

patients with K-L grade 4 of knee deformity ($p=0.012$) and diabetes ($p=0.003$) presented higher porous SP. Those with essential hypertension presented lower BMD of SP ($r^2=0.635$, $p<0.001$).

Conclusions: This study firstly unveiled the interplay of localized knee deformity based on x-radiography using K-L grading system, preoperative Knee Society score and Functional Scales and systemic disorders, i.e. diabetes and essential hypertension, in end stage of knee OA, in terms of their contributions to the subchondral bone disturbance.

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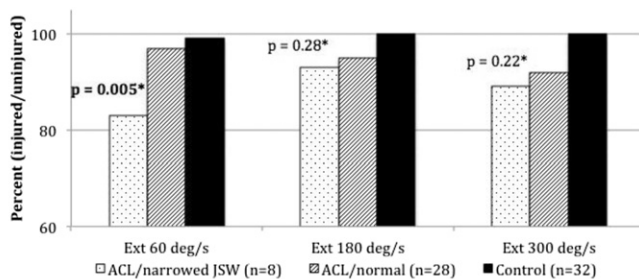
RELATIONSHIP BETWEEN ISOKINETIC STRENGTH AND TIBIOFEMORAL JOINT SPACE WIDTH CHANGES FOLLOWING ACL RECONSTRUCTION

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Purpose: Following anterior cruciate ligament (ACL) injury and reconstruction (ACL-R), quadriceps muscle weakness and low hamstring-to-quadriceps muscle strength ratios have been associated with post-traumatic osteoarthritis (PTOA) as well as primary OA. However, this relationship has not been examined using tibiofemoral joint space width difference (JSW-D) as a measurement of PTOA onset. JSW-D is a measurement technique that is sensitive to PTOA changes prior to the clinical manifestation of the disease. It is important to determine risk factors associated with the onset and progression of PTOA at the earliest time point in the disease process when intervention can alter the progression of the disease. Consequently, the focus of this study was to examine the relationship between isokinetic knee strength and JSW-D at one and four years post-ACL-R compared to a group of healthy, non-injured subjects of similar sex, age, BMI, and activity level.

Methods: A secondary analysis of data collected during a longitudinal study of biomarkers of PTOA following ACL-R was utilized for this exploratory study. Entry criteria for injured subjects included: age at time of ACL-R = 14-55; BMI = 18.5-30; Tegner activity score > 4 ; $< 2/3$ meniscectomy; $<$ grade IIIa articular cartilage lesions; no history of joint surgeries, knee injections, or other knee pathologies; no abnormal knee laxity or evidence of radiographic OA at baseline. Additional criteria for controls included: no knee pain/dysfunction, and normal clinical evaluation and baseline MRI. At 1- and 4-years post ACL-R, standing, bilateral metatarsal phalangeal (MTP) view knee x-rays were obtained for JSW assessment. Subjects were considered to have significant narrowing if their injured minus normal (contralateral) knee JSW difference (JSW-D) fell below the 95% confidence interval of controls. At the same time point, isokinetic knee strength was assessed at 60, 180, and 300 deg/sec, and normalized to body weight. Relationships between strength and JSW-D were evaluated between ACL subgroups (normal and narrowed) and controls using analysis of covariance adjusted for age, sex, BMI, and time since surgery. Post-hoc group comparisons were made using Fisher's LSD.

Results: Of the 34 ACL-R patients included, 6 had significant JSW-D narrowing at 1-year follow-up, and 8 had narrowing at 4-year follow-up. The mean strength values for all ACL-R subjects ("normal" and "narrowed JSW-D" groups combined) were found to be significantly less than the control group at both time points. However, ACL-R subjects with narrowed JSW-D did not differ from normal JSW-D subjects (all $p > 0.20$) with one exception: extension at 60 degrees/second at four-year follow-up ($p = 0.005$). The pattern of knee extension strength at 60 deg/sec at 1-year follow-up was similar to changes observed at 4-year follow-up. Extension to flexion strength ratios were not found to have a significant association with JSW-D at any speed.



