Using Blood Samples to Monitor the Effects of Exercise on Musculoskeletal Development in Foals

Summary: In a previous study, researchers at Utrecht University in the Netherlands compared the musculoskeletal health of foals that were stalled, pastured or stalled with exercise. Researchers with the CSU Orthopaedic Research Center analyzed the blood samples that were collected monthly from these foals for specific molecules that may indicate disturbances in the normal metabolism of musculoskeletal tissues. They concluded that free pasture exercise was the best for maintaining steady and favorable blood levels of the biomarkers of collagen turnover. This study demonstrates the great potential in using blood tests to measure the levels of specific biomarkers for monitoring the normal development of the musculoskeletal system of the horse and for allowing the early identification and treatment of developmental abnormalities, particularly osteochondritis dissecans.

Developmental orthopaedic disease (DOD) refers to a group of conditions that are a significant problem in the young, growing horse, and are a significant cause of economic burden to the equine industry. Osteochondrosis (OC) is the most common of the DOD's and is essentially a disturbance in endochondral ossification, a process in which cartilage is gradually converted into bone and is responsible for bone elongation in the growing horse. It is a multifactorial disorder with genetic traits, growth rate, mineral and hormonal imbalances, toxins, dietary factors, conformation, and trauma all being implicated to some degree. There is also considerable evidence that exercise may modulate development in the first months after birth and may specifically influence the development of OC.

A study was performed by researchers at the Faculty of Veterinary Medicine at Utrecht University in the Netherlands utilizing 43 Dutch Warmblood foals, genetically predisposed to developing OC. All foals remained with their dams in a paddock for one week after birth and were then divided into 3 groups that were subjected to different exercise regimens until weaning at 5 months. The 3 exercise groups were:

a) Box-rested – foals were kept in 3 x 3.5 m box stalls

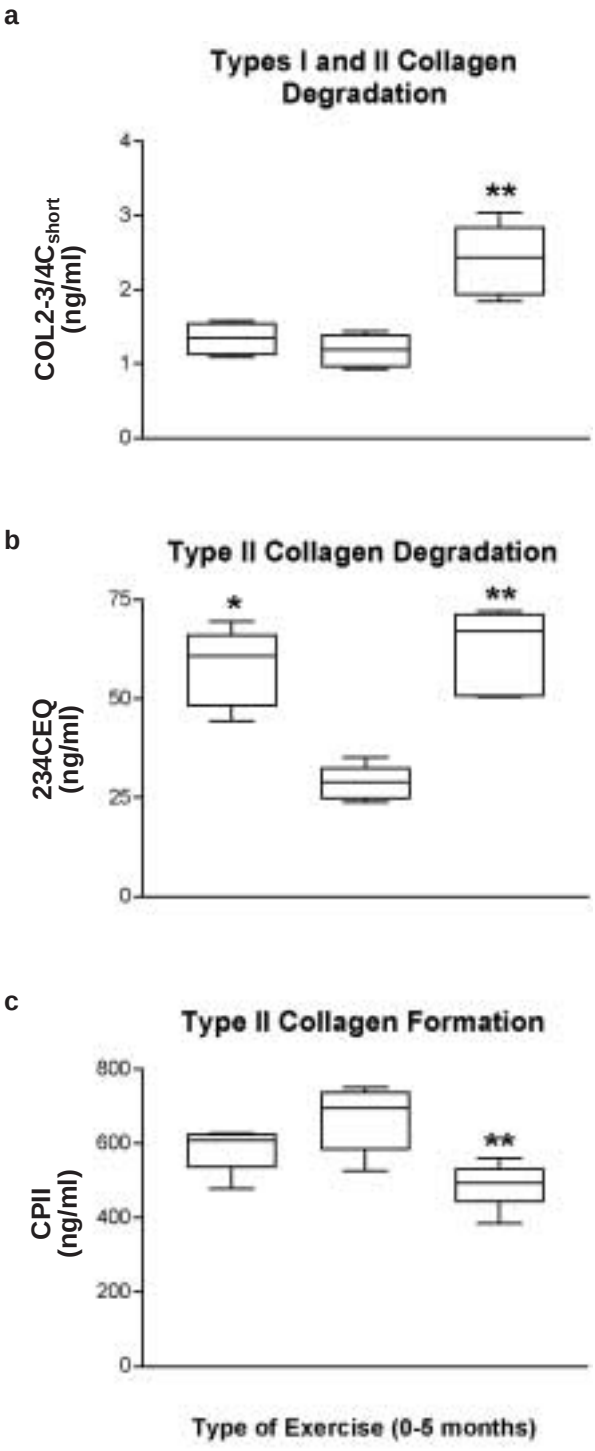
b) Pasture – foals were kept at pasture 24 hours a day

