Lameness, Hoof and Leg Issues in Dairy Cows

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Take Home Messages

- A complex interaction of both internal and external factors determines the prevalence of lameness in a dairy herd.
- A comprehensive approach should be utilized to optimize the level of hoof health in a herd, including lameness prevention, identification of lame cows, and proper management of lameness cases.
- Prevention of lameness involves reducing the risk of lameness by determining which internal and external factors contribute to increased levels of lameness in a herd, and correcting them in an effective manner.
- Identification of lame animals involves recognition by the owners and managers of the importance of lameness, and a commitment to identifying and managing lame cows in a timely manner.
- Records should be maintained and analyzed in order to permit an assessment of the trends, patterns, and risk factors for lameness, and inform further lameness prevention efforts.
- Management of lame cows must be done in a timely fashion to address both economic and animal well-being concerns.
- Competence and capacity is necessary to deal with any moderately or severely lame cow within 12-24 hours.
- An investment in acquiring the necessary competence and capacity has an extremely high probability of showing a substantial positive return.

Introduction

Lameness is a major welfare and economic concern for the dairy industry. Animals that do not walk soundly may experience a number of associated problems, including decreased feed intake, weight loss, reduced reproductive

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performance, mastitis, and decreased production. In addition, not only do lame cows experience production losses and incur treatment costs, they are also at risk of leaving the herd prematurely. This results in lameness costing, on average, more than $300/case in most herds.

Lameness is also a very real animal well-being concern. Both acute and chronic lameness are very painful conditions, which is one of the reasons that some of the associated problems are observed. For example, most lame cows have lost, or subsequently lose, a substantial amount of body condition, and end up being very thin. They may spend extended periods of time lying down due to the pain that occurs when walking, and therefore are less likely to achieve adequate dry matter intake. In addition, the "public" can easily detect when cows are moderate to severely lame, and they usually perceive that these animals are experiencing a painful condition. For these reasons it is not only ethically appropriate, but also good for public relations, to minimize the amount of lameness that occurs, and promptly address any lameness problems.

Dealing with the hoof health situation in a herd involves a strategic and comprehensive approach. Simply hiring a professional hoof trimmer to come in and trim cows, even if the visits occur on a regular and frequent basis and the trimmer is highly competent, is not adequate. Similarly, a quest to find the ‘best’ concoction for a footbath solution, even if it is successful, will seldom be enough to solve a herd’s lameness problem.

A more useful strategy to optimizing the level of hoof health in a herd is to employ a three-pronged approach, including:

- Preventing new cases of lameness by reducing various risk factors,
- Identifying cows that become lame as soon as possible, and
- Managing cows appropriately that are identified as lame.

Prevention

Knowledge about the various factors that put a cow at risk of becoming lame is critical in order to prevent lameness. Research and experience have shown that the interaction of many different factors is responsible for determining whether or not a dairy cow becomes lame, and if so, whether she becomes mildly, moderately, or severely lame. The relative importance of these factors, and the way they interact, varies from farm to farm, and even from season to season within a farm. Therefore, awareness of these risk factors, and how they can be ameliorated, will help farmers, veterinarians, hoof trimmers, and other consultants minimize lameness in their herds.

A healthy claw capsule maximizes the likelihood that the claw can withstand at least some of the potentially negative external influences it may experience. (Because the vast majority of lameness occurs in the feet of dairy cattle, this discussion will concentrate on those factors affecting this region of the leg.) Since the corium is the layer of the dermis that produces the tissues that comprise the claw capsule, it follows that it is important to maintain a healthy corium, that does not become compromised, in order to produce a continuous thickness of high-quality, strong tissue to form the capsule. This requires an adequate flow of blood through the cells of the corium, as well as specific nutrients.

There is evidence to support the theory that the release of vasoactive endotoxins from bacteria, due to rumen acidosis, mastitis or metritis, can negatively affect the circulation in the corium. Although a cow experiencing one of these conditions does not necessarily become lame, it does put her at higher risk of becoming so. Therefore, it is important to monitor the ration that is being fed, consumed, and digested, in order to minimize the amount of rumen acidosis in a herd. It is important to realize that these effects may not be observed until weeks after the dietary change occurs.

