Age-Related Differences in Strain Transfer Mechanisms from ECM to Cell

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Tendinopathy is a highly prevalent clinical condition mainly caused by overuse or age-related degeneration of tissues. The transfer of strain from the ECM to the cell triggers extracellular matrix (ECM) remodeling. Therefore, a reduction in strain transfer could lead to a reduction in ECM remodeling and ultimately, tissue degeneration. A bioreactor with the capabilities of applying controlled loads and imaging loaded tissues would enable the study of strain transfer at the cellular level. The team inherited previously established hardware and control software for a customized mechanical loading bioreactor, which has the potential to be used in conjunction with the Olympus FV3000 confocal microscope. The team first improved the load reading of the system to be able to distinguish changes of load of at least 10 grams to improve the systems sensitivity. The team then developed a custom program using MATLAB App Designer to track cells and calculate strain transfer between images generated by confocal microscopy. The data analysis software uses image processing and tissue-level displacement data to calculate multi-scale strains and strain transfers. The team then conducted experiments to observe age based differences in mice tendons to demonstrate the effectiveness of the bioreactor system. Utilizing nuclear and cellular staining procedures, the team produced multi-level strain transfer measurements utilizing confocal microscopy and the bioreactor system. Utilizing the bioreactor system will further enable the study of strain transfer within the Conizzo Lab through the combination of real time mechanical loading and fluorescent imaging.