Chondrotoxic Thresholds Following Vancomycin-Soaked Of Autologous Soft Tissue Grafts For Anterior-Cruciate Ligament Reconstruction

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Summary:
This study describes the short term postoperative intraarticular vancomycin concentration in synovial fluid following ACL Reconstruction with Hamstring and Quadriceps tendon autografts. No chondrotoxic thresholds were reached in the synovial fluid on average 15 minutes after implantation of the graft.

Data:
Background: Studies revealed that vancomycin-soaking of hamstring autograft could drastically reduce the incidence of postoperative infections following ACL-Reconstruction. However, it remains unclear whether chondrotoxic thresholds of Vancomycin in the synovial fluid are reached. Several studies investigated the chondrotoxic concentration of Vancomycin in in-vitro experiments and described 1000 μg/ml as a critical threshold. The purpose of this study was to measure the Vancomycin-concentration in the synovial fluid following Anterior Cruciate Ligament (ACL)-Reconstruction with vancomycin-soaked autografts. It was hypothesized that intra-articular Vancomycin-concentrations in synovial fluid do not reach a chondrotoxic threshold of 1000 μg/ml following Vancomycin-Soaking of autologous Semitendinosus and soft tissue quadriceps grafts for ACL Reconstruction. Methods: This study included 10 patients undergoing an ACL-Reconstruction using four-strand semitendinosus tendon autografts and 10 patients undergoing an ACL-Reconstruction using soft tissue quadriceps tendon autografts. Each graft was intraoperatively wrapped in 5 mg/ml vancomycin-soaked gauze swabs prior to implantation. Following wound closure, an aspirate of 5 ml synovial fluid was taken from each patient. Time was measured from soaking to implantation and from implantation to aspiration. In addition, the graft size was noted, and remnant ACL tissue was preserved. The aspirates were analyzed using high-performance liquid chromatography and mass spectrometry (HPLC/MS) regarding the vancomycin concentration. Spearman-Rho correlation coefficients were used to identify relations between the parameters and t-test to test for differences between the grafts. A p-value of < 0.05 was considered statistically significant. Results: 20 patients (15 women; 5 men, 29.35 ± 11.3 years) were included in the study. The mean concentration of Vancomycin measured in the synovial fluid was 23.229g/µl (± 21.68 µg/ml) with a minimal concentration of 2.324g/µl and a maximal concentration of 71.564g/µl. There was no significant difference between the two grafts (p=0.911). A significant positive correlation (r = .644 p <0.05) was observed between the concentration of Vancomycin and the duration from implantation to fluid aspiration (r=-0.73 p=0.841) as well as the concentration of Vancomycin and the graft diameter (Median 8.5mm Range 6.0-10.0mm r=-0.026 p=0.914) for both grafts. Conclusion: Chondrotoxic concentrations of equal to or greater than 1000g/µl were not reached in any aspiration of synovial fluid following ACL-Reconstruction using soft tissue autografts that were intraoperatively soaked in a 5mg/ml vancomycin solution. Against the backdrop of multiple studies showing significantly reduced infection rates after ACLR when using vancomycin-soaking of the graft, this study distinctly attenuates the counter-argument of the chondrotoxic side effects of this method.

Predictors of Radiographic Osteoarthritis Following Anterior Cruciate Ligament Reconstruction at 5 Years Post-Operatively

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Summary:
This study evaluated predictive factors of post-traumatic radiographic osteoarthritis (OA) in the medial, lateral, and patellofemoral compartments, within a large randomized clinical trial at 5-years post-ACL reconstruction. Varus alignment and medial meniscectomy increase risk of medial OA. PT graft, lateral meniscectomy, meniscus repair, and chondral damage increase the risk of lateral OA.

