Selection for Calf Shape

Would It Really Reduce Calving Difficulty?

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Remarks By R.J. Lipsey, Ph.D. *We thought it would be educational and fun to "dredge up" some great articles from previous issues. The improvement of calving ease was and will continue to be critical to the future of SimGenetics. In history, perhaps no breed has improved calving ease like Simmental (go to www.simmental.org, then Genetic Improve/Education, and review Simmental genetic trends). How have we accomplished this feat?*

In the early days of Americanizing Simmental, some believed the secret was changing the shape of calves. Somehow, that theory morphed into the notion that changing the shape of mature animals would change the fetal shape. We favored tall, long bodied, slender (some would say light muscled) designed cattle. Some of those modern conformation bulls ultimately earned better Calving Ease EPDs, Alas, some were terribly hard calving sires and we had to rethink strategies to reduce dystocia.

Now that we have the opportunity to be "Monday morning quarterbacks", we know the best and most effective route to changing traits is data collection, genetic evaluation, and EPD selection. Calving ease EPDs result from both calving ease scores and birth weights submitted to our database. We hope you enjoy this historical article. We think it is just as pertinent today as it was when it was first printed in the March, 1992 Register.

It is common to hear a breeder discuss the body shape of a possible herd sire when he's assessing the potential for calving difficulty, in the bull's calves. It is often assumed that the body shape of a bull is closely related to the body shape of his calves at birth and further, that the shape of a calf at birth will be related to calving difficulty. Intuitively, the body shape of a calf should influence its ability to pass through the cow's pelvis and therefore be useful in predicting dystocia. A study conducted by Virginia Tech, however, suggests that intuition and reality in this instance may not be the same. The objective of the study was to examine the usefulness of calf shape in predicting and selecting against dystocia.

Calf birth weight and pelvic area of the cow are the two most important factors associated with calving difficulty. Both traits are moderately heritable and can be used as selection criteria to reduce calving difficulty. However, birth weight and pelvic area generally account for less than 50% of the variation in calving score (e.g. 1 = no difficulty, no assistance to 4 = Caesarean section or other surgery). Thus, even if cow pelvic area and calf birth weight were known, the predictability of calving difficulty for a single mating would be low. The identification of a trait in addition to birth weight and pelvic area that could help to consistently predict the occurrence of calving difficulty would be useful to every cow-calf producer.

Before discussing the results of the Virginia Tech study, it is necessary to examine what would be required of calf shape to be a functional selection criterion. To be a useful trait for selection, calf shape must be: 1) EASILY MEASURED — how do we define calf shape and is there an easy way of measuring? 2) HERITABLE - if we expect to make progress selecting for the trait there should be differences among animals that are related to genes that they can pass on to their offspring; 3) consistently related to dystocia INDEPENDENT OF BIRTH WEIGHT — this last point is the key.

Birth weight is relatively easy to measure, heritable and strongly related to calving difficulty. Additionally, birth weights are commonly recorded and birth weight EPDs can be used to help predict the tendency of a bull to sire calves born with difficulty. If some measure of calf shape is to be useful, it has to be related to dystocia independent of birth weight. In simple terms, calf shape, in addition to birth weight, must consistently be helpful in predicting calving difficulty for that measure to be a trait worth of selection.

The results from the study indicated that calf shape could be measured and was heritable. More importantly, calf shape was not consistently related to either observed calving difficulty or genetic merit for dystocia independent of birth weight. The implications of these results were straightforward. Select bulls on calving ease EPD or birth weight EPDs to control calving difficulty. Do not worry about the body shape of a bull when trying to evaluate his potential for causing calving difficulty.

Three separate sets of calves were used in the Virginia Tech study: 204 half-Simmental calves produced from the AI mating of 27 Simmental bulls to Polled Hereford x Angus one-and-two-year-old females calving for their first and second time, respectively, and 374 purebred Angus and 438 Polled Hereford x Angus calves out of mature cows. At birth, calves were weighed and measure for head circumference, should width, heart girth, hip width, cannon bone circumference, cannon bone length and body length. These body measures were used as indication of calf shape and were easily obtained when the calf was held in the same body position that it assumes during birth (Figure 1).

