Joint Angles for Feet and Leg Conformation Traits in Second Gestation Sows

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Summary and Implications

This study is a portion from the validation process of an objective methodology to measure feet and leg joint angles and to evaluate their relationship with sow longevity. Five feet and leg conformation traits (knee, hock, front and rear pasterns and rear stance) that have been described in the literature as being related with sow longevity were selected for this study. Profile and rear stance digital images were obtained from 277 sows during their 2nd gestation (26.7 ± 17.2 days of gestation; range 0 to 87 days). Sows were obtained from a single gilt population and were moved to three different farms. Significant differences ($P < 0.05$) between farms were identified in the knee, both pasterns and the rear stance joint angle measurements. Asymmetric joint angle measurements (i.e. difference in the joint angle between the left and right legs) were identified for the knee, and both pasterns. Knee, front pastern and hock joint angles changed as gestation progressed. Results suggest that environmental factors are related with variation in joint angles. However, as the differences in joint angles are relatively small, they may not be biologically relevant.

Introduction

Several individual conformation traits, such as pasterns, knees and hock position, are associated with sow longevity and survivability in sows. In a previous study, joint angles for feet and leg conformation traits were measured in multiparous sows using digital imaging technology. Results indicated that objective feet and leg conformation trait measurements could be successfully implemented as alternatives to subjective methods for selection of replacement gilts as it is repeatable and provides an accurate representation of the joint. Using this method to measure environmental and gestation age differences could provide more understanding into the conformational changes as the replacement female grows and undergoes major life changes. Understanding feet and leg conformation trait changes will help further the validation process and provide a better understanding for a range of the joints that contribute to increased longevity. The objectives of this study were to investigate joint angle symmetry and possible joint angles changes as gestation progresses and between farms in sows that originated from a single location during their second gestation.

Materials and Methods

Profile and rear stance digital images were obtained from 277 sows during their 2nd gestation (26.7 ± 17.2 days of gestation; range 0 to 87 days). Sows were obtained from a single gilt population and were moved to three different farms (farm A = 82; farm B = 98 and farm C = 97 sows) at the time of selection. Joint angles for the knee, front and rear pastern, hock, and rear stance were measured using the angle feature in image analysis software ImageJ (ImageJ, National Institute of Health, Bethesda, MD). Data were analyzed using mixed model equation methods in SAS PROC MIXED (SAS Inst. Inc., Cary, NC). The effect of farm, side where images were taken (left or right) and gestation age (included as a continuous covariate) were evaluated. Animal was used as a random effect.

Results and Discussion

Table 1 shows the LSMeans (±SE) by farm, side and regression coefficient for gestation age for all joints measured. Significant differences ($P < 0.05$) between farms were observed in the knee, front and rear pasterns and the rear stance measurement with the largest difference observed in the rear pastern followed by the rear stance (4.4 degrees and 6 degrees, respectively) between farm C and farm A (4.4 degrees); followed by the rear stance (6 degrees) between farm C and B compared with farm A. Asymmetry was detected in the knee, and front and rear pasterns ($P < 0.05$). Gestation age was a significant source of variation for knee, front pastern and hock. As gestation progressed, knee angle deceased and front and hock angles increased ($P < 0.05$). The biological importance of the differences found may not be meaningful due to the differences between the joints being relatively small.

Results also suggest that environmental factors such as farm where animals are housed, and possibly husbandry practices, contribute to angle differences. Additionally, results indicate that joint angulation changes as sows become older and could be related to increased body weight due to gestation and age. Further investigations are needed to determine the biological implications for the angle changes within the same individual to the end of their growth cycle. These results will be collectively used to validate the previous work done in the objective measurement process.

Table 1. *Differences in feet and leg conformation trait joint angles (LSMeans ± SE) from 277 sows during their 2nd gestation[1] housed in three different farms*

Variable	Knee		Front Pastern		Rear Pastern		Hock		Rear Stance	
	LS Means	SE	LS Means	SE	LS Means	SE	LS Means	SE	LS Means	SE
***Farm*[2]**										
A	159.0[a,b]	0.3	55.6[a]	0.6	51.4[a]	0.6	146.4[a]	0.5	82.5[a]	0.7
B	158.5[a]	0.3	58.2[b]	0.6	54.5[b]	0.6	147.4[a]	0.5	88.4[b]	0.7
C	159.5[b]	0.3	57.5[b]	0.6	55.8[b]	0.6	147.6[a]	0.5	88.5[b]	0.7
Side										
L	159.4[a]	0.2	57.9[a]	0.4	54.5[a]	0.4	147.8[a]	0.3	NI[3]	
R	158.6[b]	0.2	56.3[b]	0.4	53.3[b]	0.4	147.5[a]	0.3	NI	
***Gestation Age*[4]**	-0.02 ± 0.01*		0.04 ± 0.02*		0.02 ± 0.02		0.05 ± 0.02*		-0.01 ± 0.02	

[1]Average gestation age 26.7 ± 17.2 days; range 0 to 87 days

[2] Sows were obtained from a single gilt population and were moved to three different farms (farm A = 82 sows; farm B = 98 sows and farm C = 97 sows) at the time of selection.

[3] Not included in the model; $P > 0.05$

[4] Results for continuous covariates are presented as the regression coefficient ± SE

[a,b] Within columns, significant differences between predictor variables; $P < 0.05$

* $P < 0.05$