Development of a CT-based biomarker model of fetlock joint disease

Chris Kawcak, Colorado State University, US
(Major Research Grant: USD 314,914)

Catastrophic injury in the thoroughbred racehorse is unfortunately common, and the industry's social license to continue horse racing has come under scrutiny in large part because of severe injuries to the fetlock joints. The scientific community has worked to describe the microstructural changes that occur in the joints of injured horses, and advances in diagnostic imaging (namely to development of computed tomography - CT) have allowed veterinarians to identify horses that might be at risk of injury when a small fracture is present. However, identification of the microstructural changes that occur in the subchondral bone of racehorses prior to fracture formation would be ideal and allow the veterinary community to identify horses at risk of injury sooner in their career to better monitor and manage their training. Based on this premise, the investigators plan to develop analysis techniques from CT-based data that can be used to characterize the microstructural changes that commonly occur with fetlock joint injury. Specifically, the investigators aim to use well-established shape determination and textural correlation techniques from CT data to discriminate diseased from normal bone and then apply machine learning techniques to those data to develop a software model that can be used for the clinical determination of fracture risk.

Specifically, we hypothesize that joint shape, subchondral bone architecture, bone lysis and sclerosis patterns, as represented by image-based shape and texture features, will interdependently predict susceptibility of the bones to injury. We will use two specific aims to address this hypothesis. Specific Aim 1: To develop a reference morphologic model of the equine fetlock joint using UHR CT in normal and abnormal joints of racehorses. Based on strong microCT evidence in the literature, we hypothesize that there will be a difference in model characteristics between the 2 populations of horses, allowing for optimization in recognition of those differences. Specific Aim 2: To correlate model characteristics between the findings of Specific Aim 1 and results from other fan- and cone-beam systems currently available for equine imaging. We hypothesize that shape and texture findings on current clinical scanners can be correlated back to the results of the reference UHR CT. The results of this study will help to inform clinicians as to characteristics that may predispose horses to injury versus those that are a response to intense modeling and might actually be protective to the horse. These results can form the base model onto which variables external to the horse can be overlaid.