on a six months period after trimming a whole herd of 300 cows.

## COWSLIPS - AN ALTERNATIVE FOOT BLOCK

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In the treatment of sole ulcers and white line disease it is now common to leave the corium exposed, without any dressing (Blowey 1993). Even with heavy faecal contamination healing does not appear to be retarded. However, to promote healing a variety of prosthetic devices have been applied to the sound claw. The type of device used is partly a matter of personal preference and includes tie-on shoes ("Shoof"), nail-on rubber blocks and wooden blocks glued to the sound claw (Technovit; Demotec). More recently a moulded PVC shoe ("Cowslip" -Giltspur Ltd.) has become very popular in the United States (Shearer & Elliott 1994), Australia (Pyman) and the UK (Blowey 1993). The shoe is very easy to fit and seems to have several advantages over other products on the market including:

- the glue (powder and solvent) can be easily mixed in the shoe
- when applied, the wall of the shoe holds the semi-solid adhesive in position, preventing excess dripping off the foot.
- because the shoe is firmly attached to the wall of the hoof by adhesive, weightbearing is taken primarily on the wall.
- the rate of wear, particularly at the heel, seems to be less than with wooden blocks.

It has been recommended that any foot block should be removed after four weeks (Toussaint Raven 1985) and the sound claw trimmed to restore normal weightbearing. However, the Author has treated numerous cases where blocks have remained in place for three to four months, without any obvious deleterious effects, thus allowing optimum time for the resolution of slow-healing lesions such as sole ulcers. Cowslips may be removed by clipping the wall/sole junction of the Cowslip from heel to toe. It is easy to judge the correct depth, so that only the Cowslip and underlying glue is removed and the hoof wall remains intact.

The paper describes the practical aspects of fitting Cowslips and the persistence of adhesion of Cowslips in a group of cows monitored during the course of treatments in a veterinary practice.

## MANAGEMENT OF TIBIAL FRACTURES IN CATTLE: 36 CASES (1990-1995)

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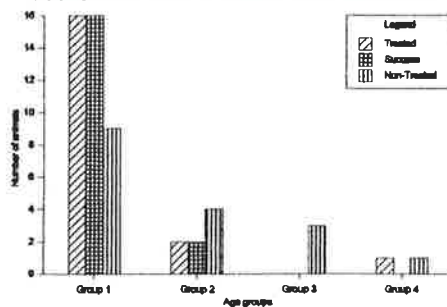
Tibial fractures are seen in cattle of all ages and comprise approximately 12% - 18% of all fractures seen<sup>1,2</sup>. Over the years, the literature contains several references to different treatment regimens, each claiming good success rates. This retrospective study was performed to evaluate the effectiveness of contemporary treatment modalities in the light of recent work with selected tibial fractures.

Medical records of 36 animals presented with tibial fractures to the WCVM-VTH from 1990 to 1995 were reviewed. Twenty-five (69.4%) animals were younger than 1 month (Group 1), six (16.6%) were between one and six months of age (Group 2), three (8.5%) were between six and twelve months (Group 3) and two (5.5%) were older than one year. The configuration of the fractures varied and the left leg was more commonly affected (66.1%). Nineteen (52.8%) fractures were repaired with an overall success rate of 94.7%. Significantly more males (68.4%) than females (31.6%) were repaired. A variety of fixation methods were employed including bone plating, cerclage wiring, lag screws and Thomas-Schroeder splinting. There was a significant difference in treatment method selected relative to age group. Out of sixteen animals in group 1, eleven (68.7%) were treated with a splint. In total, twelve of thirteen fractures (68.4%) which were treated with splinting alone, had a positive outcome. Five fractures (26.3%) were repaired by internal fixation plus a T-S splint. All of these had positive outcomes and there was no differences between the method of internal fixation used. The one (5.3%) animal in which internal fixation was used as the only means of support had a successful outcome. Fractures were most commonly treated in group 1 and 2 animals. Only one fracture in an animal older than six months of age were repaired. There was no significant difference between age groups regarding outcome.

Time between injury and presentation varied from 3 hours to two months.

Amongst the animals not treated (17), nine (52.9%) belong to group 1, four (23.5%) to group 2, three (17.6%) to group 3 and one (5.9%) to group 4. Of the animals not treated most were presented with concurrent problems such as additional fractures, failure of passive transfer, pneumonia, or scours. Tibial fractures in animals up to six months of age had an excellent prognosis regardless of the method of repair chosen.