Additionally, excessive and/or prolonged pressure on the corium can also result in a reduction of blood flow to a localized, or extensive, region of the corium. These conditions can come about due to a number of interacting factors, including: 1) the weight of the animal, 2) the conformation and shape of the leg and foot, 3) a lack of 'shock absorption' capacity, 4) the flooring surface, and 5) the amount of time spent standing vs. lying. Although space constraints preclude an extensive discussion of each of these factors, a brief overview will be provided.

Genetics play a role, although a relatively limited one, in the risk of developing lameness. Animals with a larger frame size tend to be at greater risk for lameness than lighter, smaller-framed animals. Similarly, the leg angle and hoof angle have been found to be associated with lameness. Even though some of these factors can be compensated for by management practices, such as routine trimming, herd owners and managers should consider the long-term implications of their breeding program on their herd's hoof health.

Hoof trimming, when employed frequently enough, and in the proper manner, can result in an optimal shape and conformation of the claw to minimize the pressure in the corium. When the toes (the dorsal hoof wall) are overgrown (**A** in Figure 1) there is a greater tendency for the pressure to be unevenly distributed across the solar surface, and therefore the corium of the sole. By trimming the claw to the appropriate length, and 'sparing the heel' (**B** in Figure 2), the hoof angle can be improved, with a resultant improvement in the pressure distribution across the sole. The sole of the claw should also be trimmed as 'flat' as possible in order to maximize the weight-bearing area

when the cow is walking on concrete. Only a relatively small area at the posterior aspect of the sole (the region underneath the back of the P3 bone) is sloped in order to reduce the pressure in this high-risk location (Figure 3).

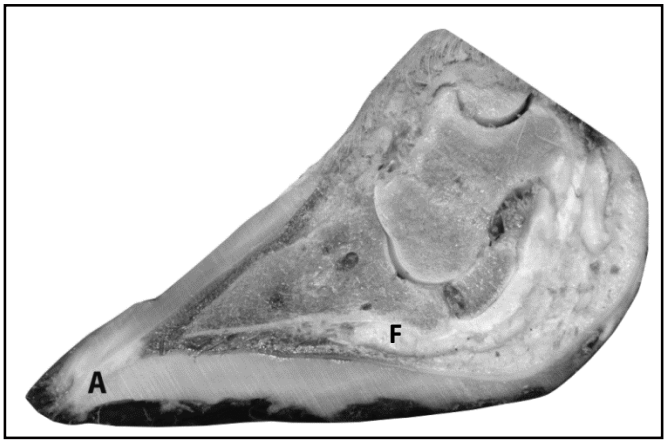

Figure 1. Cross section of claw showing overgrowth at the toe (A), and the digital cushion (a.k.a. "fat pad") (F).

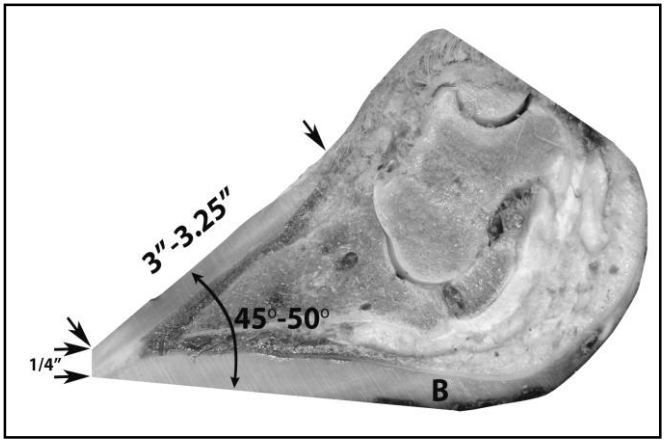

Figure 2. Same claw as Fig. 1, showing wall and sole tissue removed during trimming. Note that no tissue was removed at the sole (B).

