

Mineralized Tissue Changes Within the Anterior Cruciate Ligament Enteses Following a Tear

Nicholas Nguyen¹, Stephen Schlecht^{1 2}

¹Indiana University School of Medicine; ²Department of Orthopaedic Surgery

Background: Thirty-percent of patients under 20 years of age suffer a primary ACL graft failure. Young patients show significant bone loss at the femoral ACL-bone insertion site (entheses). We hypothesize that active bone resorption during ACL graft fixation contributes to poor graft survival in the young. We investigated distal femoral and enthesal bone morphology changes after injury in a novel mouse model to determine if previously reported post-injury patient condition anti-translates to the mouse. Confirmation of a similar condition across species will allow us to use this model to spatially and temporally track physiologic processes within this critical region.

Methods: We induced an *in vivo* ACL rupture in 24 10-week C57BL/6J female mice and sacrificed them at 7 and 28 post-injury. Both loaded ipsilateral and non-loaded contralateral knees were 3D imaged and distal femoral and ACL enthesal cortical regions have begun being analyzed. Traits analyzed include 1) cortical (Ct.) mean gray-value density, area (Ar.), thickness (Th.), and bone volume fraction (BV/TV) Statistics: two-way ANOVA and Tukey posthoc.

Results: So far, mice are temporally demonstrating bone differences between injured and non-injured knees similar to that of patients at the time of ACL reconstructive surgery. By 7 days there is a steep decline in whole distal femoral epiphysis and ACL femoral enthesal Ct.Ar (-19.84% and -11.46%, respectively) and Ct.Th (-8.09% and -3.52%, respectively). The trend in Ct.Ar loss holds at 28 days (-40.95% and -8.32%, respectively), but not in Ct.Th, which substantially increases (6.26% and 11.05%, respectively).

Conclusion: It appears bone loss is rapid following injury, and that by 28 days there is increased porosity within the cortex with new periosteal/endosteal bone formation counteracting this. If true, particularly within the enthesal region, this may prove problematic for long-term graft outcomes when surgery is performed at the time of significant macrophagic activity.