REDUCING PERFORMANCE HORSE INJURIES THROUGH NUTRITION

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INJURIES TO HORSES

Skeletal injuries in performance horses are relatively common creating many issues. Arguably one of the most important deals with the welfare of the animal. Typically injuries are accompanied by pain or discomfort. A second would be public perception, which is a concern when horses are injured in front of the general public. When a horse breaks down in front of a large audience, the backlash to the industry can be substantial. A third is the cost associated with treating injuries and the lost income when a horse is not able to train and compete. Any of these issues by themselves should be reason enough to try to minimize skeletal injuries but, when combined, it is obvious that the reduction of injuries is vitally important to those in the horse industry.

Many factors can play a role in why horses are prone to injuries. These include genetics, structure, nutrition, management, and training. Often it is a combination of these factors that predispose an animal to injury. Though one cannot be expected to change the first two factors, the remaining three are under the control of a horse owner or trainer and by applying current knowledge, a reduction in injuries can be expected.

CALORIC INTAKE

Feeding horses appropriately is the first step in making a strong skeleton and reducing injuries. However, deciding whether one is doing such is not as easy as it might seem. Only energy requirements can be evaluated easily to determine if one is meeting the animal's requirements without being excessive. That is done by simply body condition scoring the horse (Henneke et al., 1983). A moderate body condition score (BCS) of around 5 appears to be most desirable for most athletic horses as evidenced by studies involving endurance horses (Lawrence et al., 1992) and racehorses (Gallagher et al., 1992a,b). At a BCS of 5, the ribs will not be visible but can easily be felt. A horse much below a BCS of 5 will not have sufficient energy reserves to perform adequately. When a horse is much greater than a 5, they will have greater difficulty in dissipating heat. Additionally, they will tire sooner as they carry the extra weight associated with fat stores and the extra weight also causes increased load on the legs subjecting them to an increased risk of injury.

PROTEIN, CALCIUM, AND PHOSPHORUS INTAKE

Unfortunately, it is much more difficult to assess whether the requirements for other nutrients are being met without being excessive. Doing so requires calculating the quantity of nutrients (such as protein and minerals) and comparing that to the animal's requirements. In many cases, the extra nutrients required due to exercise are met by the increased feed consumed to meet the increase in energy demands associated with work. However, several studies emphasize an increased need for dietary calcium, compared to what was recommended by the 1989 NRC, during early periods of training when bone turnover and formation is increased (Nielsen et al., 1998; Buchholz-Bryant et al., 2001). Fortunately, if a good quality hay and a balanced, commercially-prepared concentrate is being fed, the increased calcium demand will typically be met. It is when one is feeding raw grains (i.e. straight corn or oats) that are naturally high in phosphorus and low in calcium that one might be limiting bone development by not providing sufficient calcium to facilitate proper bone development. In contrast, when insufficient exercise is not provided, even feeding calcium at about twice the required amount is not sufficient to prevent bone loss (Porr et al., 1998). Interestingly, a ten-year study in humans showed that calcium intake over that period was not associated with bone gain or bone strength (Lloyd et al., 2004). Instead, only exercise during adolescence was significantly associated with increased bone mineral density and bone bending strength. This underscores the importance of exercise in young horses to maximize bone strength. However, if sufficient exercise is provided, extra dietary calcium will likely be utilized to improve bone strength. Thus, proper nutrition is important but proper exercise appears to play an even more important role in preventing skeletal injury to horses.

OTHER MINERALS

A number of minerals besides calcium do play a role in skeletal development. One of those that gained substantial attention during the past 25 years is copper. Many believe that low copper concentrations are linked to osteochondrosis. However, despite many commercial feeds incorporating copper at the rate of 40 to 55 ppm or higher, well above the required concentration of 10 ppm recommended by the 1989 NRC, osteochondrosis still remains an issue in the horse industry. Additionally, Gee et al. (2005) studied 33 Thoroughbred foals and their dams and reported that copper supplementation of dams had no effect on the frequency or severity of lesions in articular cartilage. The authors concluded that copper is an over-emphasized factor in osteochondrosis. One should keep in mind that if copper concentrations in the diet are lower than the required amount, problems likely will arise. However, it is unlikely that supplementing at a much higher rate will greatly reduce the incidence rate of osteochondrosis.

