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# Effects of Sex and Weaning on Serum Osteocalcin Concentration in Horses

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## Story in Brief

Twelve Quarter Horse foals were weaned at 4 mo of age to evaluate variation in serum osteocalcin concentration at weaning. Blood samples were collected daily prior to and 1 week following weaning. Abrupt and gradual weaning were compared to evaluate differences in osteocalcin concentration due to weaning method. Osteocalcin concentrations declined 1 to 2 d following weaning but returned to preweaning levels within one week. Concentrations of osteocalcin were affected by sex of foal. Osteocalcin concentrations were greater in colts than fillies ( $19.3 \pm .6$  vs  $17.2 \pm .5$  ng/mL, respectively). Method of weaning did not alter serum osteocalcin concentration. Postweaning decline in osteocalcin concentration may reflect a decline in bone turnover. Stress related to weaning and a more restrictive environment could be responsible for this decline. Minimizing stress and changes in environment could help reduce trauma and growth losses at weaning.

(Key Words: Horses, Weaning, Osteocalcin, Bone Metabolism.)

## Introduction

Optimal foal growth and performance is advantageous for horses intended for show or sale as weanlings or yearlings. Developmental orthopedic disease (DOD), a class of skeletal abnormalities that includes osteochondrosis, epiphysitis and flexural deformities, has become an increasing concern to producers. Explanation for the incidence of DOD is multifactorial, but is evident that a method to identify the potential for developmental abnormalities is needed. A better understanding of the mechanism of bone metabolism is necessary for early identification of DOD. Osteocalcin is a bone-specific protein, synthesized by osteoblasts that is a specific biochemical marker of active bone formation in horses (Maenpaa et al., 1988). Serum osteocalcin has a biphasic circadian pattern (Lepage et al., 1991). Age is inversely correlated with serum osteocalcin in standardbred horses (Lepage et al., 1990). Concentrations of osteocalcin vary between breed and type of horse. Osteocalcin concentrations of draft horses are significantly less than warmblood horses of similar age (Lepage et al., 1997). The purpose of this study was to evaluate the effects of weaning and sex on serum osteocalcin concentration in clinically normal Quarter Horses at 4 mo of age.

## Materials and Methods

Twelve Quarter Horse foals were weaned at 4 mo of age to evaluate changes in peripheral osteocalcin at weaning. Foals were removed from pasture and placed in catch pens (10 x 20 ft) at weaning. Two types of weaning were implemented; abrupt (Ab) and gradual (Gr). Abruptly weaned foals were completely separated from mares and removed from the premises. Gradual weaning allowed mare and foal to remain in close visual proximity, but prevented suckling for 2 d prior to removal of the mare. Horses were weaned in pairs to minimize stress. Sex of foal was recorded. Jugular blood samples were collected 1 d preweaning, immediately prior to weaning, 4 h postweaning, and daily for 1 wk postweaning. Blood samples were collected at 1:30 p.m. each day to limit variation due to circadian rhythm. Osteocalcin in serum was quantified using a commercially available radioimmunoassay kit<sup>4</sup> validated for use in horses (Hope et al., 1993). Split-plot analysis of variance was used to determine the influence of sex and weaning method on serum osteocalcin. Means were compared by protected least significant differences.

## Results and Discussion

Concentrations of osteocalcin were similar to those of clinically normal horses (Hope et al., 1993). Osteocalcin concentrations were affected by sex of foal ( $P < .05$ ). Colts had higher

circulating osteocalcin concentrations ( $19.3 \pm .6$  ng/mL) when compared with fillies ( $17.2 \pm .5$  ng/mL; Table 1). Cole et al. (1985) found sex-related differences in serum osteocalcin concentrations of children. Male foals less than 4 mo of age experience a greater rate of growth at limb bone extremities than their female counterparts (Goyal et al., 1981). Serum osteocalcin concentrations were not affected by sex in standardbred horses less than 5 yr of age (Lepage et al., 1992). However, reproductive status and exercise regimes of horses used were variable. Sex-related differences in the present study may be due to the influence of steroid hormones. Receptors for thyroxine, androgens, estradiol, progesterone and corticosteroids have been located on osteoblastic cells (Sato et al., 1987).

Serum osteocalcin in all horses declined ( $P < .05$ ) 1 to 2 d following weaning (Figure 1). This is in agreement with Maenpaa et al. (1988) that osteocalcin decreased when foals were transferred from pasture to stables. Osteocalcin concentrations were restored to preweaning levels within 7 d postweaning. The postweaning decline in serum osteocalcin is depicted in Figure 1. Variation in osteocalcin at weaning could be due to acute stress associated with the weaning process. Serum osteocalcin concentrations decreased following administration of corticosteroids in rats (Patterson-Buckendahl et al., 1988). Foals were moved from pasture to pens at weaning, creating a more physically restrictive environment as well as increasing stress to the animal.

Method of weaning did not affect ( $P > .1$ ) changes in serum osteocalcin at weaning. Osteocalcin concentrations were  $18.5 \pm .7$  ng/mL and  $17.7 \pm .7$  ng/mL for abrupt and gradual methods, respectively (Table 1).

Decline in serum osteocalcin at weaning could be indicative of reduced bone turnover and growth. Since bone metabolism is influenced by many factors, additional research is necessary to investigate the effects of corticosteroids and other steroid hormones on osteocalcin at weaning. Environmental factors affecting behavior and stress at weaning should be taken into consideration.

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**Table 1. Influence of sex and weaning method on serum osteocalcin concentrations of foals.**

	Sex of foal		Weaning method	
	Colts	Fillies	Abrupt	Gradual
Osteocalcin, ng/mL	$19.3 \pm .6^a$	$17.2 \pm .5^b$	$18.5 \pm .7^c$	$17.7 \pm .7^c$

<sup>a,b,c</sup> Means within a group with different superscripts differ ( $P < .05$ ).

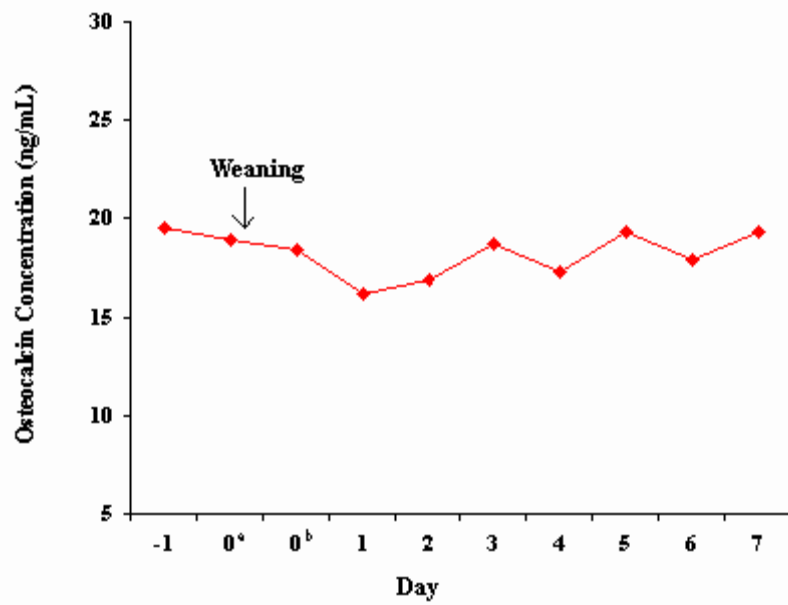


Figure 1. Osteocalcin concentrations of horses are affected ( $P < .05$ ) by day.

0<sup>a</sup> denotes preweaning

0<sup>b</sup> denotes 4 h postweaning