Treated vs Non-Treated and Success



<sup>1</sup> Ferguson JG. Compend Cont Educ Pract Vet, vol 4, No. 3, 1982, S128 - S135.

<sup>2</sup> Reichel EC. J Am Vet Med Assoc, July 1, 1956, 8 - 15.

## EFFECT OF FOOTBATHS ON THE CONTROL OF FOOT LAMENESS IN DAIRY CATTLE

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To determine the effect of footbaths in control of foot lameness a follow-up study was carried out in 23 dairies in the vicinity of Tehran during a 4 years period early in 1989. These dairies had a recognised foot lameness problem and most of them did not use a regular footbaths and had kept records of lameness cases for at least 6 months before the commencement of the study. In all dairies the days of spring and fall seasons were considered in each of the successive years as proper time for footbathing and a walk-through footbaths was sited near the exit to the milking parlour. Formalin and copper sulfate were used at 5 and 3 per cent solution as disinfectant/astringent ingrediants respectively. The cows were walked through the bath after each of three successive milkings per day and the bath solution was refreshed every two to four days interval based on the population size of dairies under study. In 14 dairies which hoof ulcer was more prevalent recommendation was made as follows: formalin in 3 dairies, copper sulfate in 6 dairies and both ingrediants with defined time interval in 5 dairies. In 9 dairies which lameness was confirmed to be associated with digital dermatitis (known as mortellaro disease), 4 dairies were advised to use formalin (test) and copper sulfate was recommended in 3 dairies (Positive control) and in two dairies no footbath was suggested as negative control. This procedure was repeated for the entire period of the study (March 1989 through March 1992). Annual mean prevalence rate of lameness in each year was calculated and compared statistically with that in the year before on each of the group dairies which specific footbath material was advocated, using paired student " t " test. Results of this field study suggested that spring and fall footbathing containing 5% formalin together with 3% copper sulfate could be beneficial in reducing the prevalence of lameness due to sub-clinical laminitis and related injuries such as white line, hoof ulcer and heel horn erosion. But formalin as well as copper sulfate cannot be expected to be wholly effective in control of digital dermatitis. In this regard the new cases and/or relapsing the case should be anticipated.

## THE HANDBOOK FOR THE PREVENTION OF THE DAIRY CATTLE LAMENESS : GOAL AND PROCESS ; STRATEGY AND EVALUATION OF ITS DIFFUSION

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From the results of an ecopathological study on the risk factors for lameness in dairy cattle, the Ecopathology Center has elaborated a program for the transfer of knowledge and know-how to farmers, about the lameness prevention. The central point of this program is the Handbook for dairy cattle lameness prevention. This document allows to make a diagnosis of the situation of the farm regarding the risk factors for lameness, and allows to build a strategy and a prevention program based on the deletion of the risk factors.

This prevention tool, intended to be sold, has been designed for two complementary purposes : for a personal use by the farmers (self-diagnosis of the risk factors, self-management of the prevention program), and for use within the framework of the farmer organization extension programs, as a tool for the individual and collective advice to the farmers by the advisers (veterinarians, ingeneers and technicians, cattle chiropodists).

The goal was to diffuse the prevention handbook all over the French territory. It was achieved with a strategy using various means (awareness campaign, training, communication and diffusion campaigns, follow-up and evaluation) and based on the mobilization of the networks of all individuals involved in the dairy cattle industry (farmers, technicians, veterinarians), as well as the technical and economical dairy farmer organizations.

During a 18 month period (November 1993 thru April 1995), 1 597 prevention handbooks were sold in 71 departments (over 90). The paper shows the results and the evaluation of the diffusion that has been made according to the different diffusion ways (Ecopathology Center, dairy cattle press, farmer organizations), in terms of geographical and socio-professionnal distribution of the purchasers.

An impact and satisfaction study, based on a phone survey carried out on a 59 farmer sample who had bought the handbook, gave information on the appropriateness of the handbook to the farmer demand : 70 percent of the farmers were satisfied with the handbook, 57 percent of them had taken some measures for the deletion of the risk factors for lameness. This study outlines the existence of an information and training demand from the farmers about the foot care and the claw trimming of the dairy cows affected by lameness ; this demand is complementary to the prevention processes that has been suggested.

