

Tendon Elastin And Lubricin: Biology And Mechanics

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Elucidating the underlying biology and mechanical roles of tendon interfascicular matrix proteins, elastin and lubricin, is essential to identify overuse injury mechanisms and develop novel therapies.

The elastic strength of equine superficial digital flexor tendon (SDFT) is mainly due to the sliding motion between type I collagen rich fascicles that are separated and connected by the interfascicular matrix (IFM). The IFM is mainly made of non-collagen proteins, elastin and lubricin. Despite the important role of the IFM in SDFT function and the high incidence of SDFT injuries in racehorses and sport horses, the underlying biological processes, and the remodeling of tendon matrix proteins as they relate to SDFT function, are poorly understood. Additionally, since it has been shown that the non-collagen tendon proteins maintain collagen synthesis, regulate collagen fiber assembly and enable the sliding motion between collagen bundles, also known as fascicles, determining the biological and mechanical roles of IFM elastin and lubricin is essential for developing effective treatments for equine tendon injuries.

Our research teams will leverage our complimentary expertise in elastin and lubricin biology and use cutting-edge methodologies previously not used in equine tendon research to address the unmet needs of the equine tendon field. In Aim 1, we will dissect the mechanical roles of elastin and lubricin by conducting cyclical mechanical testing (simulating in vivo loading) on elastin- and lubricin-digested fascicles, IFM and experimentally-injured whole tendons. In Aim 2, we will use spatial transcriptomics to identify distinct molecular programs in SDFT fascicle and IFM to then identify and define cell types regulating elastin and lubricin gene expression. In Aim 3, we will investigate the altered tissue distribution of elastin and lubricin in histological sections of clinically injured flexor tendons of Thoroughbred racehorses. The results of this research will unravel the biology and the specialized mechanics imparting functional elastic strength to equine SDFT.

Importance to Industry: SDFT injuries continue to be a common cause of wastage in racehorses and sport horses. At present, treatment strategies for tendon injuries emphasize improving only the collagen fiber architecture even though tendon function is largely mediated by the sliding motion between collagenous fascicles governed by the matrix between the fascicles. Therefore, current tendon treatments fail to address the underlying biology and altered structure-function in tendon injury. The proposed research is important because investigating the biology and mechanical roles of elastin and lubricin using cutting-edge techniques is crucial to understand overuse mechanisms linked to cumulative microdamage that precede clinical tendon injuries. The results of this research will also lay the groundwork for developing effective novel treatments that restore SDFT structure and function, reduce tendon fibrosis and reinjury rates.