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Preliminary Studies on Breed Variations in the Rate of Deposition of Compact and Cancellous Bone During Pre-Weaning Growth in the Bovine

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Story in Brief

Six Angus and six Charolais steer calves were used to study the influence of animal scale on the rate of compact and cancellous bone deposition during pre-weaning growth in the bovine. Experimental data were obtained from radiograms of the left metacarpal bone of each calf taken at four periods during the calves' pre-weaning life. From the radiograms, visual changes in the periosteal and metaphyseal regions of the metacarpal bones were evaluated via a subjective score, based on a scale of 1 to 6.

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Both breeds exhibited significant increases in compact and cancellous bone tissue during pre-weaning growth. Data indicated that the metacarpal bones of the small scale calves matured in diameter more rapidly than in length. The small scale calves attained maximal rate of new bone deposition in the periostal and metaphyseal regions (of the metacarpal) during mid pre-weaning life. The large scale calves, however, had the greatest rate of new bone deposition during the last preweaning test period. Results suggest that small scale bovine attain a significant level of skeletal maturity prior to weaning or between 5 and 7 months of age.

Introduction

Bone, especially long bone, though it may seem to be rather dense, ...t and inelastic is actually a very dynamic tissue, being extremely re...sive to existing environmental conditions, nutritional as well as ...iological.

Bone growth takes place when minerals are added to the tissue at a ...aster than they are withdrawn. Long bone may increase in both ...t and diameter or thickness. An increase in the length of long bone ...mplished by adding new tissue to the surfaces of pre-existing bone ... area of the epiphyseal plates, causing an enlargement of the meta... The metaphyses are located at the proximal (top) and distal ...n) ends of the long bone diaphysis or "shaft". Supportedly, in... the length of long bone terminate when the epiphyseal plates ... when the bone reaches "physiological maturity".

...eases in the diameter of long bone occur by adding new tissue ...face of pre-existing bone at the periosteal or "periphery" region ...g bone shaft. Bone deposition in the metaphyseal region is re...s carcellous or "spongy" bone, whereas at the periosteal region ...l compact or cortical bone.

...urpose of this study was to compare changes in compact and ... bone deposition in the metacarpal bone of a large and small ... of beef cattle during their pre-weaning growth phase.

Materials and Methods

...ental animals utilized in this study were six gray Angus ...d six Charolais steer calves (7/8 Charolais x 1/8 Angus). The ...were selected so as to represent the small scale breed whereas ...is calves were selected to represent the large scale breed. ... were kept with their respective dams, under similar range ...ing pre-weaning life.

...tal data were obtained from radiographs of the left

metacarpal bone of each animal. The radiog
periods during the calves' pre-weaning life, the first being tak
the calves averaged 32 days of age and at 56 day intervals thereafter. From the radiograms the periosteal and metaphyseal regions of the metacarpal bones were evaluated, as well as epiphyseal plate closure. A subjective score, based on a scale of 1 to 6, was used to indicate visual changes in the above tissue areas.

Results and Discussion

At the outset of the experiment the six Angus calves ranged in age from 24-41 days, the Charolais, 24-39 days. The average age of all calv

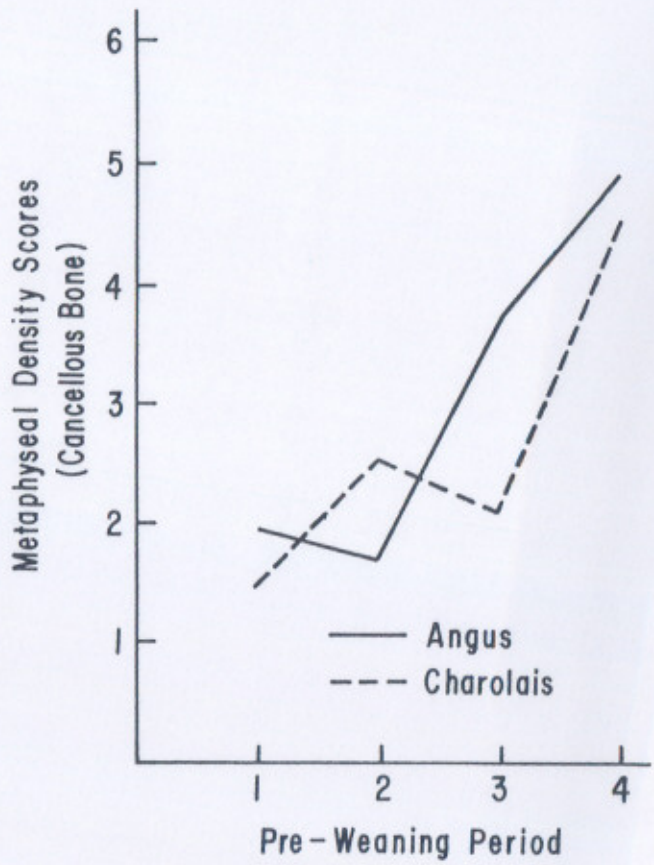

Figure 1. The influence of animal breed and scale on c
deposition in the bovine during pre-weaning

at periods 1, 2, 3 and 4 was 32, 88, 144 and 200 days, respectively.

