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# Embedded Micro-Computer Base Force Plate as an Objective Tool to Measure Hoof Lameness Phases in Multiparous Sows

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### Summary and Implications

The objective of this study was to compare differences in weight placed on each hoof from sows in differing lameness phases. Twelve, clinically healthy, mixed-parity, crossbred sows (228.89±19.17 kg) were used. The sow was the experimental unit and a cross-over design with a 2 (hind left and hind right hoof) x 3 (days: D-1, D+1 and D+6) factorial arrangement of treatments were compared. On induction day, 10 mg of amphotericin B were injected in the distal interphalangeal joint space in both claws of one hind hoof. All sows served as their own control and treatment. After completion of the first round, sows were given a 7-day rest period and then the round procedures were repeated with the opposite hind hoof induced. Sows stood individually on an embedded force plate for 15 minutes, and weight on each hoof was measured independently. All data were statistically analyzed using the PROC MIXED procedure in SAS. On the D+1, sows exhibited less weight bearing on the induced lame hoof compared to D-1 ($P < 0.0001$). Regardless of which hoof was injected, sow weight distribution did not vary between the injected left or right hind hooves ($P = 0.99$) or between rounds ($P = 0.64$). Findings from our study indicate that the embedded force plate exhibited differences between sound and most lame phases indicating the potential as an objective tool for detecting differences in weight distribution when sows are sound and lame.

### Introduction

Lameness has been ranked as the number 3 reason in the U.S. for culling sows (15%). Today, U.S. producers primarily treat sow lameness using husbandry tools, for example housing sows individually to enable access to feed and water, and/or the provision of mats. Currently, producers assess sow lameness using subjective scoring systems, which have been shown to be variable in their application and conclusion. Objective tools to measure sow lameness on farm are required. Therefore, the objective of this study was to compare differences in weight distribution on each hoof from sows in varying lameness phases.

### Materials and Methods

***Animals and housing:*** This project was approved by the Iowa State University IACUC. Twelve, apparently healthy, mixed-parity, crossbred sows (228.89±19.17 kg) were purchased from a commercial producer in Iowa. To avoid injury due to aggression, sows were housed in individually. Each sow was housed in a concrete pen providing 5.1 $m^2$ and a 0.6 m deep concrete ledge along the rear wall of the pen where sows were fed. A rubber mat was provided for sow comfort. All sows were fed twice daily to meet their dietary requirements. Sows had *ad libitum* access to water via one nipple drinker that was positioned over a grate. Pens were set up in two rows with a central aisle and allowed for nose to nose contact with cohorts. Lights were on a 12:12 light dark cycle with light hours between 0600 and 1800. Sows were acclimated for 10 days before any treatments were applied. The research was conducted July-August 2011.

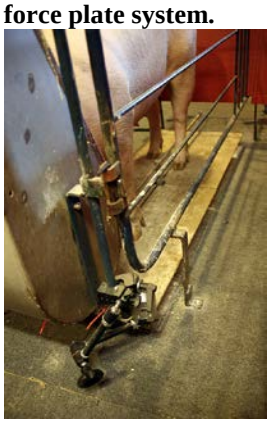
***Experimental design and treatments***: The sow was the experimental unit. A cross over design with a 2 (hooves: right hind and left hind) x 3 (days: D-1, D+1 and D+6) factorial arrangement of treatments were compared. Three days were compared: ***D-1*** (sound phase; defined as 1 day pre-induction of lameness); ***D+1*** (most lame phase; defined as 1 day post-induction of lameness) and ***D+6*** (resolution phase; defined as 6 days after the induction of lameness). All sows served as their own control and treatment. After completion of the first round of induction, sows were given a 7-day rest period and then a second round was conducted with the opposite hind hoof induced.