Data:
Purpose To evaluate predictive factors of post-traumatic radiographic osteoarthritis (OA) in the medial, lateral, and patellofemoral compartments, within a randomized clinical trial at 5-years post-ACL reconstruction. Methods Three-hundred-and-thirty patients (14–50 years) were randomized intra-operatively to ACL reconstruction (ACLR) with patellar tendon (PT), single-bundle semitendinosus/gracilis tendon (HT), or double-bundle semitendinosus/gracilis tendon (DB) autografts. Clinical and quality-of-life-outcomes were previously published. Baseline, 2- and 5-year standardized radiographs (bilateral P-A weighting, 45 degrees flexion; lateral 40-45 degrees, and bilateral skyline patella views) were assessed for radiographic OA in the medial, lateral, and patellofemoral compartments, using the International Knee Documentation Committee (IKDC) scale. Presence of radiographic OA was defined by IKDC Abnormal or Severely Abnormal grades. An independent fellowship-trained orthopaedic surgeon blinded to all outcomes assessed the radiographs. Primary outcomes included radiographic OA and Anterior Cruciate Ligament Quality-of-Life (ACL-QOL) scores. Five-year medial, lateral, and patellofemoral radiographic OA were the respective dependent outcome variables in three multi-variable logistic regressions. Independent predictor variables included: age, sex, knee alignment, clinical stability (Lachman, pivot shift tests), meniscal treatment, chondral condition at surgery, graft type, graft failure, re-injury, and secondary surgery.

Bivariate logistic regressions were performed for each predictor; individual predictor variables with p<0.1 were added into the multi-variable model. Odds ratios and 95% Confidence Intervals (95%CI) were reported. An ANCOVA investigated the association of radiographic OA in each compartment and ACL-QOL scores at 5-years. Results Five-year IKDC grades for radiographic OA were available for 302 patients (91.5%). Thirty-five patients (10.6%) had radiographic OA in the medial compartment. Varus alignment, meniscectomy, chondral damage, age>35, and male sex were identified as individual predictors. Only medial meniscectomy and varus knee alignment were statistically significant predictors of medial OA in the multi-variable model, with odds ratios of 5.8 (95%CI 2.7–12.6, p=0.01) and 2.4 (95%CI 1.1–5.1; p=0.03), respectively. Sixty-seven patients (20.3%) had radiographic OA in the lateral compartment. Graft type, pivot shift, valgus alignment, meniscectomy, meniscal repair, and chondral damage were identified as individual predictors. Only PT graft, lateral meniscectomy, lateral meniscal repair, and lateral chondral damage were statistically significantly predictors of lateral OA in the multi-variable model, with odds ratios of 2.4 (95%CI 1.2–4.8, p=0.02), 2.6 (95%CI 1.3–5.2, p=0.01), 3.3 (95%CI 1.5–7.4, p=0.01), and 2.0 (95%CI 1.0–3.9, p=0.04), respectively. Only 9 patients (2.7%) had patellofemoral OA; insufficient to progress to a multi-variable model. Bivariate analyses showed patellofemoral chondral damage as the only significant predictor of OA at 5-years (odds ratio of 5.7; 95%CI 1.5–21.8, p=0.01). Graft failure, traumatic re-injury, and secondary surgery did not predict radiographic OA at 5-years in any compartment. No significant associations were shown between 5-year ACL-QOL scores and presence of medial, lateral, or patellofemoral OA. Conclusions Varus alignment and medial meniscectomy at ACLR significantly increase the risk of developing medial OA. PT graft, and meniscectomy, meniscus repair, and presence of chondral damage in the lateral compartment significantly increase the risk of developing lateral OA. Higher proportions of OA cases would increase the confidence in these associations.
Abstracts

