

Stop Creating Chronic Lameness – Detecting Lameness: Anytime and all the time

Karin Orsel

University of Calgary, Calgary, AB
Email: karin.orsel@ucalgary.ca

Calgary lameness research team: Herman Barkema, Ed Pajor, Gordon Atkins. Graduate students: Casey Jacobs, Jesse Schuster, Michelle van Huyssteen. Collaborating with FACA Steve Mason and Laura Solano, WCHTA and specifically trimmers Rob Geier (Casper trimming) and Elbert Koster (no-tilt hooftrimming).

■ Take Home Messages

- ▶ Lameness is a sign of pain and discomfort, resulting in production losses.
- ▶ Not all lameness is caused by claw diseases.
- ▶ Know which cows are most likely to be lame.
- ▶ Prevention of chronically lame cows starts with (early) lameness detection.
- ▶ Lameness detection not only needs to be done regularly, but more importantly, corrective actions must be taken.
- ▶ Technology can support lameness detection.

■ What is Lameness?

Lameness is a clinical sign due to an injury or disease of the foot or leg. The majority of lame cattle have a hoof problem (approximately 80-90%), with the rear feet being most commonly affected. Several factors may contribute to the development of hoof lesions, including: breeding, nutrition, housing design, flooring surface, herd management, stockmanship and concurrent disease.

Clinical signs associated with lameness are (Van Nuffel et al. 2015):

- ▶ Changes in gait (asymmetry, lateral movement, irregular stepping, reduced tracking)

- Changes in posture or body movement patterns (including arched back)
- Changes in weight distribution patterns (limping, head bobbing)
- Changes in behavior (reluctance to move, reduced feeding)
- Joint stiffness

Due to pain, lame cattle have lower milk production, reduced feed intake, and are less likely to display estrus, all of which increase the risk of culling. Therefore, lameness is considered one of the most important animal welfare problems in the dairy industry (behind mastitis and reproductive failure). In a study we performed across Canada in 2011, on average 20% of dairy cows housed in freestall barns walked lame, with a range of 0 to 69% (Solano et al. 2015). We attributed the wide variety to differences in facilities and farm management. Remarkably, estimates of lame cows averaged 20% and 9% for researchers and producers, respectively (Higginson et al. 2017). One of the most important reasons for this difference is likely the definition of a “lame cow”.

Many scoring systems have been developed to define and identify a cow as walking lame, with the system promoted by Zinpro and UBC amongst the most commonly used (score 1-5) (University of BC Animal Welfare Program). The recently introduced lameness scoring as part of the proAction initiative is a simplified scoring method. ProAction looks for the presence or absence of an obviously limp (score 4/5), which results in lower lameness prevalence estimates compared to commonly used 1-5 scoring systems in research that include any limping cow (score 3/4/5). More advanced lameness grading systems have been published, but they are mainly used to evaluate lameness treatment.

■ Which Cow is Most Likely to Become Lame?

With producers having limited time, it is helpful to know which cows are more likely to become lame and focus on identification of lameness in cows at greatest risk. Most research agrees that 4 weeks before to 4 weeks after calving is a risk period for many diseases, including lameness. Although changes in diet were once regarded as the sole reason for this increase in lameness, it is more likely due to thinning of the digital cushion, combined with changes in the integrity of the suspensory apparatus of the hoof around calving (Newsome et al. 2017). Another potential reason for increased lameness in fresh cows might be related to the stress of moving to a different group, as hierarchy and social status needs to be re-established in the lactating herd. Furthermore, the risk of lameness was higher with increasing parity (Figure 1) or in cows with poor body conditions (Figure 2). Knowing that multiparous, and especially thin or injured, cows are more likely to become lame, management of these cattle to improve cow comfort, for example,

improving slip resistance and stall comfort, can reduce lameness. Also, spending the dry period in more comfortable housing would allow a chronically, or mildly affected, cow to recover from lameness.

