Relationship between Equine Cartilage Mechanical Properties and Biochemical Composition

Summary: The Colorado State University Orthopaedic Researchers joined forces with scientists at the Cartilage Tissue Engineering Laboratory at University of California—San Diego to do tensile testing and biochemical component analysis on cartilage from selected areas of equine joints. This work will provide a baseline on how the biochemical makeup of equine cartilage is related to its physical reaction to forces.

The CSU Orthopaedic Research Center (ORC) and the Cartilage Tissue Engineering Laboratory (CTE) at University of California–San Diego have joined efforts to shed light on how cartilage reacts to physical forces in selected areas of equine joints. The goal of this project is to provide reference for future ORC studies related to equine joint tissue healing, injury, and disease. The medial trochlear ridge, medial femoral condyle, and the third metacarpal condyle were the joint surfaces of interest. The medial femoral condyle and the medial trochlear ridge areas were chosen for their popular use in cartilage regeneration research. On the other hand, the third metacarpal condyle was chosen for its predisposition to exercise-related fatigue damage causing cartilage degeneration and subchondral bone collapse.

All samples were acquired from routine necropsies at the Colorado State University Veterinary Teaching Hospital. Currently, joints from eight adult horses (two year olds) and three weanlings (five to six month olds) have been collected for analysis. To help orientate the superficial cartilage component (collagen) in the direction of tensile testing and to shed light on how this alignment is dispersed over the stifle joint, a splitline technique was performed on over sixteen stifle joint surfaces. This simple technique, which has been used since the 1800's, visually depicts how the superficial collagen fibers are orientated, which is highly related to joint motion. This splitline work has helped orientate specimens during the procedure performed at University of California–San Diego's Cartilage Tissue Engineering Laboratory and will do so in the future.

Due to the strong collaborative efforts between the ORC and CTE, samples were tested in La Jolla, California within Dr. Robert Sah's laboratory in December 2001. With the help of five graduate students, Amanda Williamson, Won Bae, Michelle Temple, Van Wong, Chad Lewis (ORC PhD student), and assistant research scientist, Dr. Albert Chen, surface staining, indentation, dynamic confined compression, and tensile tests were performed on most of the four areas of interest noted above. Confined compression properties and tensile properties were obtained.

All tested site samples (64 total) are in the process of being analyzed for biochemical components, which are highly correlated with physical function (i.e. mechanical properties). This part of the study will be performed at ORC's biochemistry laboratory. This information will provide a baseline on how the biochemical makeup of equine cartilage is related to its physical reaction to forces.

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