Another mineral that has been implicated in the reduction of skeletal problems is silicon. Despite substantial amounts being found in the environment, most forms are not readily absorbable. One type that appears to be is the silicon found in sodium zeolite A. By increasing plasma silicon, sodium zeolite A was reported to decrease injury rates and increase distances traveled in their training program before experiencing an injury in Quarter Horses in race training (Nielsen et al., 1993).

SOURCE OF MINERALS

Interestingly, the source of mineral may play a role in skeletal health also. Often, due to limitations in research techniques, it is difficult to detect significant differences in indicators of bone metabolism when feeding different mineral sources. However, studies have shown different sources of minerals to result in alterations in markers of bone turnover (Nielsen et al., 2008), mineral balance (O'Connor et al., 2008), and hoof growth (Warren et al., 2009).

NUTRITION AND EXERCISE

Though nutrition can certainly have an impact on bone mass and strength if not provided in sufficient quantities, small differences in the quantity do not seem to have a major impact as evidenced by a large number of research studies not being able to detect treatment differences due to small changes in diets when minimum requirements are met (Nielsen and Spooner, 2008). This is in contrast to changes in bone developing when only small differences in exercise are introduced. Thus, when examining ways to make a stronger skeleton, it is critical that the amount and type of exercise a horse receives is evaluated in addition to its nutrition.

LACK OF PROPER EXERCISE

Stalling of horses is a common practice; however, in recent years evidence has accumulated showing the detrimental effects of stalling without affording sprinting opportunities to the horse. Nielsen et al. (1997) reported a decline in the mineral content of the third metacarpal bone of two-year-old Quarter Horses put into race training. This relatively rapid decline in mineral content, and likely associated decrease in strength, during the first two months of training was unexpected. However, review of the management of the horses gave some indication of the cause. Prior to the initiation of training, the mineral content of the third metacarpal bone was increasing. This was expected as yearling horses are still growing. When horses were put into training, they were also removed from pasture and put into stalls. During the first couple of months of training, horses were trained in the traditional manner and were only walked, trotted and cantered slowly in the manner typically called "long, slow distance" to develop a fitness foundation. It was not until the horses had been in training for about 2 1/2 months that they were first asked for speed. Ironically, this corresponds to the time in training when most bone-related injuries occur. This is not surprising. With lowered mineral content, the bones would have been substantially weaker than before training began and the horses were more susceptible to injury. Shortly after the increase in the speed of exercise, the mineral content of the third metacarpal bone began to increase.

STALLING VERSUS PASTURE

In order to verify that removal from pasture and placement into stalls truly caused the decrease in mineral content, Hoekstra et al. (1999) took a group of long yearlings that had been raised on pasture and randomly put half into stalls and half remained on pasture. By day 28, horses that had been placed into stalls had lost a dramatic amount of mineral from the metacarpal bones. Despite walking horses for an hour per day on a mechanical horse walker, the mineral loss still occurred. After three months the horses were started under saddle and were ridden at the walk, trot and slow canter for an additional two months but the mineral content of the metacarpal bones never increased. In fact it remained lower than it was at the start of the study. The results clearly showed that stalling young horses is detrimental to bone strength though the question remained as to how much exercise is needed to prevent bone loss.

SHORT SPRINTS

In other species only a minimum number of bone loading cycles (similar to strides) is necessary to prevent disuse osteoporosis (Rubin and Lanyon, 1984; Inmam et al., 1999). To prevent bone loss, the duration of turn-out likely only needs to be enough to allow a few fast-paced strides. This is because bone responds more readily to how much force is placed upon it rather than how many times the force is applied. An increase in speed results in increased force to the leg, which causes the bone to bend. The bone responds to this strain as it tries to maintain a balance that allows the bone to bend to a limited degree. This response is logical from an evolutionary standpoint. If the horse runs faster than it has in recent runs, the bone will bend more. The increase in strain is recognized and the body responds by adding more mineral in order to reduce the amount of strain. In contrast, if the horse does not run and, hence, the bone does not bend, the body senses the decrease in strain and removes mineral that is perceived as unnecessary. By doing so, a balance is struck between having enough mineral present to withstand regularly encountered forces but not so much as to be energetically inefficient.

