Larger Lateral Femoral Condyle to Lateral Tibial Plateau Ratios are Highly Predictive of Primary ACL Tears and ACL Reconstruction Failures

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INTRODUCTION:

Distal femoral morphometric characteristics may influence anterior cruciate ligament (ACL) injury risk and reconstruction failure. The purpose of this study was to compare femoral parameters including notch width (NW), condyle width (CW), notch width index (NWI), lateral femoral condyle ratio (LFCR), and lateral femoral-tibial anterior to posterior ratio (LFTap) among patients with an intact ACL (ACLi), primary ACL tear (ACLp), or ACL revision (ACLr). We hypothesized that decreased LFTap, NW, and NWI would be associated with ACL injuries.

METHODS:

Skeletally mature patients (ages 16–40) were retrospectively identified and grouped into ACLi, ACLp, and ACLr cohorts (n=56 per group). Morphometric measurements were obtained from preoperative MRI and radiographs. LFTap was calculated by dividing the anterior to posterior distance of the lateral femoral condyle by the anterior to posterior distance of the lateral tibial plateau on lateral knee radiographs. Logistic regression was performed to identify independent predictors of ACL injury and revision.

RESULTS:

LFTap was significantly lower in ACLi (1.80±0.06) compared to both ACLp (1.22±0.07) and ACLr (1.21±0.08) (p=0.005). CW was significantly smaller in ACLp (76.4±7.5 mm) than ACLi (79.6±7.3 mm) (p=0.04). In regression, LFTap independently predicted ACLp (odds ratio [OR], 2.91; 95% CI: 1.46–6.70; p=0.004) and ACLr (OR, 1.99; 95% CI: 1.07–3.70; p=0.03). For combined ACL injuries (ACLp + ACLr vs. ACLi), LFTap remained significant (OR, 2.20; p=0.005). In the revision model, younger age (OR, 0.93; p=0.03) and higher BMI (OR, 1.12; p=0.01) were also predictive of failure.

DISCUSSION AND CONCLUSION:

LFTap was the strongest predictor of both primary ACL injury and revision. Specifically, a disproportionately larger anterior–posterior dimension of the lateral femoral condyle relative to the lateral tibial plateau significantly increased the likelihood of primary rupture and subsequent graft failure. These results highlight the critical role of femoral-tibial morphology in ACL integrity. Surgeons may consider incorporating this anatomical parameter into preoperative risk assessment and patient counseling.