Comparing agreement between methods of lameness detection in Holstein Friesian dairy cattle

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Introduction

- Lameness still 1 of top 3 reasons for culls in UK
- DairyCo recommends weekly mobility scoring
- UK dairy farms decreasing in number but increasing in size
- Time consuming
- Is automated detection the answer?
Aims

- Explore force plate lameness detection
- Compare ground reaction forces to lesions
- Recommend viable on-farm practices
- Reduce timeframe for treatment
Methods and Materials

- 5 force plates
- Built into parlour exit
- Walked over twice daily
- Cows electronically tagged
- Weekly mobility scores
- Distal limb radiographs
- Foot trim
- Lesion score (Bergsten 1995)
Data gathered

**Ground Reaction Forces (GRF)**
- Stance Time (ms)
- Load Rate (N/ms)
- Centre of pressure travel (mm):
  - (x) Forward/Backward
  - (y) Sideways
  - (COP) Total travel

COP
# Data gathered

<table>
<thead>
<tr>
<th>Lesion Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No haemorrhage</td>
<td>0</td>
</tr>
<tr>
<td>Slight haemorrhage (small area)</td>
<td>1</td>
</tr>
<tr>
<td>Slight haemorrhage (large area)</td>
<td>2</td>
</tr>
<tr>
<td>Moderate haemorrhage (small area)</td>
<td>3</td>
</tr>
<tr>
<td>Moderate haemorrhage (large area)</td>
<td>4</td>
</tr>
<tr>
<td>Severe haemorrhage (small area)</td>
<td>4</td>
</tr>
<tr>
<td>Severe haemorrhage (large area)</td>
<td>5</td>
</tr>
<tr>
<td>Exposed Corium</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radiographic Pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteophyte(s)</td>
</tr>
<tr>
<td>Remodelling</td>
</tr>
<tr>
<td>Osteitis</td>
</tr>
<tr>
<td>Horn disruption</td>
</tr>
<tr>
<td>Severity 0-3</td>
</tr>
</tbody>
</table>
Statistical analysis

Fixed model analysis run in ASReml

Model used

GRF = mu + parity + foot + (RS or SL)

GRFs include load rate, stance time, forward movement, sideways movement and COP
## Results: GRFs vs Limb damage

<table>
<thead>
<tr>
<th></th>
<th>Forward (mm)</th>
<th>Sideways (mm)</th>
<th>Stance Time (ms)</th>
<th>Load Rate (N/ms)</th>
<th>COP (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>87.9</td>
<td>66.3</td>
<td>253</td>
<td>40.2</td>
<td>124</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>40.2</td>
<td>23.2</td>
<td>46.2</td>
<td>12.6</td>
<td>46.1</td>
</tr>
<tr>
<td><strong>Solar Lesion Score</strong></td>
<td>-</td>
<td>*</td>
<td>-</td>
<td>**</td>
<td>* Left</td>
</tr>
<tr>
<td><strong>Radiographic Pathology Score</strong></td>
<td>-</td>
<td>* Right</td>
<td>* Left</td>
<td>* Left</td>
<td>*</td>
</tr>
</tbody>
</table>

* = $P < 0.05$

** = $P < 0.01$
Results: Lesion Score effect on Load Rate

Rate of loading decreases as solar ulcer severity increases
Conclusions

Significant association between certain GRFs and clinical limb damage

- Load rate and stance time especially

More reliable lameness indicator than radiographs

Force plates can highlight limb/foot pathology
Further investigation

- Predict lame feet using GRF thresholds
- Larger study group: more “damaged” limbs
- Study contralateral limb compensation
Thank you for listening

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