Risk assessment for condylar stress fracture in the racing thoroughbred

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Injuries to the Thoroughbred racehorse that lead to euthanasia are termed catastrophic; 80% of such injuries involve the locomotor system. Condylar stress fracture represents ~25% of catastrophic injury. Race performance after surgical treatment of Thoroughbreds with condylar fracture is often disappointing. There is a critical unmet need for development of clinically relevant methods differentiating dangerous from safe lesions given the high prevalence of stress injury to fetlock bone. With use of standing computed tomography (sCT), fetlock bone injury can be readily identified. Our long-range goal is to reduce the incidence of catastrophic injury in racehorses by sCT fetlock screening, which can be performed without disruption to training.

The objective of this application is to advance identification of racing Thoroughbreds with concerning injury to fetlock bone that have a high imminent risk of serious injury. We aim to develop a fast, accurate, clinically relevant analysis method. Our hypothesis is that a patient-specific computer model, known as a finite element model, for analysis of fetlock sCT features will enable identification of horses with imminent risk of serious injury from condylar stress fracture. Our hypothesis is based on strong preliminary data. In this project, we will compare two complimentary approaches for building patient-specific models and compare their predictive accuracy. This approach will rapidly optimize our computational approach for clinical screening, thereby yielding substantial reductions in serious injury in racehorses across the world and a strong rationale.

To accomplish our objective, we will pursue the following specific aims: (1) Identify horses with a high fracture risk using a 3D model of the fetlock joint to assess bone injury using an analytical method that considers cumulative cyclic loading of the joint and (2) Identify horses with a high fracture risk using a simpler and faster thin slice model of an oblique frontal plane slice of the joint surface. Under Aim 1, we will extend our validated 3D patient-specific modeling capabilities to include consideration of cyclic loading in the stress fracture risk analysis and analyze longitudinal sCT scans from Thoroughbreds beginning race training. Under Aim 2, we will analyze a simplified patient-specific 2D FE models of an oblique frontal slide of the joint surface and compare predictive performance of thin slice and 3D FE models. As a prelude to this project, we have designed and built a state-of-the-art commercially available sCT scanner for the standing horse that has enabled routine fetlock CT scanning clinically. The approach is innovative because it exploits the capabilities of sCT imaging systems. Regarding outcomes, we expect to develop a solid basis from which routine fetlock screening of large populations of Thoroughbreds with minimal risk and no disruption to training, thereby providing a high translational impact. Horses with concerning lesions and a high risk of imminent injury can be identified for personalized care. Clinical implementation of this work will save the lives of many racehorses. Routine implementation of preemptive longitudinal monitoring of horses in training will mean improved care for racehorses and better prevention of condylar stress fracture.