AAEP 2008: Racehorse Exercise Predicts Bone Strength

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Nearly 20% of fatal musculoskeletal injuries in Thoroughbred atheletes are due to complete humeral (forearm bone) fractures, which often occur early in training or following an prolonged layup. Rachel Entwistle, BS, of the University of California, Davis, discussed the wastage that occurs with humeral fractures in these atheletes at the 2008 American Association of Equine Practitioners convention, held Dec. 6-10 in San Diego, Cailf. Complete fractures are typically characterized by a pre-existing, underlying stress fracture (periosteal bone callus). In Thoroughbred athletes this is often a bilateral disease (occurring in both front legs).

Entwistle explained that the maturity of the callus that bridges the fracture line is the best predictor of bone strength at the injury site. She noted that bone strength decreases in early stages of callus formation and attempts to return to normal with maturation as bone modifies its structure relative to its loading environment. Bone-tissue changes can be detected early by nuclear scintigraphy or MRI, and they can be seen later by radiography.

The study objective was to determine the functional consequences of stress fracture at both a common site (actual point of stress fracture) and distal (lower) site in the humerus, as well as to examine the relationship of bone strength and exercise history. Entwistle and colleagues hypothesized that bone tissue strength at the stress fracture site would be altered, yet the distal site would not be affected by stress fracture. They also hypothesized that bone tissue strength is altered by microstructural tissue changes likely affected by exercise regimes.

The distal site successfully adapted and recovered, but the site of stress fracture did not adapt as successfully. Strength at the affected site was dictated by amount of bone tissue present. It was proposed that the loading environment was likely the mechanism that was preventing adaptation at the stress fracture site. If stresses and strains are applied continuously to a weakened area of bone that has sustained a stress fracture, bone material cannot function appropriately; subsequently, it deteriorates, defined as decompensation. This is likely due to remodeling activity related to intense exercise training with accumulated micro-damage.

The humerus must adapt to changing loads associated with racing and training, otherwise it becomes susceptible to injury. In early stages of stress fracture disease, a horse might present with lameness. However, no radiographic changes are evident. Later in the disease process, veterinarians can detect periosteal callus on radiographs. Unsuccessful humeral adaptation is characterized by decompensation, weakened bone material, and, in some cases, complete fracture. Successful adaptation is characterized by lack of injury and eventual blunting of the curvature of the topmost rear region of the humeral neck.

It is important to allow adequate recovery time for remodeling activity to initiate and near completion before reintroducing horses with humeral stress fractures to high-intensity racing and training.