Biomechanics and Lameness in Dairy Cattle

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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.”
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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

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

Force plate – cow walking

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

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

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

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  

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

Heel horn and digital cushion are important for sound feet
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

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

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)

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


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