## OSTEITIS AND FRACTURE OF THE THIRD PHALANGES FOLLOWING ROUTINE HOOF TRIMMING IN A DAIRY COW

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A 3-year-old Ayrshire cow, 4 months into her second lactation, was presented to the Onderstepoort Veterinary Academic Hospital, Faculty of Veterinary Science, University of Pretoria with a severe hind limb lameness. She had a history of an acute drop in milk production accompanied by lameness 14 days previously. The farmer treated her with a potentiated sulphonamide and phenylbutazone, with no response, and did not seek veterinary attention until the cow was obviously losing a lot of condition.

On examination, the cow showed a grade 4 lameness in the right hind limb and also appeared to be lame in the left hind. Separation of the wall from the coronary band was evident abaxially on the lateral claw of the right hind limb. The cow stood with both hind limbs stretched out behind her and the right hind was also abducted. Her right hind foot was lifted using a rope, but was found to be too painful to work on. The cow was therefore placed on a tilting table and regional intravenous analgesia was administered by injecting 20 millilitres of 2 % lignocaine into a branch of the lateral saphenous vein distal to the hock. Five million units of sodium benzylpenicillin were dissolved in the lignocaine prior to injection. The tourniquet proximal to the hock was left in place for 60 minutes during which time the foot was radiographed and trimmed. A small crack was initially seen in the sole of the toe of the lateral claw. On further examination, the entire sole and part of the abaxial wall were found to be undermined and were removed. This revealed an ulcer-like defect, about 20 mm in diameter, in the underlying sole of the toe. When the cavity was probed, the distal phalanx could clearly be felt. Radiographs revealed that a 20 mm portion of the tip of the bone had fractured and an osteitis appeared to be present. Examination of the left hind limb revealed virtually identical lesions, this time in the medial claw. Wooden blocks were then fixed to the sound claws of both hind feet using Demotec®, a polymethylmethacrylate adhesive. The lesions in the toes were cleaned and the feet bandaged. The degree of lameness improved dramatically following application of the blocks.

Further examination of the farm records then revealed that the cow had undergone a routine hoof trimming 20 days before the lameness had first been detected. It seems likely that, after trimming, the sole of the toes had been penetrated resulting in infection down to the distal phalanx. The bone then became weakened, resulting in pathological fractures and acute, severe lameness.

Two days later the cow was again placed on the tilting table and regional intravenous analgesia and antibiotics was again applied. Using a foetotomy wire and handles, the entire toe of the affected claw of the right hind foot, including the wall, corium and distal fragment of the third phalanx, was sawn off and removed. The wound was then cleaned and any remaining bone fragments removed before bandaging the foot. In the affected claw of the left hind foot the ulcer was debrided and all visible infected tissue was removed. It is hoped that the cow will in time regain the function of the affected claws. The response to treatment will be reported later.

This case is used to illustrate the potentially disastrous consequences of injudicious hoof trimming in cows. Excessive thinning of the sole may result in severe bruising of the corium and/or foreign body penetration of the sole. This may lead to deep infection involving the distal phalanx. In this case, the soil on which the animals walked contained a lot of small stones, thus the sole should have been left even thicker than usual. The lameness which may result from such overtrimming will reduce milk yield, incur the cost of veterinary treatment and may even result in the cow being culled, thus having a severe negative economic impact on the farmer.

## LONG-TERM SURVIVAL AFTER TREATMENT OF INFECTIOUS ARTHRITIS OF THE DISTAL INTERPHALANGEAL JOINT

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Infectious arthritis of the distal interphalangeal joint is mostly treated by amputation of the digit or by resection of the joint, leading to ankylosis. The latter therapy leads to retention of a weight-bearing claw, thus supposedly to an extended productive life. Disadvantages of joint resection are the relative complexity of the surgical technique under farm-conditions, the high costs of the treatment and, moreover, the substantial loss of production due to the long recovery time. Amputation of the digit can easily be performed, is cheap, and often leads to a rapid return to normal body condition and productivity (1). Amputation of the digit is supposed to shorten the life-span, compared to resection of the joint (2).

A survival analysis was done, comparing three cohorts of cows with infectious arthritis. Ten cows were treated by joint resection as described by Nuss and Weaver (2), 28 cows were treated by amputation of the digit performed under "ideal" circumstances at the Department of Large Animal Surgery, and 26 cows were treated by amputation of the digit performed under "farm" circumstances by the ambulatory clinic of the Faculty of Veterinary Medicine.

