Biomechanics and Lameness in Dairy Cattle

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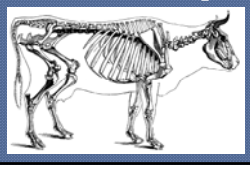


What do we know?

- Cattle evolved walking on earthen surfaces

What do we know?

- Now, most dairy cattle live in nice drylots or freestalls

What do we know?

- Or sometimes, not so nice drylots and freestalls

Lameness is increasing

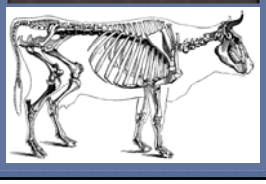
- Pasture – less lameness
- Drylots – intermediate lameness
- Freestalls (concrete) – most lameness
  - 3 well-managed dairies in the central valley have from about 35-55% of the cows lame per year

What does lameness cost?

- Each case of clinical lameness costs $300-$400
  - Decreased milk 4 months before and 5 months after lameness event (UK)
  - Lactational incidence estimates are from 30-60%
- At 30% the producer loses more than $90/cow/lactation
  - This is enough to support preventive measures

Where do lameness causing lesions occur?

- Mostly on the feet
  - Mostly rear feet
    - Mostly lateral (outside) claws
- Front leg soft connection
- Rear leg solid connection

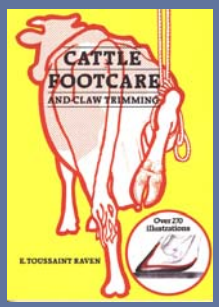


Cows can do 3 things

- Stand up
- Walk
- Lie down (12-14 hours/day)

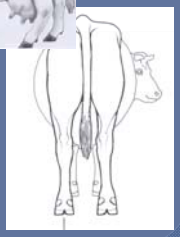
Adrian: "While a cow is lying down, there is no force acting at the extremity so there are no chances of getting lame."

E. Toussaint Raven, 1985



Biomechanics according to Toussaint Raven

~60% of cows weight is on front limbs

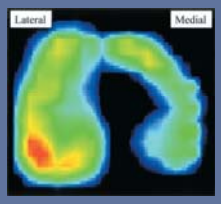


Cow standing squarely
- ❖Her weight is evenly distributed between the medial and lateral claws.

When cow moves side to side, proportionately more weight is on lateral claw

Biomechanics according to Rik van der Tol (2004)

- Force plate: standing cows
- Front claws 50:50 weight distribution
- Rear claws
  - Before trimming 80:20
  - After trimming 70:30
- Most weight on lateral sole

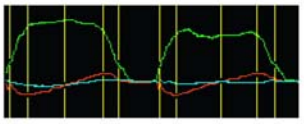


van der Tol et al. J. Dairy Sci. 2002; 85:1476

Force plate – cow walking

a) Ground reaction forces of a measurement of the left fore and hind limb.

|-- forelimb --| |-- hind limb --|

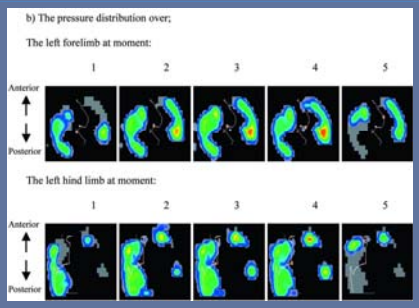


1 2 3 4 5 1 2 3 4 5

1 = Heel strike
2 = Maximum braking
3 = Midstance
4 = Maximum propulsion
5 = Push off

van der Tol et al. 2003 J. Dairy Sci. 86:2875.

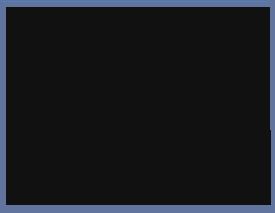
Force plate - cow walking



van der Tol et al. 2003 J. Dairy Sci. 86:2875.

Heifer walking

- 18 Brown Swiss heifers
  - 12 months old
  - 840 lbs.
  - Before and after trimming
- 500 frames/second



Meyer, Weishaupt, Nuss. 2007. J. Dairy Sci 90:670.

Front feet

- Front feet from straight ahead

Meyer, Weishaupt, Nuss. 2007. J. Dairy Sci 90:670.

Right front

- Front feet from side

Meyer, Weishaupt, Nuss. 2007. J. Dairy Sci 90:670.