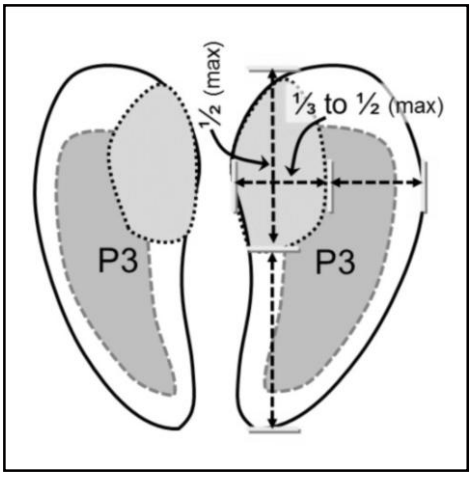

Figure 3. Schematic of soles of claw showing area to be 'sloped'.

In a normal, healthy, claw there is a layer of tissue (the "fat pad" or digital cushion) located between the P3 bone and the corium. This is especially prominent at the back of P3, where the flexor tendon attaches to the P3 bone (**F** in Figure 1). This pad helps to distribute the pressure on the corium in this high-risk region of the sole. However, as cows lose body condition (and likely due to some hormonal factors as well) the fat pad thins – and sometimes very dramatically! This increases the risk of excessive pressure points on the corium in the area where sole ulcers are most prone to develop (see **A** in Figure 4).

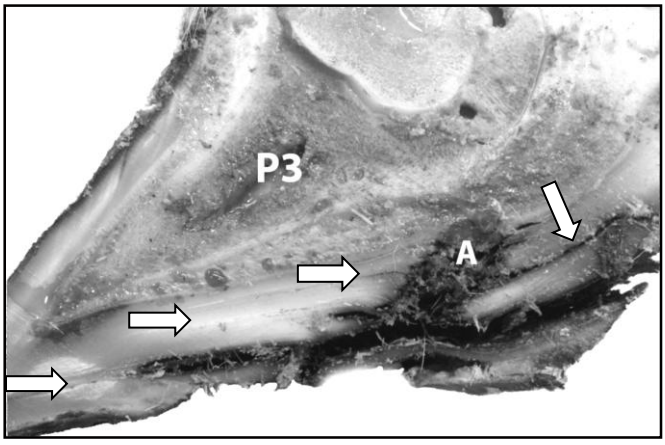

Figure 4. Cross section of claw showing areas of poor quality/undermined sole tissue (⇨) & a sole ulcer (A). P3 bone is labeled.

For many herds, it is beneficial to employ the services of a competent professional hoof trimmer. Ideally, regularly scheduled visits by the trimmer will permit implementation of a systematic preventive/maintenance trimming program to ensure that the whole herd is routinely examined and trimmed. If the hoof health program for the herd is functioning properly, the trimmer should be able to spend the majority of their time trimming healthy cows, rather than lame cows, since this is more profitable. Ideally, each cow will be examined and trimmed at least twice during her lactation, and more frequently if abnormal hoof growth occurs.

The flooring surface also plays a significant role in determining the pressure distribution in the corium. Whereas a completely flat, smooth walking surface would provide the most surface area, and therefore the lowest pressure in the corium of the sole, this does not provide adequate traction for the cow, especially if the surface is inelastic. For this reason, most concrete floors have a pattern floated or stamped into them when they are poured, or subsequently cut into them. While this can noticeably decrease the slipping experienced by the animals, the size and pattern of the grooves must be optimized to balance the need for traction with the need for maximal weight-bearing area (Figure 5). The texture of the floor between the grooves must also be considered, especially on new floors that have not been properly finished, or ones that have gravel or stones on them. Very significant pressure points can develop in the corium, potentially leading to bruising or damage.

Figure 5. Rough surface due to floor degradation. Could result in very high point loads in solar corium.

Poor cow comfort is also a significant risk factor for lameness. When a cow stands on her feet for excessive periods of time, the circulation in the corium

can be compromised. Many factors play a role in determining whether or not cows have adequate lying time, including stocking density, time away from pen, stall design, bed surface and bedding condition, heat stress, social dynamics, etc. Numerous papers and other resources are available that address how to achieve an optimal lying time. Due to space constraints, these will not be covered in this manuscript.

