THIGH MUSCLE WEAKNESS 4 YEARS AFTER PARTIAL MENISCECTOMY IS ASSOCIATED WITH RADIOGRAPHIC FEATURES OF OSTEOARTHRITIS 11 YEARS LATER

Y.B. Ericsson, H. Owman, E.M. Roos, M. Englund, L.E. Dahlberg, Dept. of Orthopedics, Skane Univ. Hosp., Malmö, Sweden; Res. Unit for Musculoskeletal Function and Physiotherapy, Dept. of Sports Sci. and Clinical Biomechanics, Univ. of Southern Denmark, Odense, Denmark; Dept. of Orthopedics, Clinical Sci., Lund Univ., Lund, Sweden; Clinical Epidemiology Res. & Training Unit, Boston Univ. Sch. of Med., Boston, MA, USA

Purpose: To examine the association between thigh muscle strength 4 years after partial meniscectomy due to a medial non-traumatic tear, with radiographic features of osteoarthritis 15 years after the meniscectomy.

Methods: 34/45 subjects (11 women) with mean age 57 (range 50-61) years, who participated in an exercise trial post-meniscectomy and underwent baseline testing for isokinetic thigh muscle strength 4 years after surgery, came back for radiographic examination 15 years after surgery. Endpoints were grade of joint space narrowing (JSN) and osteophyte (OF) score in the medial tibiofemoral compartment (MTFC) of the index knee and the contralateral knee. Radiographs were read by two observers separately, blinded to the exposure status and consensus reached by adjudication. We tested the association between muscle strength and the radiographic OA features using linear regression analyses adjusted for age, sex and body mass index (BMI).

Results: At baseline (pre-exercise) mean age was 46 years, mean BMI was 26.0, mean knee extensor and flexor strength deficit in the index leg were 11% and 3%, respectively. At the 15 year follow-up, all subjects but one had joint space narrowing (JSN) in the MTFC of the index knee, and 23/34 subjects had JSN in the MTFC of the contralateral knee. 27/34 subjects had osteophytes (OF) in the MTFC of the index knee and 22/34 subjects had OF in the MTFC of the contralateral knee.

In the index knee we found a negative association between baseline knee extensor and knee flexor strength and grade of JSN at follow-up both in the crude and adjusted model ($R^2 = 0.43$ and 0.40, $p = 0.014$ and 0.028, respectively, adjusted model).

Further, in the index knee, knee extensor and knee flexor strength were inversely associated with OF score ($R^2 = 0.40$ and 0.38, $p = 0.013$ and 0.021, respectively, adjusted model).

In the contralateral knee, the association between baseline knee extensor and knee flexor strength and JSN grade at follow-up was weak and nonsignificant ($R^2 = 0.25$ and 0.24, $p = 0.48$ and 0.61, respectively, adjusted model). However, we found a tendency to a negative association between knee extensor strength and OF score ($R^2 = 0.46$, $p = 0.057$, adjusted model) but no significant association between knee flexor strength and OF score ($R^2 = 0.45$, $p = 0.093$, adjusted model).

Conclusions: Better thigh muscle strength 4 years after surgery was associated with less OA changes in the meniscectomized knee but not in the contralateral knee 11 years later. Our findings indicate that good thigh muscle strength may reduce the risk of radiographic knee OA development after meniscectomy due to a non-traumatic tear.