Rear feet

- Oblique angle

Meyer, Weishaupt, Nuss. 2007. J. Dairy Sci 90:670.

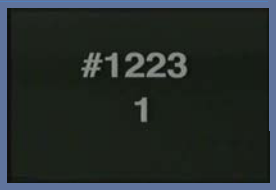
Right rear

- From side

Meyer, Weishaupt, Nuss. 2007. J. Dairy Sci 90:670.

Locomotion score 1 cow

- Flat concrete
- Slightly wet with layer of sand (good footing)



SL Berry, UCDavis & Zinpro Corp, 2002

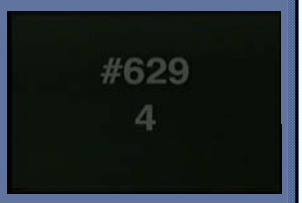
Locomotion score 3 cow

- Flat concrete
- Slightly wet with layer of sand (good footing)

SL Berry, UCDavis & Zinpro Corp, 2002

Locomotion score 4 cow

- Flat concrete
- Slightly wet with layer of sand (good footing)



SL Berry, UCDavis & Zinpro Corp, 2002

Summary of what we know:

- Concrete is not good for cows' feet
- Moisture softens horn and increases wear
- Cow strikes on heels
  - Weight is evenly distributed in front
  - Lateral, rear claw supports 70-80% of weight
  - Functional trimming will decrease average force but not maximum force
  - Beneficial effects of functional trimming are short-lived

Summary of what we know:

- Cows on concrete support most weight on soles (not wall, as on rubber or pasture)
- Increased weight bearing on lateral claw causes faster growth

Summary of what we know

- Heel horn and digital cushion are important for sound feet

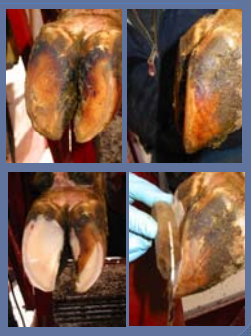
HARD
soft
HARD

What are preventive measures?

- Functional claw trimming
- Hygiene, hygiene, hygiene!
- Cow comfort
- Soft flooring, especially in critical areas
  - Stockmanship when moving cows
- Nutrition and feeding management

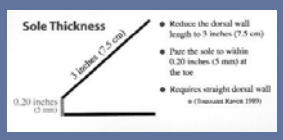
Functional claw trimming

- According to the "Dutch method"
  - Claws are trimmed flat and square (to the leg) to maximize the surface area
  - Claws are balanced
  - Spare the medial heel
  - Axial sole is "modeled" to open up the interdigital space and take pressure off of the "typical site"



Claw Trimming - US study

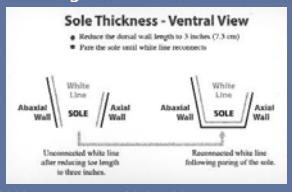
- The Dutch method versus another:
  - The "Dutch Method" had very few thin soles
    - Trim medial claw to 3 inches
    - Spare medial heel
    - Match lateral claw to medial claw



van Amstel, et al. 2002 Bovine Pract. 36(2):136

US study

- The Dutch method versus another:
  - The other method trimmed medial claw to 3" and pared sole until white line was continuous
    - Large percentage thin soles



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Swiss study

- Post mortem study, normal hind feet
- All trimmed to 5 mm at toe, 8 mm at heel
- Toes same length (just over 3 inches)

Nuss & Paulus. 2006. Vet. J. 172:284

Swiss study

- But…lateral claw was "thicker"
- Found lateral condyle longer
- When lateral claw was trimmed to same thickness (balanced)
  - Lateral sole too thin

Nuss & Paulus. 2006. Vet. J. 172:284

Functional trimming:

- "Dutch method" is conservative
- Must pay attention to sole thickness
- Preserve medial heel

Hygiene

- Moisture softens horn, increases wear
- Manure slurry contributes to heel erosion, digital dermatitis, and footrot
- Cow strikes on heel when walking

Hygiene

- Cow strikes on heel when walking

Cow comfort

- Clean, comfortable, dry place to lie down
- Every cow has a stall
- Lying time 12-14 hours/day

Softer flooring

- Cows on rubber bear weight on wall of claw
- Growth and wear are slower
- Fewer lame cows
- Lameness less severe, recover faster

Finis