When the corium is compromised, it may fail to produce sole, white line, or hoof wall tissue for a period of time, or it may produce tissue that is of inferior quality. As this compromised tissue grows toward the wearing (exterior) surface, it is more prone to damage, penetration, and excessive wear, resulting in an increased chance of the cow becoming lame. In Figure 4, there is significant evidence of poor quality and interrupted sole tissue production (arrows), in addition to the presence of a sole ulcer (**A**), which is a full-thickness defect through the sole, exposing the corium.

Animal handling and movement are factors that are often overlooked, but can also affect the probability of an animal becoming lame. Video observations by the Penn State Veterinary Extension Team show that animals that are walking at an unhurried pace, on a good quality flooring surface, without any pushing, shoving or prodding from other animals or animal caretakers, will generally not slide or rotate their foot while it is weight-bearing. Conversely, if an animal is rushed or prodded to move or turn, she may slide or rotate a weight-bearing foot along the walking surface. This can produce tremendous frictional wear, and/or shear forces in the foot, producing potentially deleterious mechanical wear and damage (Figure 6).

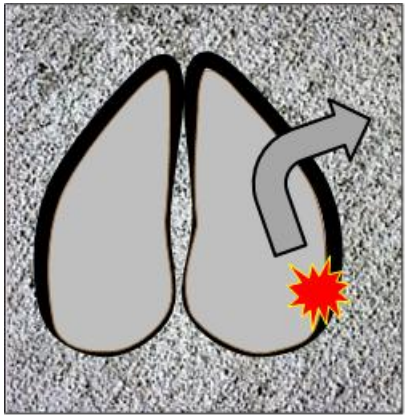

Figure 6. Potential shear stress site if turning while weight-bearing.

Poor hygiene of the hoof has also been shown to be a risk factor for lameness. Feet that are constantly, or frequently, manure-covered and wet, are more likely to suffer damage, defects and infectious claw disease.

Furthermore, if the quality of the claw tissue is sub-optimal due to compromise of the corium, the effects of poor hygiene can be exacerbated. Therefore, efforts must be made to reduce the amount of standing manure in the housing areas and travel lanes. In some situations, farmers have observed an improvement in the efficacy of footbaths by washing the feet of the cows in the parlor prior to them passing through the bath.

Footbaths are frequently a necessary and essential component of a lameness prevention program. However, the research literature is relatively sparse when it comes time to make recommendations as to which product should be used, in what concentration, and with what frequency. This is because in addition to the specific product being used, numerous factors interact to determine the efficacy of a footbathing program, including such things as the presence of specific diseases and lesions in the herd, the design and management of the footbaths, the hygiene of the feet/legs of the animals passing through the footbaths, and the quality of the claw tissue produced by the corium.

It should be obvious that a lameness prevention strategy needs to consider many different risk factors, and how these factors interact. A systematic review of these risk factors will help determine which are the most likely to be compromising the hoof health in an individual herd, so that an informed, reasonable, and economical action plan can be developed to decrease the future risk of lameness.

Since no prevention program will prevent every case of lameness, it is essential that a system is in place to identify animals that become lame. It is important to realize that a mild case of lameness frequently progresses to a moderate, and even a severe, case of lameness if left unmanaged. Therefore, it is not only in the best interest of animal well-being to attend to lameness cases as soon as practicable, it is also an economically-prudent decision.

■ Identification

The first step in an effective lameness identification program is for the herd owner and managers to be committed to dealing with lameness promptly and properly, and to convey this commitment to their employees. If it is common knowledge that a new case of lameness needs to be dealt with immediately, rather than simply looking the other way and hoping the situation improves, the employees are much more likely to take an active role in identifying and managing lame animals.

In addition to the commitment, a system has to be put in place to detect lame animals, and to report any cases that are observed. Various systems have been used to evaluate a cow's gait and posture, and most of these can be

easily taught and implemented to help identify lame cows – especially those mildly lame cows that are at risk for becoming more severely lame. This system can be utilized by the people moving cattle to and from the milking parlor, or someone can be tasked with walking through the pens on a regular basis to assess the animals. People working with dry cows and springing heifers should also be attuned to looking for any lame animals.