***Induction of Lameness:*** All sows were restrained in a standing position using a humane pig snare and then anesthetized using a combination of Xylazine (4.4 mg/kg), Ketamine HCl (2.2 mg/kg), and Tiletamine HCL and Zolazepam in combination (Telazol®;4.4 mg/kg) administered IM. The assigned hind claws to be injected were washed with mild soap and water to remove obvious fecal contamination, scrubbed for 3 minutes with iodine based surgical scrub using 10 x 10 cm sterile gauze pad, and rinsed with 70 % isopropyl alcohol until no evidence of the

surgical scrub remains. Ten mg of amphotericin B were injected in the distal interphalangeal joint space in both claws of one hind hoof. All sows were monitored continuously until fully recovered.

***Data Collection:*** The embedded microcomputer based force plate system measured 1.5 m x 0.57 m x 0.11 m (length x width x height) and had a 6.4-mm thick aluminum plating on each load cell. Each load cell measured 0.76 m x 0.28 m (length x width). A separation bar divided the area in half to limit the sow from placing more than one hoof on individual load cells. Each load cell was accurate to 0.45 kg and was calibrated between sows. Weight distribution on each of the 4 hooves was collected twice per second for a total of 15 minutes on each of the 3 days. Sows had free access to feed during this data collection (Figure 1).

**Figure 1. Sow on the embedded microcomputer-based force plate system.**



***Statistical Analysis:*** PROC UNIVARIATE determined that data was normal. Data were analyzed using the PROC MIXED procedure in SAS. The model included round, and the interaction of leg by day (leg defined as the measurement of weight placed on a hoof). Two separate models were used, one for right hind (RH) induction and one for left hind (LH) induction. A separate model was used for assessing differences between round and hoof induced. This model included round, hoof (left or right hoof induced) and the interaction of leg*day. Sow within day and sow within round were fit as random effects. A PDIFF was used to determine differences and a $P$ value of $\leq 0.05$ was considered significant.

## Results and Discussion

No differences were observed for sows that had lameness induced in the left vs. right hoof (57.13 ± 1.45 and 57.10 ± 1.46 kg; $P = 0.99$) or between first and second rounds of induction (56.62 ± 1.46 and 57.61 ± 1.45 kg; $P = 0.64$). On the D+1, sows exhibited less weight bearing on the injected hoof compared to D-1($P < 0.0001$; Table 1). On D+6, sows placed less weight on the lame hoof compared to D-1 ($P < 0.0001$) but were resolving to sound phase levels. Findings from our study indicate that the embedded force plate tool exhibited differences between sound and most lame indicating the potential as an objective tool for detecting differences in weight distribution when sows are sound and lame. However, because sows did not return to baseline levels by resolved day lameness model modification may be needed to establish resolution of lameness using this tool.

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**Table 1. Weight distribution on hooves for D-1, D+1 and D+6 for the Prototype Embedded Microcomputer-based force plate system**

| | | Day | | |
|---|---|---|---|---|
| **Hoof induced** | **Hoof** | **D-1** | **D+1** | **D+6** |
| LH | LF | 64.48 ± 2.32[a] | 68.90 ± 2.40[a] | 67.55 ± 2.32[a] |
| | RF | 69.62 ± 2.32[a] | 68.77 ± 2.40[a] | 70.15 ± 2.32[a] |
| | LH | 49.10 ± 2.32[a] | 32.72 ± 2.40[b] | 36.13 ± 2.32[b] |
| | RH | 48.00 ± 2.32[a] | 53.51 ± 2.40[b] | 55.97 ± 2.32[b] |
| RH | LF | 63.95 ± 2.18[a] | 67.67 ± 2.18[a] | 67.06 ± 2.18[a] |
| | RF | 70.18 ± 2.18[a] | 69.51 ± 2.18[a] | 72.28 ± 2.18[a] |
| | LH | 46.94 ± 2.18[a] | 55.58 ± 2.18[b] | 56.00 ± 2.18[b] |
| | RH | 50.08 ± 2.18[a] | 30.82 ± 2.18[b] | 35.43 ± 2.18[b] |

[ab]Within a row, means without a common superscript differ ($P < 0.05$)