In Figure 1 are presented the mean metaphyseal density scores of the metacarpal bones from the two test breeds at the various pre-weaning periods. Visually, this region appeared as a sclerotic zone on the radiogram and what was actually evaluated was the amount of metaphyseal sclerosis. Whether the sclerotic zone was caused by actual new cancellous bone deposition or a reaction to an inflammatory condition, epiphysitis, engendered by some nutritional imbalance or physical stress or a combination of the above, cannot be fully elucidated at this time.

The discussion to follow is based on the assumption that the changes in the metaphyseal sclerotic area were due, primarily, to the deposition of new cancellous bone tissue. Results in Figure 1 show that both breeds

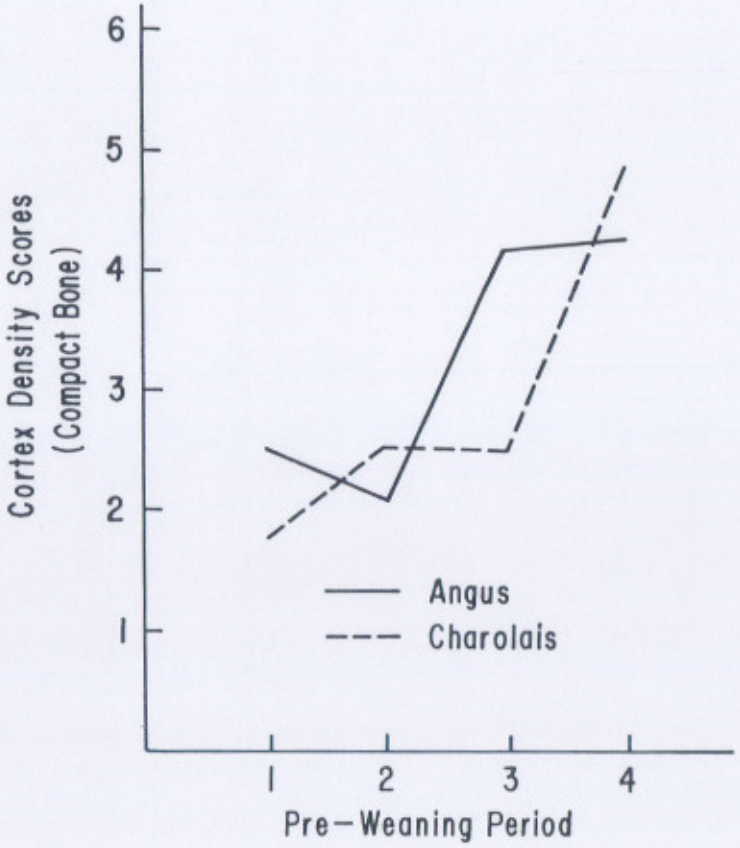

Figure 2. The influence of animal breed and scale on compact bone deposition in the bovine during pre-weaning life

displayed a net increase in new bone deposition, with the small scale Angus calves accumulating greater amounts than the large scale Charolais, except for period 2. A comparison of the curves, for the two breeds, between periods 3 and 4 indicates that the Angus calves had begun to decline in their rate of linear bone increase, or cancellous bone deposition, during this phase of their pre-weaning life. However, for the Charolais calves this was the period of maximum rate of linear bone deposition. Apparently, then, the Angus calves had attained a more advanced state of physiological maturity than did the Charolais during pre-weaning life.