*p-values represent difference between ACL normal JSW-D and ACL narrowed JSW-D groups

Figure 1. Isokinetic extension peak torque at final follow-up.

Conclusions: Strength deficits present as early as one year following ACL-R and persist at 4-years post. In general, ACL-R group subjects were not found to have significantly different strength values within JSW subgroups. In contrast to previous studies, the current investigation did not reveal an association between PTOA and low extension to flexion strength ratios. It should be noted that no subjects in this study reported appreciable pain/dysfunction or reduced physical activity, which is indicative of the clinical manifestation of OA. However, subjects with narrowed JSW-D had significantly lower extension strength at 60 degrees/second than controls and injured subjects with normal JSW-D. It may be that individuals that lose a significant amount of knee extension strength are at greater risk for tibiofemoral JSW narrowing following ACL trauma.

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TIBIOFEMORAL CONTACT AREA REMAINS ABNORMAL FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Purpose: Injury to the anterior cruciate ligament is highly prevalent, especially in active populations, with approximately 90,000 ACL ruptures in the U.S. each year. The cartilage contact points are significantly changed in the ACL deficient state, and degenerative changes develop in 82-89% of these patients. The goal of ACL reconstruction is to stabilize the knee and restore normal cartilage contact. Multiple operative techniques are utilized for ACL reconstruction, including the mini-two incision (MT) technique and the anteromedial portal (AM) method. There have been no prior reports to our knowledge regarding the in vivo contact areas after MT reconstruction. We hypothesized that both the MT and AM techniques would result in cartilage contact area that was not significantly different from the patient's contralateral knee.

Methods: Seven patients (4 female; average 15.5 months post-operative) with MT reconstruction and 12 patients (7 female; 12 months post-operative) with AM reconstruction underwent kinematic MR imaging. T2-weighted sagittal images were obtained of the reconstructed and uninjured knee in extension and 30 degrees of flexion with an applied load of 125 N. Cartilage contact areas were manually segmented using in-house Matlab software. The defined Bezier splines were connected with triangles, and the contact area was defined as the summation of the area of the triangles (Figure 1). The contact centroid was defined as the centroid of the triangles. Statistical analyses were performed with a paired t-test with alpha of 0.05 for comparisons of each patient to the contralateral knee.

Results: The contact area (Figure 1) of the medial compartment was significantly lower in MT reconstruction compared to the uninjured side at 90.1% (standard deviation 4.8%) in extension ($p=0.003$) and 86.3% (7.3%) in flexion ($p=0.004$). For AM reconstruction, the only significant change was in the lateral compartment in flexion, which was higher in the reconstructed knee at 111% (18.9%) ($p=0.03$). With the MT reconstruction, the medial contact centroid shifted laterally by 9.5 mm in extension ($p=0.05$) and 10.2 mm in flexion ($p=0.02$) between the reconstructed and contralateral knees. In knees with AM reconstruction, the lateral contact centroid shifted anteriorly by 3.5 mm in extension ($p=0.05$) and the by 4.4 mm ($p=0.03$) in flexion as compared to the normal knee.

Conclusions: The MT technique results in partial restoration of medial compartment articular cartilage area. Additionally, the medial contact centroid is shifted laterally in the MT reconstructed knees. The AM reconstructed knees showed a significant change in the medial and lateral contact centroids in extension. The cartilage contact area was more closely restored in the patients with AM reconstruction. Morimoto et al showed significantly decreased medial and lateral contact areas in single bundle ACL reconstructions. Li et al demonstrated a posterior and lateral shift of the medial contact centroid in ACL deficient knees. Persistent changes in cartilage contact area may contribute to early degenerative changes. Our results suggest that the AM technique may offer improved restoration of cartilage contact areas versus the MT technique, though persistent changes in contact area and centroid location remain with both techniques.