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Review of "Evaluation of a new strategy to modulate skeletal development in Thoroughbred performance horses by imposing track-based exercise during growth"

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Why was this study done?

Musculoskeletal injury is the most common cause of wastage for racehorses, and indeed for many types of horses. While some injuries are the unavoidable result of routine impact, many are the result of repeated loading and the inability of the musculoskeletal system to adapt at a rapid enough rate to keep pace with the increased demands of athletic training.

Bone, tendon, and joint tissues respond to the stresses of exercise. The authors point out that, while bone tissue continues to respond to exercise throughout the horse's life, cartilage loses almost all of its ability to adapt or regenerate by the time the horse is mature. The biomechanical strength of cartilage is influenced by loading in the horse's early juvenile period. A few months after birth, the opportunity for optimal conditioning of this tissue declines sharply.

There is little information as to the ability of tendons to adapt. In one study of treadmill exercise with young horses, the only response of the digital flexor tendon was degenerative change. In another study using two-year-old Thoroughbreds, adaptive responses were clearly seen in bones and modest changes were noted in tendons and cartilage. In both trained and untrained horses in this study, however, the articular cartilage in the fetlock joints showed degenerative changes.

In a study where groups of foals were kept at pasture, in stalls, or in stalls with short bouts of intensive exercise, the pastured foals were superior with respect to the conditioning of their musculoskeletal systems. The authors of this report theorized that, in order to improve resistance to injury, foals would have to be subjected to exercise protocols in addition to free pasture exercise. The challenge was to develop a conditioning program that would stimulate a response without causing injury or compromising the welfare of the foals.

The hypothesis of this study was that imposing a defined exercise program on juvenile horses during growth would substantially increase workload compared to foals allowed free pasture exercise, and that the increased work would not raise the rate of injury or cause other undesirable effects.

How was the research conducted?

Thirty-three Thoroughbred foals of both sexes were put in one of two groups shortly after birth. Foals in the PASTEX group were raised on pasture. Foals in the CONDEX group were also pastured, but in addition they were subjected to an exercise protocol of gradually increasing intensity.

Exercise was begun when foals were about 3 weeks old and continued until they were 19 to 21 months old. Initially, foals were taught to trot and canter around a sand track inside a large paddock. They were

exercised five days a week, alternating directions every other day, for 1030 meters at an average speed of 5.36 meters per second. In the second phase (after weaning, at about four months) the average velocity increased to 7.52 meters per second. For the final phase, beginning when the young horses were about eight months old, exercise began with the horses moving at 9.62 meters per second followed by a sprint of 129 meters at a speed of 13 meters per second.

The cumulative workload intensity (product of distance traveled and the average velocity) was calculated for each phase. This increased by 40% between the first two phases and by 82% with the addition of the sprint in the final phase.

All horses were observed daily for health; examined monthly for lameness and leg or joint swelling by a veterinarian; and weighed, measured, and scored for condition every two weeks. Blood samples were collected and evaluated for cortisol level before and after exercise.

At the end of the third phase, all horses' limbs were examined radiographically and the images were scored for abnormalities. At this point, twenty horses continued with training. The others were euthanized, limbs were removed, and joint surfaces were examined for abnormalities. Joint fluid, cartilage, and digital tendons were harvested for later analysis.

What results were found?

Horses in the CONDEX (conditioning exercise) group showed a significant increase in the incidence of effusion (leakage of fluids) in the knee joint while reducing the incidence of hock effusion compared to the PASTEX (pastured) group. Effusion was minor and had a low incidence in both knees and hocks. The incidence of fetlock effusion was similar in both groups.

There was no significant difference in height, weight, or condition score between the groups, although CONDEX foals tended to have a slightly lower average condition score and a more muscular appearance near the end of the trial (12 months of age and older). Growth and development were typical of Thoroughbred foals reared at pasture as compared to figures from Brown-Douglas (2005) and Pagan (1996). Evaluations of behavior showed no significant differences between groups in the amount of time spent grazing, lying down, interacting socially with other foals, or performing high-intensity behavior. Plasma cortisol levels were not significantly different between the groups at any time, an indication that enforced exercise was not a cause of significant stress.

Radiographic studies showed no significant differences between the groups as to bone and joint abnormalities. For most joint surfaces, few abnormalities were found on post-mortem examination, and those that were seen were small. The knee and hock joints had a greater (about 65%) incidence of minor abnormalities, but these numbers were not significantly different between the CONDEX and PASTEX groups.

How does this study advance our knowledge about the safety and long-term effects of imposing exercise regimens on very young horses?

The authors state, "Research in this area is timely given the increasing evidence that biochemical make-up and hence biomechanical resistance to forces of musculoskeletal tissues that are both lesion-prone and are known to have little if any regenerative capacity in the horse, can be manipulated through early exercise." They conclude that the low incidence and minor nature of joint abnormalities found in this study indicate that the imposition of this level of exercise did not have a detrimental clinical effect on the health status of joints in this population of foals. The effect, if any, on reduction of future injuries and/or increased ability to recover from injuries is unknown. The authors suggest that, while the study did not prove that increased workload induced positive changes in the structure and function of the musculoskeletal tissues, this work can serve as a benchmark for the design of further trials.

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