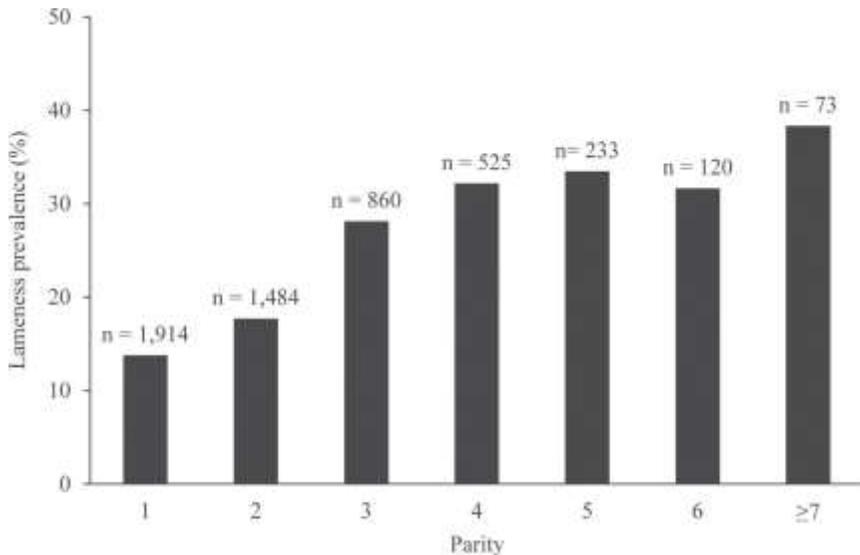


Figure 1: Percentage of lame cows per parity (n = number of cows per category). From Solano et al 2015.

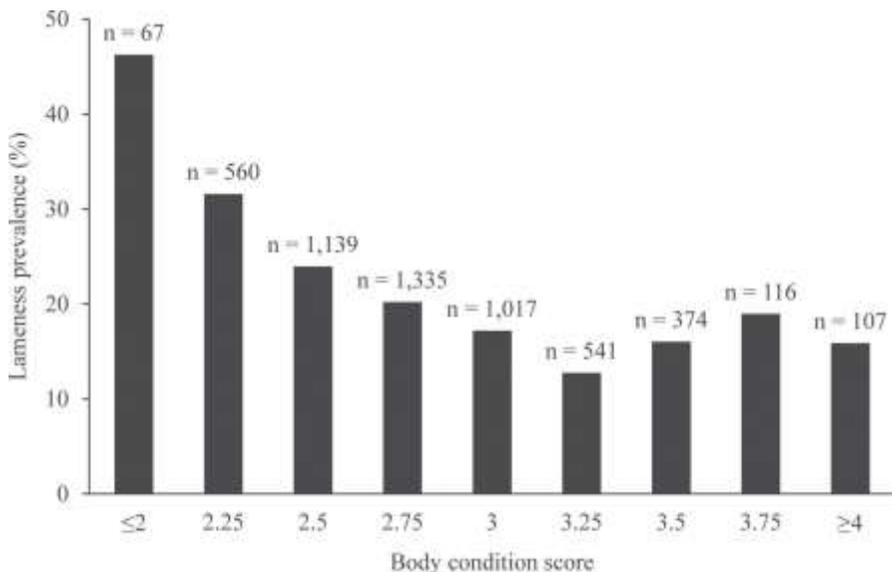


Figure 2: Percentage of lame cows per BCS category (n = number of cows per category). From Solano et al 2015.

■ Why Do We Need to Detect Lamé Cows?

Detection of lameness has one major goal: to identify cows that would benefit from intervention or treatment. Although some early stage claw lesions may be difficult to detect based on gait, others, for example sole ulcers, can be prevented at an early stage using anti-inflammatory treatment to prevent severe lameness. Therefore, early recognition and prompt treatment may indeed lead to a full or partial cure. Conversely, failure to treat may cause a cow to become chronically affected and more difficult to treat, thereby reducing productivity and increasing the risk of premature culling. Many experts emphasize early detection and early intervention (Bell, 2016), as continuous treatment of cows with abnormal locomotion will decrease the prevalence of claw lesions. For example, white line disease is associated with chronic lameness and would benefit from regular lameness scoring and early intervention (Schulz et al. 2016).

AHDB-dairy (agriculture and horticulture development) from the UK recommends daily observations. Careful assessment of all cows is important to recognize changes in the way individual cows move, their ability or willingness to walk or stand up, and to detect changes that indicate health or lameness issues. Daily observation makes you more familiar with cow movements and better able to identify more subtle changes common of lame cows, as opposed to cows that become suddenly lame due to injury or acute illness. Daily observation may not be realistic for most producers, although we learned in our study that most people undertake lameness observations when moving cows to the milking parlor.

If our goal is to detect a cow that would benefit from an intervention, like treatment, we must realize that lameness observation is not perfect. This is referred to as the sensitivity of the diagnosis. If a test, like lameness observation, is not very sensitive, we are not able to detect all cows that are lame. This problem is referred to as a false negative outcome. However, few cows that are not lame will be falsely identified as lame – the so-called false positives. Therefore, whenever a cow is detected lame, she very likely is lame (positive predictive value is high) and would benefit from treatment. Conversely, not all cows that don't show obvious lameness signs are not lame (negative predictive value is low) and won't be treated where treatment could be beneficial.

