Characterization and Symmetry Study of Objective Feet and Leg Joint Measurements in Five Separate Lines of Maternal Gilts

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Summary and Implications

This study involves the initial measurement and joint description of five maternal gilt lines for the validation of objectively measured feet and leg joint angles in regards to sow longevity. The initial measurement was used to characterize all gilts used in the study based on age and line as well as to study the symmetry between the left and right sides of the animals' body. Significant differences ($P < 0.05$) between lines were identified in both pasterns. Results suggest ($P < 0.05$) that the knee and the hock angles increase with age. Symmetry difference, difference between right and left, ($P < 0.05$) was observed in the knee. These measurements will be used in association with production records through the animals' first parity to validate past joint measurements from sows that have remained in their respective herds longer than their contemporaries and to identify a range of acceptable joint angles that allow an animal to remain in the herd for a long production life.

Introduction

Several individual conformation traits, such as pasterns, knees and hock position, are associated with improved longevity and survivability in sows. Visual methods have been developed to score feet and leg conformation in gilts and sows that are widely used in the pig industry. However, their reliability depends on the observers training and experience. Developing an objective method to select replacement gilts with the most desirable structural soundness would likely decrease the likelihood of a gilt to be culled due to leg problems which is reported as the second most important reason for involuntary culling of sows in breeding herds after reproductive performance. This in return would likely increase profitability of the commercial swine breeding herds as fewer replacement gilts will be needed, and the herd mean litter size and number of pigs weaned per sow lifetime will increase. The objectives of this study were to characterize the feet and leg joint angle measures from five replacement gilt lines and to evaluate the symmetry between same angles from each leg pairs. These initial results will later be used to attempt to validate the previous work done in the sow population.

Materials and Methods

In total 319 maternal gilts from 5 genetic lines at 21.6 ± 1.8 average weeks of age (range 19 to 25 weeks) were video recorded in a three day time span. In total, 1767 profile digital images (857 left and 910 right), and 671 rear stance digital images were extracted from the video recordings using computer software (AVcutty v3.5, Andreas von Damaros, Krefeld, Germany, www.avcutty.de) based on gilt body position and image quality, resulting in an average of 2.7 left, 2.8 right and 2.1 rear stance images per gilt. Joint angles for the knee, front pastern (Figure 1) and rear pastern, hock (Figure 2), and rear stance (Figure 3) were measured using the angle feature in image analysis software ImageJ (ImageJ, National Institute of Health, Bethesda, MD). Mixed model equation methods were used to evaluate the effect of gilt line and age at measurement (included as a continuous linear covariate) as well as the symmetry of joint angle between the pairs of legs evaluated. PROC MIXED of SAS (SAS Inst. Inc., Cary, NC) was used to analyze the data.

Results and Discussion

The average measurements for each joint angle are as follows: knee $159.9° \pm 3.2°$, front pastern $56.5° \pm 7.0°$, hock $140.1° \pm 7.4°$, rear pastern $58.3° \pm 7.8°$ and rear stance $92.3° \pm 6.3°$. Significant differences ($P < 0.05$) between gilt genetic lines were observed in the front and rear pastern angle measurements (Table 1). Knee and hock angles increased as age at measurement progressed ($P < 0.05$). Joint measurements were symmetric between the gilts left and right legs ($P > 0.05$) except for the knee where a difference of $0.69° \pm 0.26°$ ($P < 0.05$) was observed with the right knee being a higher degree angle (Table 2). Genetic line seem to influence pastern angulation. Results from this study suggest that the knee should be measured separately on each gilt's leg. However, further examination of the technique in which the knee is measured is necessary. Additionally, further investigation is required to determine the biological implications for the angle changes on the knee and hock as age progresses as well as knee asymmetry on replacement gilts as they enter the breeding herd. The individual importance for the range of these measurements will be evaluated using production records upon completion of the gilts' first parity.

Table 1. Comparison of angles by line.

		Knee	Front Pastern	Rear Pastern	Hock	Rear Stance
Line A	LSMEANS	158.90[a]	54.65[a,b]	58.26[a,b]	140.65[a]	93.52[a]
	SE	0.75	1.95	1.97	1.62	1.95
Line B	LSMEANS	158.77[a]	56.54[a]	53.34[a]	139.57[a]	91.34[a]
	SE	0.91	2.34	2.37	1.98	2.24
Line C	LSMEANS	159.84[a]	52.46[b]	57.12[a,b]	139.69[a]	91.50[a]
	SE	0.43	1.68	1.30	0.36	0.44
Line D	LSMEANS	159.93[a]	55.28[a]	58.27[b]	141.15[a]	93.08[a]
	SE	0.31	0.83	0.80	0.65	0.79
Line E	LSMEANS	158.53[a]	58.00[a]	65.03[c]	141.20[a]	89.24[a]
	SE	0.86	1.25	2.17	2.04	2.43

[a,b] Values in a column are degree measurements and those without common superscript are significantly different ($P < 0.05$)

Table 2. Comparison of angles by side.

		Knee	Front Pastern	Rear Pastern	Hock
Left	LSMEANS	158.85[a]	54.93[a]	58.19[a]	140.13[a]
	SE	0.41	1.25	1.12	0.73
Right	LSMEANS	159.54[b]	55.84[a]	58.61[a]	140.77[a]
	SE	0.41	1.25	1.12	0.74

[a, b] Values in a column are degree measurements and those without common superscript are significantly different ($P < 0.05$)

Figure 1.

Figure 2.

Figure 3.