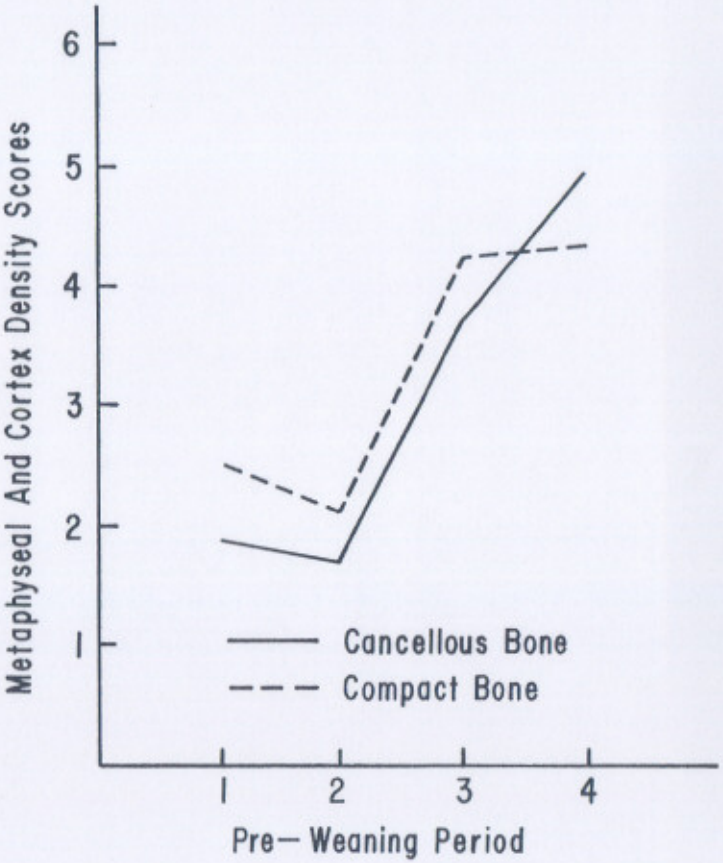

Figure 3. The relationship between compact and cancellous bone deposition in small scale (Angus) bovine during pre-weaning life

The rate of compact or cortical bone deposition was assessed via visual observation of the area and density of the cortex. These results are represented by the graphs in Figure 2. Although both breeds showed a net increase in compact bone deposition during pre-weaning life, it is obvious that the metacarpal bones of the small scale Angus calves matured in diameter or thickness at a much faster rate than did the larger scale Charolais. Moreover, at period 4, the Charolais had surpassed the Angus calves in total amount of cortical bone.

The relationship between metacarpal cancellous and compact bone formation is portrayed in Figures 3 and 4, respectively, for the Angus

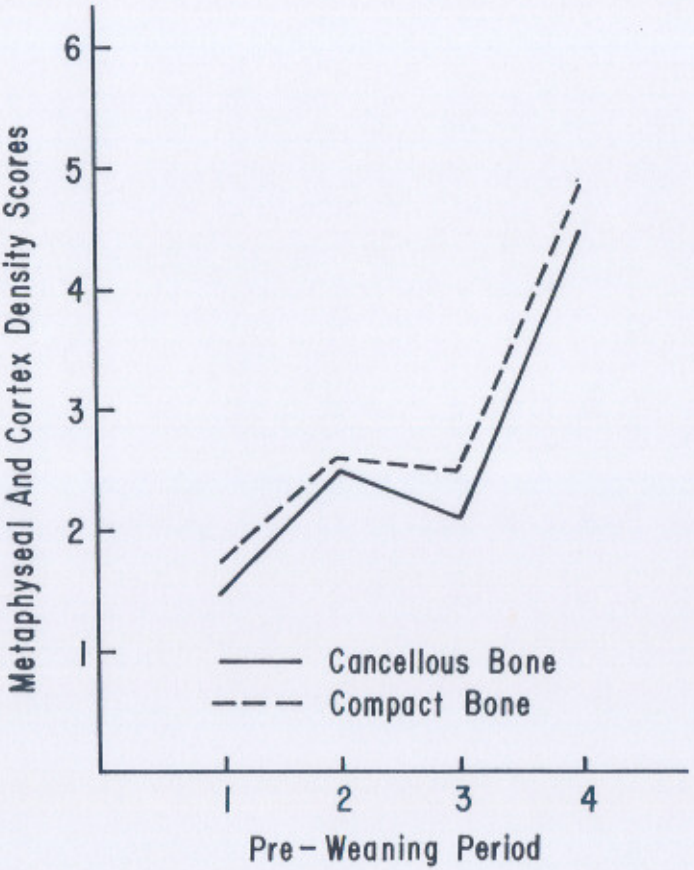

Figure 4. The relationship between compact and cancellous bone deposition in large scale (Charolais) bovine during pre-weaning life

and Charolais breeds. A positive relationship between these two types of bone deposition can be noted, for both breeds, through period 3. Between periods 3 and 4, however, compact bone deposition in the Angus calves decreased considerably, whereas in the Charolais calves it tended to parallel cancellous bone formation.

From the above data, it would appear that the metacarpal bones of small scale animals mature more rapidly in diameter than they do in length. Also, the results suggest that small scale bovine attain a notable degree of skeletal maturity prior to weaning or between 5 and 7 months of age.