PREDICTORS OF KNEE PAIN (KOOS) CONSISTENT WITH OA SYMPTOMS AT 2 AND 6 YEARS AFTER PRIMARY ACL RECONSTRUCTION: A MOON PROSPECTIVE LONGITUDINAL COHORT STUDY


Purpose: Knee pain after anterior cruciate ligament (ACL) reconstruction (ACLR) can be severely disabling in some patients, and may be moderated by concurrent injury, subsequent injury, or patient demographic factors. In a cohort of patients with intact cruciate ligaments who had undergone meniscectomies, Englund et al. previously identified score thresholds of the Knee Injury and Osteoarthritis Outcome Score (KOOS) which significantly correlated with both radiographic and symptomatic osteoarthritis (OA). However, this definition has yet to be utilized in a cohort of anterior cruciate ligament (ACL) reconstructed (ACLR) patients to identify the prevalence and risk factors for pain consistent with symptomatic OA. As such, the objective of this study was to apply Englund’s definition of a “symptomatic knee” to a cohort of primary ACLR patients with varying meniscal and articular cartilage pathologies, and to determine risk factors for the development of knee pain consistent with symptomatic OA 2 and 6 years following ACLR.

Methods: Englund’s criteria of a symptomatic knee consistent with OA is based on threshold cut-off scores from the KOOS (KOOS quality of life subscale < 87.5 and at least two of: KOOS pain < 86.1, KOOS symptoms consistent with symptomatic OA). As such, the objective of this study was to identify the prevalence and risk factors for pain consistent with symptomatic OA 2 and 6 years following ACLR.

Patients were obtained from a prospective longitudinal cohort of the Multicenter Orthopaedics Outcome Network (MOON), who had ACLR surgery between 2002 and 2005, and who are followed up at 2, 6 and 10 years. Patients with prior contralateral ACLR or where the index event was a revision ACLR were excluded. Independent variables included patient demographics (age, gender, BMI, smoking status, education level, main sport played at the time of injury, enrollment year), validated outcome instruments (KOOS, WOMAC, Marx activity level), surgical characteristics (graft type, meniscal pathology/treatment, articular cartilage pathologic findings), and incidence of subsequent surgery on either knee. Proportional odds models were used to predict risk factors among independent variables for a painful knee at either 2 or 6 years following index ACLR.

Risk factors consistent in both models are reported with odds ratios (OR) and associated 95% confidence intervals (CI). All p-values were considered two-sided with alpha set at 0.05.

Results: 1,733 ACLR patients met the inclusion criteria. At 2 years, follow-up was available in 1,488 (84.9%), and at 6 years in 1,491 (85.1%). The cohort included 982 males (56%) with a median age of 23 years at the time of surgery and a median BMI of 24.8 kg/m². The number of patients who met the criteria for a symptomatic knee in mild OA was 656 (44%) at 2 years and 586 (39%) at 6 years. In multivariate models, subsequent ipsilateral revision ACLR and ipsilateral arthroscopy significantly increased the odds of having a painful knee at both 2 and 6 years (Table 1). A lateral meniscal tear left untreated (compared to no tear), was protective against the development of a painful knee. Only at 2 years was the chondral status at the index ACLR predictive of a painful knee, including a grade IV lateral meniscal tear (OR = 3.6 (1.1, 12.0); $p = 0.038$) and grade IV patella lesion (OR = 1.6 (1.02, 2.6); $p = 0.04$). These relationships did not hold at 6 years. Conversely, a high Marx activity level at 2 years proved to be protective against the development of a painful knee at 6 years only (OR = 0.70 (0.54, 0.91); $p = 0.01$).

Conclusions: Approximately 40% of our cohort met Englund’s criteria for symptomatic knee OA 6 years after a primary ACLR. The strongest predictors were subsequent ipsilateral revision ACLR or arthroscopy. Patients who require subsequent surgery should be considered high-risk, and the relationship between these patient-reported outcomes and structural changes (i.e., the development of radiographic OA) warrants further study.