c) Trained – .foals were kept in box stalls but were given 40-m gallop sprints 6 days a week that increased over the 5 months from 12 to 32.

The results of the effects of exercise on OC lesion development have been previously published by the Utrecht researchers in the *Equine Veterinary Journal* (Supplement 31, 1999). They reported that exercise had no influence on the number of OC lesions, but was related to the distribution of lesions within a joint. Lack of exercise (box-rest) generally delayed the development of the tissues of the musculoskeletal system of these foals. In particular, there was evidence that the withholding of exercise had lifelong effects on some characteristics of the collagen of articular cartilage. Moreover, the training protocol used appeared to have long lasting negative effects on cartilage, bone and tendons. It was concluded that exercise seems to be an important factor in the determination of the final make-up of the tissues of the musculoskeletal system of the horse.

The goal of Orthopaedic Research Center researchers Dr. Clark Billinghurst, Megan Knowlton and Dr. Wayne McIlwraith, who worked on this study with Drs. P. Brama and R Van Weeren from Utrecht University, The Netherlands, was to analyze the blood samples that were collected monthly from these foals for specific molecules that may indicate disturbances in the normal metabolism of musculoskeletal tissues. These molecules, that are the released into the animal's circulation in health and disease, are the byproducts of tissue turnover. It was the goal of this project to try to identify which molecules, specific for bone and cartilage metabolism, may be of value in screening the serum of foals during their first year of life for the presence or potential of developing abnormalities in musculoskeletal tissue metabolism. The results relating to the development of OC show that the blood levels of certain biomarkers of collagen turnover, especially during the first 5 months of life, are significantly elevated in those foals with increased number and severity of OC lesions, many of which are not evident on radiographs.

When analyzing the biomarker levels in these foals in relation to the type of exercise they had during their first 5 months of life, it was shown that the



foals having free exercise in pasture with their dams had the fewest negative alterations in the blood levels of the biomarkers of collagen metabolism. These pastured foals had the lowest mean blood levels for molecules resulting from collagen degradation (COL2-3/4C_{short} and 234CEQ) and had the highest blood levels of molecules that are the byproduct of cartilage collagen formation (CPII). Forced training from 0-5 months, on the other hand, appeared to negatively affect collagen turnover as this group of foals had significantly increased levels of collagen degradation products in their blood and significantly lower levels of those molecules indicating type II collagen formation, when compared to the levels in the pastured foals (Figure 1). The foals that were kept in box stalls also had significantly higher blood levels of degradation products of type II collagen of articular cartilage compared to the levels in the pastured group, but the levels of the type II collagen formation marker were only slightly lower in the rested group.

In summary, free pasture exercise was the best for maintaining steady and favorable blood levels of the biomarkers of collagen turnover. This supports the conclusion, based on previously performed biochemical studies of articular cartilage taken form these same foals, that pasture exercise is the best for developing healthy cartilage that is resistant to injury. This study demonstrates the great potential in using blood tests to measure the levels of specific biomarkers for monitoring the normal development of the musculoskeletal system of the horse and for allowing the early identification and treatment of developmental abnormalities.

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