■ How Do We Detect Lamé Cows?

Lameness can be detected through careful visual inspection, including stance and movement. From a distance, look carefully at each cow's back, shoulder, pelvis and major limb joints. Cows are usually more difficult to examine than horses as most are not halter broke, they don't tolerate limb handling, and we

cannot force cows to walk or trot to examine them – especially since flooring usually puts them at risk of falling (Desrochers et al. 2001).

When observing cows in their normal environment, the following aspects need to be considered (Van Nuffel et al. 2015):

- Inconsistency (scoring is not very precise and is open for interpretation)
- Alley way observation is needed to see enough undisturbed strides
- Manure on the floor will affect strides
- Avoid social interactions between cows, as it changes behavior
- Observer presence and behavior should not affect cow movement
- Cows are prey animals and often conceal lameness signs. Recognizing clinical signs of lameness needs training (and re-training)
- Impact of udder size: a full or edematous udder will alter a cow's gait, but is not due to lameness
- Producers with robotic milking need a strategy around when and how to observe cows in the barn without excessive disturbance.

With visual appraisal of clinical signs of lameness being difficult, the producer can decide to use automated equipment to detect lame cows. Producers tend to be motivated to introduce equipment, as it outperforms visual inspection (Van De Gucht et al. 2017). This equipment is either focused on detecting altered gait directly related to lameness (e.g. number of steps, stride length, etc) or indirectly detecting lameness due to altered behavior (reduced feed intake or milk production).

Many methods are tested under experimental conditions but not in field conditions (e.g., floor plates and weighing platforms). However, pedometers/accelerometers and activity meters are common. Pedometers mainly measure the number of steps taken, with an increase most often triggered by estrus behavior. More useful is identifying a decreased number of steps due to lameness, particularly when linked to milk recording systems that measure changes in milk yield levels. However, this behavior is not necessarily specific to lameness and can be detected in most illnesses.

In our study in Canada, we used accelerometers (Hobo's). These devices can detect the total lying time per day, number of times a cow is rising (lying bouts), as well as the length of the lying session (lying bout duration). When analysing the value of these three measures to detect lameness, when compared to video recordings of cow movement, lame cows were lying down for fewer but longer lying bouts. Cows lying down for more than 14 h/d, or < 5 lying session or more sessions of more than 110 min, were three times more

likely to be lame. Regardless, we concluded accelerometers needed to be interpreted in the context of knowledge of cow specific characteristics (e.g. parity and DIM) (Solano et al. 2016).

Examples of equipment to detect indirect behavioral changes are monitors for feeding and drinking behavior. Combined with altered mobility (i.e. less standing time, fewer steps, slow and shorter strides), lame cattle eat and ruminate significantly less than their counterparts. Although this report was done under almost perfect experimental conditions, it was still only able to detect 90% of the lame cows (> score of 2.5/5), with 10% of cows falsely identified as lame (Beer et al. 2016).

Unfortunately, many systems have difficulty correctly identifying the lame cow, and therefore can aid in lameness detection, but not replace visual scoring.

Technology can be of particular use for earlier detection of lame cows. Pressure-sensing platforms installed in parlor exit alleyways or AMS have shown some success. They automatically identify individual cows as they measure force and duration of the cow's steps, and analyse or score the cow. Special software then identifies cows as 'early lame'. Early detection and treatment of cows would prevent the cows from becoming more severely or chronically lame. Good recording systems of either visual or technologically identified lame cows, including their treatment, will also help evaluate treatments and improve decisions if chronic lameness has developed.

■ How Do We Know What Causes the Lameness?

As was mentioned earlier, lameness can be caused by any painful injury or infection. Although claw lameness is very common in our cattle, all components of the musculo-skeletal apparatus can cause lameness. In calves for example, lameness due to joint infections (arthritis) are more common compared to claw diseases. However, in beef cattle, injuries due to rough handling of animals or restraint in handling chutes results more commonly in injury-related lameness.

Besides the type of animal, we can also use the type of lameness to help identify cause. Two types of lameness that should be differentiated are weight bearing and non-weight bearing lameness. Alternatively, they are also called swinging limb and supporting limb lameness (Cockcroft, 2016).

