

# Use of Three-Dimensional Accelerometry for Non-Contact, Continuous Characterization of Behavior Using an Induced Arthritis Model in Calves

**B. Robert, BS; B. White, DVM, MS; D.E. Anderson, DVM, MS, DACVS; K. Schulz, DVM**  
*Agricultural Practices, College of Veterinary Medicine, Kansas State University, Manhattan, KS 66506*

## Introduction

Objective assessment of lameness is preferred to subjective assessment. There are few modalities that allow for both objective and non-contact assessment of lameness. The purpose of this trial was to evaluate two novel diagnostic tools, accelerometry and thermography, for lameness detection. We hypothesized that tri-axial accelerometry and thermography would allow for objective and non-contact assessment of lameness in calves.

## Materials and Methods

Tri-axial accelerometers were placed on the left hindlimb of ten 6-month-old calves before induction of lameness. The acceleration of the limb in space and relative orientation of the limb were recorded. Activity levels were continuously monitored for 24 hours before arthritis induction and for 24 hours post-induction. At time 0, amphotericin B was injected into the lateral distal interphalangeal joint of the left hindlimb of the calves, with two calves serving as controls. Thermographic images of the affected limb were obtained at 0, 6, 12, and 24 hours post-injection. Ratios of coronary and hoof wall mean surface temperatures were compared between the injected and non-injected claw. A previously developed classification algorithm was used to assign accelerometer data to one of three behaviors (standing, walking, or lying). General linear models were used to compare percent of time in each activity by hour of the study. Thermography data was analyzed using ANOVA with repeated measures. Significance was considered when  $P < 0.05$ .

## Results

Induction of arthritis in the lateral distal interphalangeal joint of the treated calves resulted in Grade 2

lameness in all injected calves within the first six hours of the study. The arthritis tapered in intensity at a variable rate over the course of 24 hours. Accelerometry data revealed that calves having arthritis spent more time lying down (LSM  $\pm$  SE, 53.7%  $\pm$  3.1%) during the 24 hours post-induction as compared to pre-induction (43.1%  $\pm$  2.0%). When not recumbent, arthritis post-induction calves spent more time walking (7.9%  $\pm$  0.5%) compared to pre-induction activity levels (4.7%  $\pm$  0.4%). A significant interaction was noted between the amount of time spent standing by hour of the day and readings taken pre and post arthritis induction. Calves spent less time standing after arthritis induction and this effect was more apparent during times when they were normally standing a large percent of the time (daylight hours: 8 am to 8 pm). The ratios of the coronary band and proximal hoof wall temperature to the medial claw temperatures were calculated for 0, 6, 12, and 24 hours. Proximal hoof wall means and standard deviations for 0, 6, 12, and 24 hours: 1.028  $\pm$  0.030, 1.032  $\pm$  0.041, 1.024  $\pm$  0.023, 1.063  $\pm$  0.033, respectively. Thermal ratio mean and standard deviations for 0, 6, 12, and 24 hours were 1.022  $\pm$  0.043, 1.010  $\pm$  0.025, 1.019  $\pm$  0.032, 1.030  $\pm$  0.074, respectively). There were no statistically significant thermographic differences between the laterally injected claw and the medial claw.

## Significance

Three-dimensional accelerometric analysis allowed for objective, non-contact analysis of lameness. Analysis of accelerometry data revealed statistically significant differences in activity in feedlot calves with transient arthritis, including increased time lying down and increased time walking when not recumbent. Marked differences in activity were associated with time of day. Most activity occurred during daylight hours. Thermography revealed the amphotericin model to produce a mild degree of inflammation.