Study – Solar Asymmetry of the Pedal Bone

Materials and Methods

Cadaver limbs were dissected and boiled to obtain fifty-five pedal bones (9 left front, 14 left rear, 21 right front, and 11 right rear). Pedal bones were photographed on a black back drop with markers used for scale. The bone was positioned so the edge of P3 was parallel with the camera plane (Image A).

Images were analyzed using Metron software. For image analysis points were selected from the widest part of the bone around the toe and back to the opposite side (Image B). A vertical line was placed with one end at the extreme distal point of the lunar crest structure, and the other point as close to the centerline of the lunar crest structure. A numerical optimization algorithm was used to "best fit" a 3-parameter ellipse to the periphery of the bone, with the constraint that the major axis pass through the extreme distal point of the lunar crest curve. A line was drawn from the central line to the widest part of the bone on the medial and lateral side that distance was used for analysis.

Asymmetry between the medial and lateral side was assessed using a paired t-test. An asymmetry index was also calculated using published methods (Mays et al) to illustrate the percentage of size difference between the medial and lateral sides. Significance was set at $P<0.05$.

Results

The results are displayed as the mean ± standard error of the mean (SEM). The average difference between the medial and lateral sides of the pedal bone was 0.186 ± 0.019 cm. The average ASI was 4.42% ± 0.43%. The lateral side of the hoof was on average 4.42% wider than the medial side. This difference was significant ($p<0.001$).

Discussion

The group of pedal bones used in this study had an almost uniform asymmetry in that all but one bone was greater in width on the lateral side. Of those bones that had a greater width on the lateral side 8 had an asymmetry of less than 1%, which could be considered symmetrical. Twenty-six bones had an asymmetry of 1-5% and 12 bones had an ASI of greater than 5%.

Figure 1: A pedal bone prepared for photographing.

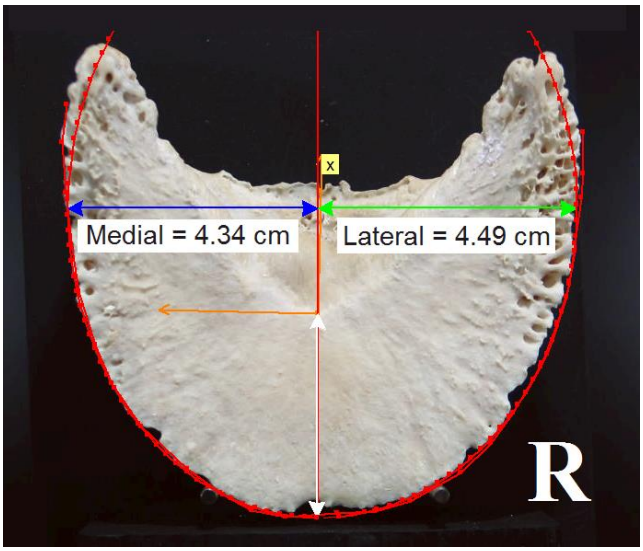

Figure 2: A pedal bone fitted with the 3-perimeter ellipse and marked for measurement.

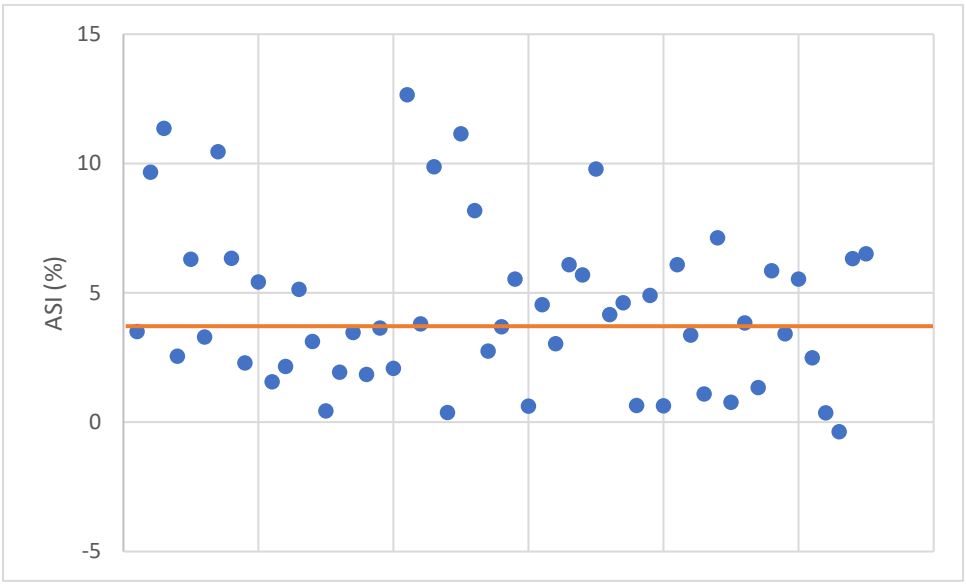

Figure 3: A graph of the asymmetry index (ASI) for all the pedal bones. Each blue dot represents one bone. The red line indicates the mean ASI. The shaded area the standard error of the mean (SEM).

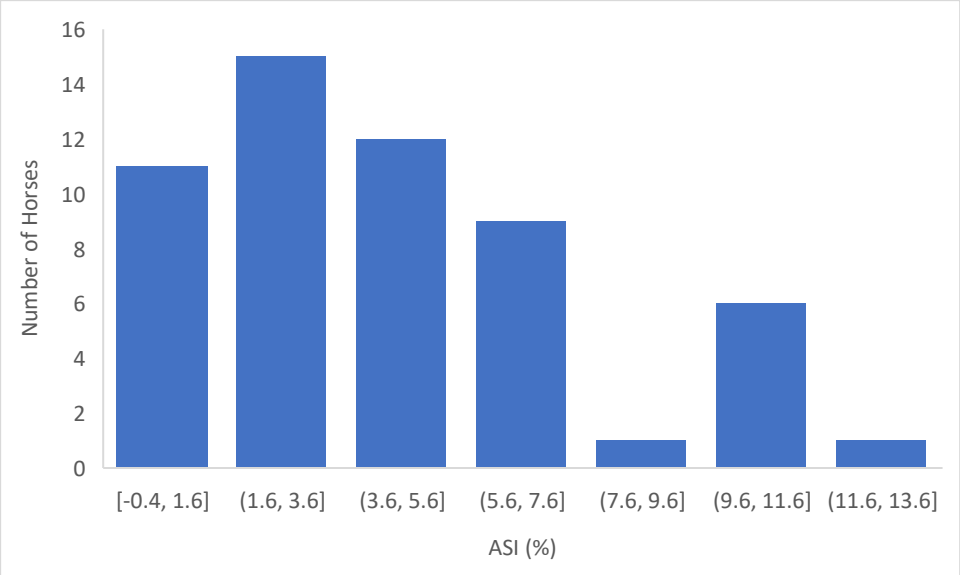

Figure 4: A histogram displaying the number of horses in each ASI category, showing that around 10 horses had an ASI of less than 1% and a larger number of horses had an ASI of between 1% and 8%. Only a few horses had an ASI of greater than 10%.