An effective method of recording and communicating the identification of a lame animal is necessary so that the appropriate person can address the problem in a timely manner. The method used may vary between farms, but in order to be effective it should be easy and convenient for all involved. For example, some herds may utilize a white board near the parlor, or in the herd manager's office, to record the ID of animals that need to be examined, whereas others may find an electronic records system more efficient.

In addition to identifying animals for the immediate purpose of treatment, it is valuable to store this information over a longer period of time so that patterns of lameness can be monitored and analyzed. Many herds have an extensive history of individual animal somatic cell counts and breeding information so that udder health and reproductive performance patterns and trends can be assessed over time. However, very few herd owners can objectively document whether the lameness situation in their herd has been improving or declining, and which group(s) of animals are at greater risk for becoming lame. Acquiring and analyzing information about the occurrence of lameness will permit a more strategic approach to preventing future cases.

■ Management

Once an animal is identified as being or becoming lame, it is important to properly manage the condition so as to halt the progression of lameness, and ultimately restore her to full health. Since lameness has a very real economic cost as well as an animal well-being cost, moderately and severely lame cows (eg. locomotion score 4/5 and 5/5) should be examined within 12-24 hours. Mildly lame cows (LS 3/5) should ideally be examined as soon as possible as well, although a delay of 48-72 hours between identification and examination likely has relatively little negative consequence.

Contacting the herd veterinarian every time a lame cow is observed is one possible approach, but in most situations this is a relatively expensive option, and is therefore unlikely to be done. (This also assumes that the vet has the competence, capability, and desire to trim and treat lame cows…which may not always be a valid assumption!) It should be evident that unless a hoof trimmer is visiting the farm every other day, farmers must have the capability and competence to examine and manage a lame cow, at least in the short term. Unfortunately, too many herds rely strictly on their hoof trimmer to handle all of their trimming needs during regularly scheduled visits, and

thereby compromise the well-being of their animals and economics of their herd.

In order to have the competence and capacity to examine and treat, at minimum, the occasional lame cow, an investment in equipment and training may be necessary. This does not usually require a substantial amount of money, and given the cost of lameness, an excellent payback on the investment is virtually guaranteed. Various manually-operated chutes are available that permit adequate restraint of an animal for trimming purposes, and a decent set of hoof knives and hoof nipper can be acquired for less than the cost of a tank of gas. For an additional tank of gas, an electric angle grinder and a basic steel trimming disc could be purchased.

However, it is crucial to make sure that the employee(s) responsible for treating/trimming lame cows understands how to do so properly, since he or she can easily exacerbate the situation due to incompetence. There are numerous avenues and resources available to acquire the training and practice necessary, such as the day-long, hands-on hoof health workshops offered in Pennsylvania and Maryland by the Penn State Veterinary Extension Team (extension.psu.edu/animal-health). Many veterinarians and hoof trimmers are also agreeable to providing coaching and advice to someone with a desire to learn. It is not essential that an on-farm employee or owner become fully competent to deal with every lameness condition, but a basic understanding of how to prevent a case from progressing, and the basics of a 'maintenance trim' are essential. They should know how to assess a lame cow, determine where the lesion(s) is that is most likely responsible for the lameness, and how to manage it, at least in the short term. In many situations this may involve the placement of a hoof block or shoe on a healthy claw, so an understanding of how and when to use these is important. It would also be useful to have written lameness treatment protocols, which can be developed in conjunction with the herd veterinarian and hoof trimmer. Finally, a periodic assessment of the effectiveness of the lameness management strategy is warranted, in order to determine if improvements or adjustments are beneficial.

■ Conclusion

Lameness is a complex, multifactorial, and costly disease, which should be dealt with using a comprehensive prevention, identification and management strategy. Through only a minimal investment of time and resources, many herds could experience a decrease in the incidence and prevalence of lameness, a positive economic return, and an improvement in the well-being of their herd.

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