Non-weight bearing lameness is often associated with sole abscess, fracture, critical joint luxation, tendon or ligament injury, nerve injury or arthritis. A confusing category can be the abnormal deviation as a result of fractures and luxations. With claw diseases being most prevalent, we can notice that cows don't want to put weight on the affected claw – more often the outer claw.

Finally, a close inspection of the animal and the claw will help define the cause of lameness. It is very important that we get the diagnosis right; the wrong therapy will not allow the cow to recover and likely leading to more chronically lame cows and reduced animal welfare.

Close inspection should start with an observation while walking, with a focus on posture, standing, actions, conformation, gait, foot, limbs, bones, muscles and tendons. It should help us identify the affected leg and locate the lesion (i.e. upper leg or foot). The second part should focus on observation while the animal is in recumbency or rising. Special attention should be paid to posture, conformation and symmetry. When looking for symmetry, a comparison between left and right is very useful to identify deviations. The final step would include a lift of the foot and careful inspection of claw, including identification of painful areas.

As lameness is a common disorder, investment in a restraint box or chute system positioned in such a way that it is easy to move a cow in facilitates a good diagnosis and proper treatment in a timely manner! If a restraining option is not available, a simple rope restraint will allow for inspection of the foot. The so-called beam hook method starts with restraining the cows head to the opposite side of whichever leg is to be lifted. Roping is shown in Figure 3.

Careful inspection combined with information on onset, duration and signs observed, whether the condition affects just one or many animals in the herd, whether the condition is mild or severe and static or progressively getting worse will ultimately allow for a clear diagnosis and treatment plan.

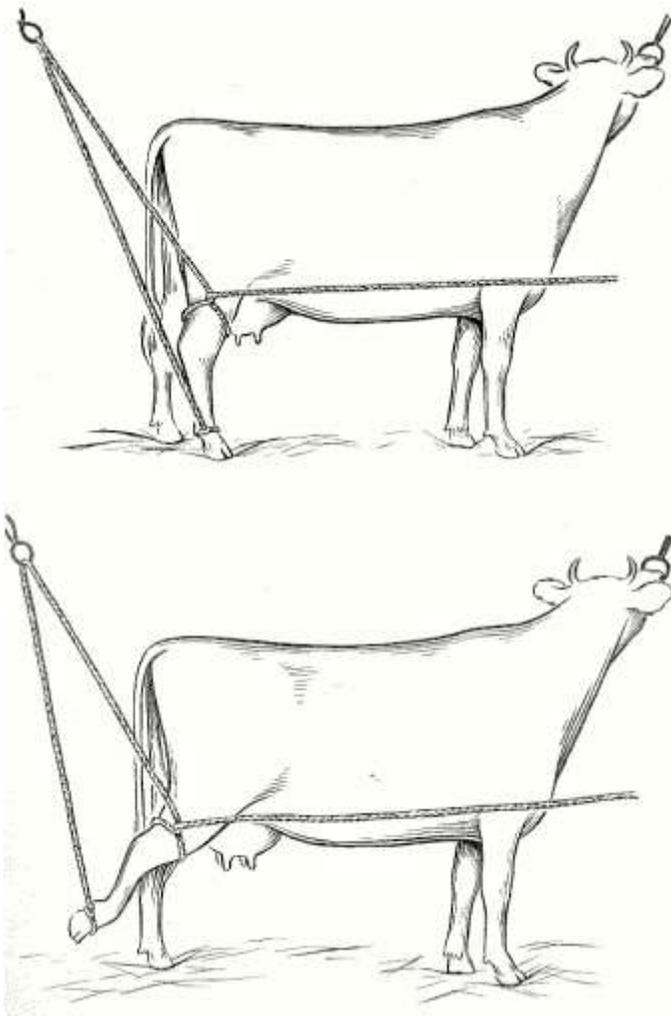


Figure 3: Beam hook rear leg lifting. Source <http://cal.vet.upenn.edu/projects/fieldservice/Dairy/COWRESTR/beamhook.gif>

■ Resources

Websites

<https://www.rvc.ac.uk/research/research-centres-and-facilities/structure-and-motion/projects/automated-early-lameness-detection-in-dairy-cattle>

<http://dairyhoofhealth.info/>

<https://www.zinpro.com/lameness/dairy/locomotion-scoring>

<https://www.dairyfarmers.ca/proaction/resources/animal-care>

<https://dairy.ahdb.org.uk/technical-information/animal-health-welfare/lameness/#.WgSQNkUrLwc>

<https://www.youtube.com/watch?v=MgxGSBEVYWY>

Apply a rope for hind leg lift

Books

Hoof signals: http://www.roodbont.nl/en/bookshop/15_Koesignalen/96-228_Hoof-Signals