Data were obtained by interviewing the owner and from information collected at the time of treatment. Cohorts were compared for survival, productivity, costs and contentment of the owner. Survival varied from two weeks to more than two years. Differences between cohorts were found, but were not as obvious as often is suggested. Although owners generally were content with the clinical results of the treatment, economic results were not always satisfactory. Resection of the distal interphalangeal joint does not extend the life-span of the treated animal enough to compensate for the loss of productivity and body condition, when compared to amputation of the digit.

1. Pesja T.G. et al. Digit amputation in cattle: 85 cases (1971-1990). JAVMA 202: 981-984, 1993
2. Nuss K. and Weaver M.P. Resection of the distal interphalangeal joint in cattle: an alternative to amputation. Veterinary Record 128: 540-543, 1991.

## DRILLING THROUGH SEPTIC ARTHRITIS IN FIELD CONDITIONS

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Here we report four severe cases of septic arthritis of the Coffin and Pastern joints with and elephant leg, which we treated by drilling at septic conditions through the joint. In all of these cases a drain was left for five days along with a techno-vit that was put on the healthy hoof. The cows were returned to the herds immediately. After 3 months no swelling or lameness could be detected in any of the cows. We find that drilling in this method suits field conditions and saves the need for hospital utilities.



## THE DEVELOPMENT OF LOOSE HOUSING SYSTEMS FOR DAIRY COWS TO IMPROVE THE HEALTH OF THEIR FEET.

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The tendency for dairy production to be organised in larger units with less labour per animal, together with the Swedish animal welfare regulations, encourages the introduction of housing systems in which the animals can move about freely. However, the results of a Danish study showed that cows kept in cubicles were more prone to hoof diseases and lameness than cows kept in tie-stalls, and other European studies have reported very high incidences of sole ulcers and white line disease in cows in cubicle systems. These hoof disorders are often associated with the concrete floors, uncomfortable cubicles and unhygienic conditions underfoot which are characteristic of these systems, and with the aggressive social interactions of large numbers of animals kept together. Any prolongation of the feeding times or of the periods spent on dirty concrete floors, as a result of increased milk yields, would further increase the risk of lameness.

No major advancements in housing have been made recently to improve the hoof health of cows. However, in the past three years a new type of feeding-place has been constructed and tested on 13 farms in a dairying district of Sweden. It has been applied to about 1400 cows and their performance has been compared with that of cows in conventional cubicle systems. The new system incorporates some of the advantages of tie-stalls in which a softer and cleaner environment have showed beneficial results for the foot health. Each cow has a feeding-stall, fitted with a rubber mat, and these stalls are arranged along the manger but raised by 20 cm; the stalls are 160 cm long and designed particularly to suit a standing cow. The contamination of the stall floor with slurry is reduced by placing partitions between each feeding place at a distance of 80 cm. The feeding platform is also raised by 40-50 cm to improve the feeding position and the availability of the fodder.

The results have been encouraging in terms of both the incidence of lameness and the social interactions of the cows at the feeding place. Preliminary data on milk production, fertility, lameness, culling rate and economics are presented.

RECENT CHANGES IN THE CLINICAL AND EPIDEMIOLOGICAL FEATURES OF INTERDIGITAL NECROBACILLOSIS (PHLEGMONA INTERDIGITALIS) IN BRITISH DAIRY CATTLE.

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Interdigital necrobacillosis has been recorded as a common cause of lameness in British dairy cattle. Prior to 1993 it was not regarded as a particular problem because of the relative ease of diagnosis and treatment. Since then a severe form of the disease previously unfamiliar to British clinicians has appeared which appears to be refractory to conventional treatment. There also appears to have been changes in the epidemiological picture. Surveys carried out in the late 70's indicated a significantly higher incidence of disease from May-October. The most recent survey has shown the peak incidence to be in the winter months November-April. An outbreak involving a 20% incidence over a 1 week period has been described by the author associated with passage through a low volume footbath. Outbreaks of disease appear to be more common in, but not exclusive to, herds in which there is a high incidence of Digital Dermatitis.

Histopathological examination of typical cases has revealed no significant differences from those lesions described previously. Bacteriological examination of a series of 12 cases revealed *Fusobacterium necrophorum* ss. *necrophorum* and *Bacteroides melaninogenicus*. Other organisms isolated included *Bacteroides fragilis* and pigmented anaerobic cocci. Antimicrobial sensitivity testing of the *Fusobacterium* strains showed full sensitivity to penicillin, amoxycillin & ticarcillin. There was partial resistance to cefoxitin, tetracyclines & chloramphenicol.

Failure to respond to treatment appears to be related more to the time elapsed before the commencement of treatment than to antibiotic resistance.