In all three groups of calves, weight was highly correlated to each of the seven body measures, suggesting that body size (usually indicated by weight) also can be represented by any of the calf body's seven measurements that were recorded. In the Simmental-sired calves, there were differences among calves due to their sire for body weight, cannon bone circumference, cannon bone length, and head

Table 1. Average size of Simmental-cross calf and difference in body measures between calves born assisted and unassisted before and after adjustment of measures for birth weight.

Body Measure	Average	Difference (assisted – unassisted) Observed	Difference (assisted – unassisted) After Adjustment for B. Weight
Birth Weight	82.1	6.8	-
Head Circumference	18.9	.4	.0
Hip Width	7.7	.3	.1
Shoulder Width	7.1	.3	.1
Body Length	20.4	.4	-.1
Cannon Bone Circumference	4.7	.2	.0
Canon Bone Length	6.1	.0	-.1
Heart Girth	28.5	.6	-.2

Note: *All measures are reported in inches except birth weight (pounds). Calves were Simmental x Polled Hereford-Angus.*
Source: *Virginia Tech.*

circumference. Thus, calves had different body sizes, in part due to their genetic makeup.

The pertinent question was whether genetic differences among calves were present in body measures at the same (independent of) birth weight. To allow for testing of genetic differences in calf shape independent of actual body size, each calf body measure was then adjusted for birth weight by linear regression. After adjustment for birth weight, there were still differences among the Simmental-cross calves in cannon bone circumference and cannon bone length due to their sire (i.e., sire effects).

Similar results were seen with Polled Hereford and Angus-sired calves: hip width, body length, cannon bone circumference and heath girth differed among sire groups after removal of differences due to birth weight alone. Differences in body measures of calves at the same birth weight measures of calves at the same birth weight existed and could be attributed to their sire.

To confirm this result, three calf body shape indices were constructed separately for each breed group using the body measures adjusted for birth weight. The body shape indices described three independent aspects of calf shape that were not related to birth weight. The first index for the Simmental-sired calves described skeletal width, the second index described skeletal thickness and length, and the third described body thickness in terms of both skeletal and soft tissue (remember, these were independent of birth weight). Just as was observed with the individual measures, sire effects were present for calf shape (as indicated by the second body shape index for the Simmentals) in all three sets of calves.

The presence of sire differences for the individual body measures indicated that the traits should be heritable. Birth weight was highly heritable (.52), while the heritability estimates of the other measures before adjusting for birth weight were low to moderate (.14 to .34). The heritabilities of the measures were near zero except for cannon bone circumference (.16) when adjusted for birth weight. This meant that skeletal thickness in newborn calves could be altered somewhat by selection without a correlated change in birth weight.

As indicated above, the real key was to determine whether shape in addition to birth weight was related to dystocia. The Angus and Polled Hereford bulls were bred to mature cows so the actual incidence of calving difficulty was low. However, the Simmental bulls were bred to young females and subsequently, 42% of the calvings were assisted (use of mechanical calf puller or Caesarean). Because many of the Simmental calves were born with assistance, it was possible to compare the size and shape of calves born unassisted with the size and shape of those born with assistance.