While the exact number of strides at speed needed to promote bone deposition has not been fully determined, some ideas are available. One study used Holstein bull calves as a model for young horses (Hiney et al., 2004a). The calves were divided into three groups. One group was group-housed with other calves and allowed free access to exercise. The two other groups were kept in tie-stalls that allowed standing and lying down but prevented exercise. One of the stalled groups was led from their stalls five days per week and the calves were sprinted down a concrete alleyway for 50 meters before being caught and led back to their stalls. After six weeks, the differences between the forced exercise group and the other groups were remarkable. Even by simply examining the cross sectional area of the third and fourth metacarpal bones, it is clear that the forced exercise group had thicker bones than the non-exercised groups. Furthermore, there was a trend for an increase in the force required to fracture bones in the sprinted group compared to the other two groups. Considering the calves were only asked to run 50 meters per day emphasizes the fact that only minimal strides at speed are needed to maintain, and even increase, bone mass.

A similar study was conducted with weanling horses, except that the exercised group was sprinted 80 meters per day on a grass alleyway (Hiney et al., 2004b). Similar to the calf study, exercised horses had greater mineral content of the metacarpal bones than stalled and group-housed horses. Aside from demonstrating that minimal strides at speed can improve bone formation, both the horse and calf studies demonstrated that group housing by itself is not sufficient to maximize bone strength. In both situations, behavior data provided clues as to why this was the case. Group-housed animals were relatively inactive, supporting the contention that if animals do not run, benefits from being on pasture or housed in groups are minimized.

EXCESS LOAD ON UNPREPARED BONE

As important as it is to place load upon the skeleton in order to maintain strength, it must be cautioned that the phrase "if a little is good, a lot must be better" does not apply to skeletal physiology. While a few strides at fast speed are necessary to maintain and strengthen bone, too many strides are taken at speed can easily overwhelm the skeleton – particularly if it has not been previously conditioned to handle that rate of speed. Bone will accumulate damage when it is repeatedly bent under large forces (such as when running at a high rate of speed). This may lead to fracture although bone has the capacity to repair itself if the rate of healing is not overwhelmed.

Recognizing these factors, it is easy to explain why young racehorses have such a high injury rate – reportedly reaching upwards of 70% (Norwood, 1978). Under traditional management and training practices high injury rates are almost inevitable. Prior to the onset of training, horses that have gone through yearling sales often are stalled for two to three months to guarantee "saleable" condition. During this period, horses are often only walked or, sometimes, trotted. The bones of young horses respond to the reduced strain load on the skeleton and lose strength. After being sold, horses are kept in stalls while being started under saddle. The first two to three months of training usually consist of walking, trotting and galloping (racetrack terminology for cantering). Unless horses are given regular turn-out time during these periods, it would be expected that the skeleton would weaken below levels prior to the horse being prepared for the sale. Another problem is that during the early conditioning period, other physiological systems such as the cardiovascular and muscular systems gain fitness and the horses become mentally ready to progress in training. The result is that horses appear and act fit to trainers, so the trainers begin to introduce speed into the training program – speed that is occurring when the bone is dramatically weaker than it was three to six months earlier. If speed was gradually introduced, bone would increase in strength and no problems would ensue. Unfortunately, speed is generally introduced rather rapidly as the horses appear to be capable of handling the speed. Before long, damage accumulation is sufficient to result in fractures of the fatigued bone – either as microfractures in the early stages or in complete fractures if not caught in time.

COMBINING NUTRITION AND EXERCISE

As most equine nutritionists realize, horse owners often expect the feed they provide to their horse to prevent all problems. In the case of injuries, improper nutrition can increase the number of injuries that are experienced, but good nutrition cannot totally eliminate injuries if horses are not trained and managed properly. A horse that is not adapted to the forces at which it will be competing will usually experience injuries regardless of what the animal is being fed. Hence, it becomes imperative that owners and trainers are educated not only on good nutrition, but also what type of stimulus is needed through exercise to allow the animal to be structurally strong.

TAKE HOME MESSAGES

The best approach to preventing injuries is using the knowledge that is becoming established in terms of exercise needed to strengthen bone and combining it with a proper nutrition program. Without proper exercise, the amount of bone present will not be optimized, as the body does not recognize a need for increased bone strength. Likewise, if proper nutrition is not present, even if there is a demand for greater bone development associated with exercise, the body may not be able to meet the needs for enhanced bone formation. Thus there is a need for both proper nutrition and adequate exercise – working together to build strong bones.

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