

RISK ASSESSMENT FOR PROXIMAL SESAMOID BONE FRACTURE

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This study will save the lives of racehorses by establishing screening using fetlock standing computed tomography for diagnosis of horses with a high risk of serious injury for personalized care.

Injuries to the Thoroughbred racehorse that lead to euthanasia are termed catastrophic. In 2022 the incidence of catastrophic injury was 1.25 fatalities per 1,000 starts in the USA, representing a loss of hundreds of horses. Stress fracture of the proximal sesamoid bone (PSB) is a common cause of fatal injury. Repair of PSB fractures, particularly biaxial midbody fractures, or fetlock salvage is associated with a poor prognosis. There is, therefore, a critical need to comprehensively improve preventative screening of Thoroughbred racehorses for the presence of concerning bone injuries that increase the risk of catastrophic injury from PSB stress fracture.

Our long-range goal is to reduce the incidence of catastrophic injury in Thoroughbreds by improving clinical screening using routine standing computed tomography (sCT) imaging in the sedated horse to check for concerning bone injury in the fetlock, particularly PSB injury that precedes stress fracture. The objective of this application is to develop a sCT screening approach for evaluation of racing Thoroughbreds with concerning fetlock bone injuries using computerized analysis of sCT images to identify horses with high imminent risk of PSB stress fracture and potential catastrophic injury. Our hypothesis is that our computerized virtual mechanical testing approach will be able to identify horses with high risk of PSB stress fracture. Our hypothesis is based on the substantial progress that we have made implementing a similar computer modeling approach for predicting risk of condylar stress fracture.

The rationale for this work is that implementation of sCT screening with computer model analysis of sCT scans in populations of racehorses will lead to substantial reductions in fatal injuries associated with fetlock stress fractures by accurately identifying horses with imminent risk of PSB

fracture. An advantage of our research approach is that other information, such as exercise history and information about the training surface are not needed for risk prediction. Risk for individual horses is predicted directly from imaging information. To accomplish our objective, we will perform mechanical testing of PSB specimens after sCT imaging.

We will relate the structural changes in the PSB, features that would not be detectable by radiography, to the propagation of a PSB stress fracture, which is a serious injury clinically. We will use these data to build a computer (finite element) model of the PSB to undertake detailed analysis of the mechanical properties of the PSB so that bones with reduced mechanical properties can be easily identified. This work will be undertaken using limbs collected from Thoroughbred racehorses that have euthanatized at the racetrack because of catastrophic injury. Under loading that models racing, mechanical testing of PSBs will be performed. Relevant features in the PSB will be determined from sCT images.

This information will then be used to build the 3D PSB computer model and optimize and validate the mechanical predictions from the computer model to identify horses with imminent risk of serious injury. As a prelude to this project, we have designed and built a helical sCT scanning system that enables routine fetlock CT imaging. The proposed research is innovative because it capitalizes on routine availability of sCT imaging. Regarding outcomes, the work is expected to contribute in meaningful ways to the substantial clinical value in routine fetlock CT imaging. Ultimately, the outcomes of this project will save many horses from serious fetlock injury and death. This is a major advance, as the incipient changes in the PSB that increase risk of stress fracture cannot be reliably identified on

radiographs of the fetlock, making it impossible for equine veterinarians up to now to effectively screen racing Thoroughbreds thoroughly for concerning bone lesions that represent high risk of injury. Advances from this research will improve the effectiveness of injury prevention programs for racing Thoroughbreds across the world as sCT imaging becomes more widely adopted. We are well positioned to pursue this research because of the expertise of our team regarding injury prevention.

Importance to the Equine Industry: This work will ultimately save the lives of many racehorses. Completion of this project will enhance knowledge of the relationship between specific structural changes in the proximal sesamoid bone and imminent risk of stress fracture propagation, a serious injury that is often catastrophic. Since true standing computed tomography imaging in horses is now routine, this knowledge is directly translatable into clinical practice because racehorses with concerning bone lesions that are not evident on radiographs can easily be identified and managed appropriately without disruption to training and racing schedules. Our virtual mechanical testing approach using computer modeling enables wide preemptive longitudinal monitoring of horses in training to implement improved personalized care for racehorses and reduced catastrophic injury.

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