Bovine Laminitis and Lameness: A hands-on approach. Edited by: Paul R Greenough, FRCVS
ISBN: 978-0-7020-2780-2

References as included in the text

- Beer G, Alsaad M, Starke A, Schuepbach-Regula G, Muller H, Kohler P, et al. Use of Extended Characteristics of Locomotion and Feeding Behavior for Automated Identification of Lamé Dairy Cows. *PLoS One*. 2016;11(5):e0155796.
- Bell NJ. Vet stresses the importance of early detection of lameness in cattle. Dugdale nutrition meeting, Settle, UK. 2016.
- Jackson, Cockcroft. *Clinical examination of farm animals*: Blackwell Publishing; 2016.
- Desrochers A, Anderson DE, St-Jean G. Lameness examination in cattle. *Vet Clin North Am Food Anim Pract*. 2001;17(1):39-51, v-vi.
- Higginson Cutler JH, Rushen J, de Passillé AM, Gibbons J, Orsel K, Pajor E, et al. Producer estimates of prevalence and perceived importance of lameness in dairy herds with tie-stalls, free-stalls and automated milking systems. *Journal of Dairy Science*. 2017;submitted.
- Newsome RF, Green MJ, Bell NJ, Bollard NJ, Mason CS, Whay HR, et al. A prospective cohort study of digital cushion and corium thickness. Part 2: Does thinning of the digital cushion and corium lead to lameness and claw horn disruption lesions? *J Dairy Sci*. 2017;100(6):4759-71.
- Schulz T, Gundelach Y, Feldmann M, Hoedemaker M. Early detection and treatment of lamé cows. Effect on duration and prevalence of lesion-specific lameness. *Tierarztl Prax Ausg G Grosstiere Nutztiere*. 2016;44(1):5-11.
- Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Zaffino Heyerhoff JC, et al. Prevalence of lameness and associated risk factors in Canadian

- Holstein-Friesian cows housed in freestall barns. *J Dairy Sci.* 2015;98(10):6978-91.
- Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Nash CG, et al. Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. *J Dairy Sci.* 2016;99(3):2086-101.
- Van De Gucht T, Van Weyenberg S, Van Nuffel A, Lauwers L, Vangeyte J, Saeyns W. Supporting the Development and Adoption of Automatic Lameness Detection Systems in Dairy Cattle: Effect of System Cost and Performance on Potential Market Shares. *Animals (Basel).* 2017;7(10).
- Van Nuffel A, Zwertvaegher I, Pluym L, Van Weyenberg S, Thorup VM, Pastell M, et al. Lameness Detection in Dairy Cows: Part 1. How to Distinguish between Non-Lame and Lame Cows Based on Differences in Locomotion or Behavior. *Animals (Basel).* 2015;5(3):838-60.



Gait Scoring System for Dairy Cows

Score	Description	Behavioural Criteria
1 Sound	Smooth and fluid movement	<ul style="list-style-type: none"> • Flat back when standing and walking • All legs bear weight equally • Joints flex freely • Head carriage remains steady as the animal moves
2	Ability to move freely not diminished	<ul style="list-style-type: none"> • Flat or mildly arched back when standing and walking • All legs bear weight equally • Joints slightly stiff • Head carriage remains steady
3	Capable of locomotion but ability to move freely is compromised	<ul style="list-style-type: none"> • Flat or mildly arched back when standing, but obviously arched when walking • Slight limp can be discerned in one limb • Joints show signs of stiffness but do not impede freedom of movement • Head carriage remains steady
4	Ability to move freely is obviously diminished	<ul style="list-style-type: none"> • Obvious arched back when standing and walking • Reluctant to bear weight on at least one limb but still uses that limb in locomotion • Strides are hesitant and deliberate and joints are stiff • Head bobs slightly as animal moves in accordance with the sore hoof making contact with the ground
5 Severely Lame	Ability to move is severely restricted Must be vigorously encouraged to stand and/or move	<ul style="list-style-type: none"> • Extreme arched back when standing and walking • Inability to bear weight on one or more limbs • Obvious joint stiffness characterized by lack of joint flexion with very hesitant and deliberate strides • One or more strides obviously shortened • Head obviously bobs as sore hoof makes contact with the ground

source: University of British Columbia Animal Welfare Program

Taken from Alberta's Humane Handling of Dairy Cattle - Standards for the Transportation of Calf Animals, original source: University of British Columbia Animal Welfare Program.