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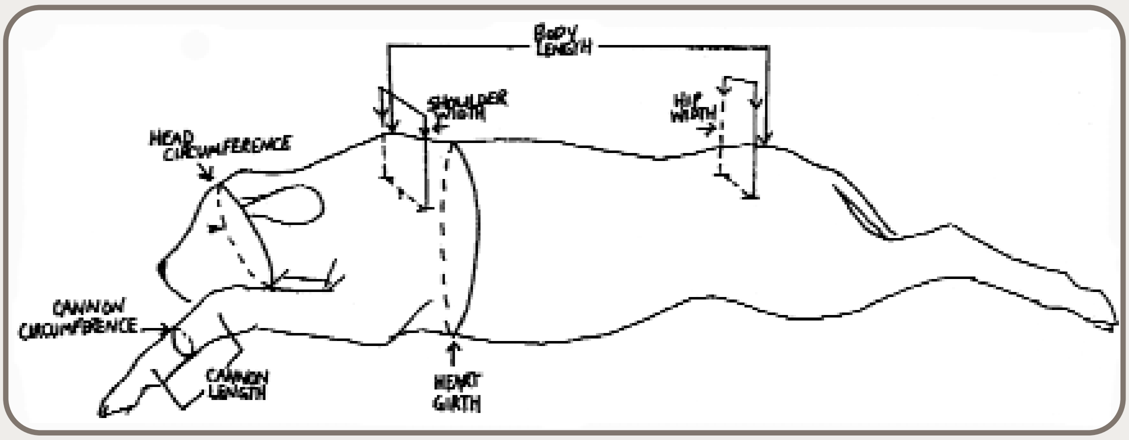

Figure 1. Seven body shape measures were recorded within 24 hours after birth on Simmental, Polled Hereford and Angus-sired calves. Calves were held in the posture they assume during birth for each measurement.

Selection for Calf Shape

(Continued from page 17)

The assisted calves were almost seven pounds heavier and were larger in all other body measures (by .2 to .6 inch) except cannon bone length (Table 1). Yet, when the data were adjusted for birth weight, there was no significant difference between the body measures of calves born with assistance and the body measures of calves born without assistance. Thus, calves that were born with assistance did have big heads and wide hips (for example), but only because they were larger and not because they were shaped differently than calves that were born unassisted!

One problem with a trait like calving score is its subjectiveness. One producer may pull a calf when another producer may wait and see if the cow can deliver the calf by herself. This leads to differences in recorded calving score data due only to human decision. To avoid using only subjective calving scores in the analysis, the birth weight-adjusted shape of the Simmental-sired calves was also compared to the EPD of their sire for heifer calving ease. The calving ease EPD indicated a sire's genetic predisposition to produce calves born without difficulty. The results showed that there was no relationship between calf shape and the calving ease EPD of their sire independent of actual birth weight.

If you still think that calf shape influences dystocia ad should be selected for, consider these other results from the study: repeatability of cow effects on her calves' body measures independent of birth weight was low (.22 or less), suggesting that the shape of previous calves does not help to predict the shape of the next calf of a given cow. Also, the correlations between body measures on a calf (independent of weight) and the same measures on the calf's dame at her birth were low (range in coefficients -.17 to .10). Finally, the same body measures on a calf at birth and at weaning independent of weight were also lowly correlated (.03 to .09). Thus body shape of a newborn calf independent of general size (weight) cannot be accurately predicted from the body shape of its parents at their birth. Furthermore, there is little relationship between newborn body shape and shape in the older animal. Looking at a prospective herd sire's body shape gives you little, if any, information on how his calves will be shaped.

In conclusion, you are probably not wrong when you swear a certain calf was born with difficulty because he has wide hips or broad shoulders. Nevertheless, those big hips or shoulders probably just means that he was big. The sire's calving ease and birth weight EPDs provide a more accurate estimate of a calf's chance for an unassisted birth than any body shape measure. Reliable prediction depends upon consistent, repeatable trends. This does not mean that a long, skinny, 95-pound calf will never be born unassisted while a seemingly square-block-shaped 75-pound calf has to be pulled. What it does mean is that, on average, progress cannot be made in decreasing calving difficulty by selecting for body shape in addition to birth weight.

Note: In 1992, Russ Nugent was a Research Animal Scientists at the Roman L. Hruska US Meat Animal Research Center, ARS, USDA at Clay Center, NE. The research on calf shape was conducted by Nugent, Dave Notter and Bill Beal of the Animal Science Department at Virginia Polytechnic Institute, Blacksburg, VA. Technical details of this product can be found in the June, 1991 issue of the *Journal of Animal Science* 69(6):2413-2433. Portions of this paper were previously published in the *Angus Journal*. ◆