Tibial Articular Cartilage Strain is Associated with Shear Forces During Gait Following Anterior Cruciate Ligament Reconstruction

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Background: Aberrant gait biomechanics after anterior cruciate ligament reconstruction (ACLR) are associated with posttraumatic knee osteoarthritis (PTOA). Altered shear loading has been linked to deleterious changes to tibiofemoral articular cartilage in idiopathic osteoarthritis, yet these associations have not been explored post-ACLR. Articular cartilage deforms in response to loading forces such as walking (i.e., strain) to transmit loads on the knee joint. Greater cartilage strain is associated with osteoarthritis.

Purpose: To determine associations between shear (anterior-posterior [AP], medio-lateral [ML]) ground reaction forces (GRFs) during gait and tibial cartilage strain post-ACLR.

Methods: Participants completed a standardized walking protocol of 3000 steps at habitual gait speed which was preceded and followed by MRI scans of the ACLR limb. Cartilage strain was calculated as the MRI-measured change in cartilage thickness from pre- to post-walking relative to pre-walking thickness. Overground gait biomechanics were collected on a separate day to calculate AP/ML GRFs. GRFs were normalized to body weight. Spearman's correlation coefficients determined the associations between AP/ML GRFs and cartilage strain of the medial and lateral tibial condyles.

Results: Twelve individuals 0.5–5 years post-ACLR participated (58% female; 22.9±3.9 years old; 25.6±2.7 kg/m^2). Greater first ML GRF peak was associated with greater lateral tibial condyle cartilage strain (R=0.64, p=.03). No other statistically significant correlations were observed.

Conclusion: Greater laterally-directed loading during gait is associated with greater lateral tibial cartilage strain post-ACLR. Future research should further assess how shear loading influences PTOA development, and whether interventions can reduce shear loading to decrease cartilage strain and PTOA risk.