MR T1p AND T2 OF MENISCUS AFTER ACUTE ANTERIOR CRUCIATE LIGAMENT INJURIES

A. Wang, E. Abramson, M. Kretzschmar, L. Nardo, T.M. Link, C.B. Ma, X. Li, Univ. of California, San Francisco, San Francisco, CA, USA

Purpose: Acute anterior cruciate ligament (ACL) injuries are high-risk factors for post-traumatic osteoarthritis. Although cartilage changes in such cases have been widely studied, little research has been conducted on MR quantitative evaluation of meniscus after acute ACL injuries. The
MORPHOLOGY AT 2 YEARS FOLLOWING ACL RECONSTRUCTION

W. Wang, K.L. Bennett, T.V. Wrigley, Y. Wang, F.M. Cicuttini, K. Fortin, D.G. Lloyd, A.L. Bryant. 1The Univ. of Melbourne, Melbourne, Australia; 2Monash Univ., Melbourne, Australia; 3Griffith Univ, Gold Coast, Australia

Purpose: Although anterior cruciate ligament reconstruction (ACLR) effectively restores anterior knee stability and improves functional capacity, several studies have failed to identify any osteoarthritis (OA) prevention-related advantages, at both the femoral condylar (TFJ) and/or patellofemoral (PFJ) joints, of surgical reconstruction compared to conservative management. Moreover, severe meniscal injury, frequently occurring at the time of ACL injury, often requires meniscectomy, which unfortunately has adverse effects on the mechanics of the TFJ that can increase the likelihood and severity of TFJ OA in the years following ACLR. It is important to identify early cartilage morphological changes following ACLR and meniscectomy so that OA prevention strategies can be implemented. The aim of this study was to examine cartilage morphology at 2 years after ACLR with or without combined partial meniscectomy compared with healthy controls using semi-quantitative and quantitative magnetic resonance imaging (MRI).

Methods: MRI was performed on the knees of 130 subjects aged between 18 to 40 years old using T1-weighted 3D gradient recall acquisition. Three groups included 79 patients with isolated ACLR, 21 patients with combined ACLR and partial meniscectomy, and 30 healthy controls. The ACLR was performed with a standard single-bundle transtibial technique using hamstring autograft. Cartilage defects were assessed using modified Outerbridge scores in five regions (medial tibia, medial femoral condyle, lateral tibia, lateral femoral condyle and patella), and cartilage volume was measured in three regions (medial tibia, lateral tibia and patella) using validated methods.

Results: The three cohorts had similar age and gender profiles, with the exception of BMI, where the combined group had significantly higher BMI and were heavier than the isolated ACLR and control groups. Cartilage defects (grade ≥ 2) across the knee were more prevalent in the isolated ACLR group (30.1%) and combined group (51.4%) than in controls (3.3%). The prevalence of cartilage defects was higher in the lateral TFJ for both isolated ACLR (lateral femoral condyle: Odds ratio [OR] = 136.3, 95% confidence interval [CI] 15.2 - 1220.1; lateral tibia: OR = 4.1, 95% CI 1.01 - 16.5) and combined group (lateral tibia condyle: OR = 348.6, 95% CI 28.9 - 4199.1; lateral tibia: OR = 5.6, 95% CI 1.02 - 30.5) than controls. Additionally, the combined group showed a higher prevalence of patella cartilage defects compared with controls (OR = 31.1, 95% CI 2.6 - 375.2). There was no difference in the prevalence of cartilage defects between the two surgical groups. Cartilage volume was significantly less in the isolated ACLR group (medial tibia: 19.0%, p < 0.001; lateral tibia: 14.3%, p = 0.001; patella: 14.4%, p = 0.001) and combined group (medial tibia: 26.4%, p < 0.001; lateral tibia: 16.4%, p = 0.003) compared with controls. Comparing cartilage volume between the surgical groups, the combined group showed significantly less cartilage volume than isolated ACLR in the medial tibia (10.0%, p = 0.022), but not at other cartilage regions.

Conclusions: Cartilage morphology, as reflected in cartilage defects and volume, of ACLR patients with and without meniscectomy at 2 years following surgery was significantly inferior compared with healthy controls. Furthermore, concomitant meniscectomy was associated with a higher level of cartilage degeneration than isolated ACLR. Our findings clarify early changes in cartilage morphology following a common surgical procedure performed on young, physically active individuals.