Introduction: A patient with an ACL-reconstructed knee (ACLR), has a great risk of sustaining a new ACL injury in either knee. Paterno et al. reported that in an active, young population who returned to pivoting activities that 25.4% sustained a new ACL injury, 75% of these injuries were to the contralateral knee. Data from the Swedish Knee Ligament Registry report a contralateral ACLR rate of close to 5% at a 5-year follow-up after primary ACLR. The purpose of this study was to 1, identify pre-, intra- and postoperative risk factors associated with contralateral ACLR 2, compare knee laxity and functional knee outcome between primary and contralateral ACLR and 3, compare activity level, patient-reported knee function at a minimum of 5 years follow-up. Methods: 1, Primary ACLR, 2005-2014 (n = 5393) and occurrence of a contralateral ACLR within 5 years. Regression analysis [age, gender, body mass index, time from injury to surgery, pre-injury Tegner], intraoperative [graft type, meniscus injury, cartilage injury] and postoperative [limb symmetry index (LSI)] for quadriceps and hamstring strength and single-leg-hop test performance] as risk factors for a contralateral ACLR. 2, Same patients who underwent primary and contralateral ACLR (n = 1756) were followed for up to 10 years. 3, A total of 98 patients with a bilateral ACLR were compared to 106 patients with unilateral ACLR. 4, Bilateral ACLR. Results: 1. The KT-1000 for knee laxity and KOOS for subjective outcome. 2, Bilateral ACLR. 2, Same patients who underwent primary and contralateral ACLR (n = 1756) were followed for up to 10 years. 3, A total of 98 patients with a bilateral ACLR were compared to 106 patients with unilateral ACLR. 4, Bilateral ACLR. The 5-year incidence of contralateral ACLR was 5.7%. Most important risk factors were good functional outcome at 6 months postoperatively and the T2* value of the ACL at 6 months postoperatively. Conclusion The T2* value of the entire reconstructed ACL at 6 months postoperatively was significantly higher than that of the entire reconstructed ACL at 9 and 12 months and the normal ACL. This indicates that the quality of the reconstructed ACL 6 months after ACLR did not reach that of the normal ACL.

Category: Knee - Other

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Summary:
Proximal tears of the ACL offer the possibility of direct repair, with the benefit of maintaining native tissue and anatomy. There has been a recent resurgence in this approach using modern surgical techniques and technology. Existing literature is promising but relatively limited. Data: Background: Tears of the anterior cruciate ligament (ACL) offer the possibility of direct repair, with the benefit of maintaining native tissue and anatomy. There has been a recent resurgence in this approach in select patients with Sherman Type I and II proximal tears (Sherman et al, 1991) using modern surgical techniques and technology. Existing literature is promising but relatively limited (Achtnich et al, 2016; Murray et al, 2020). Aim: To report the patient-reported outcome measures (PROMs), clinician-measured outcomes and MRI signal noise quotient (SNQ) (Oshima et al, 2020) of a primary ACL repair cohort and compare this with a matched cohort of ACL reconstructions by the same surgeon. Methods: A post-hoc analysis was performed on prospectively collected data from 20 consecutive patients who underwent primary ACL repair by the senior author from 2017 to 2020. This was compared to an age and sex-matched cohort of ACL reconstruction by the same surgeon, using PROMs, objective return to sport (RTS) testing, and MRI analysis. Results: ACL repairs demonstrated equivalent post-operative PROMs to reconstructions as measured by IKDC subjective score (78.5 ± 17.1 versus 83.7 ± 13.3, p = 0.333), Tegner Activity Scale (5.9 ± 1.8 versus 6.1 ± 2.6, p = 0.646) and Lysholm score (89.8 ± 10.0 versus 89.6 ± 10.4, p = 0.762). RTS assessment of repairs was conducted earlier than reconstructions (8.2 ± 2.8 months versus 10.6 ± 1.4 months, p = 0.020). There was no difference between groups in proportion passing quadriceps strength criteria (50% repairs versus 53% reconstructions, p = 0.097), hop testing and Y-balance testing. There was a significant difference in proportion passing hamstrings strength criteria (86% repairs passed versus 60% reconstructions, p = 0.023) and hamstring to quadriceps ratio (71% echo time (MRI-UTE) T2* mapping can quantify T2* values in tissues with short T2 relaxation times, such as tendons and ligaments, which cannot be evaluated with conventional MRI. T2* values reflect the amount and arrangement of collagen in the tissue, with lower values in tissues containing dense collagen, and higher values in tissues with sparse collagen. This study aimed to observe the healing process of the reconstructed ACL after ACLR using MRI-UTE T2* mapping and compare its quality in each healing phase to that of a normal ACL. Method Ten patients (10 females; mean ± SD age 18.4 ± 4.3 years) who underwent initial ACLR with autogenous hamstring tendon from 2018–2020 and 12 volunteers (6 males, 6 females; mean ± SD age, 30.8 ± 9.6 years) without any history of knee diseases or surgeries were recruited. Patients who underwent ACLR had MRI-UTE T2* mapping of the operated knee at 6, 9, and 12 months postoperatively, and volunteers underwent MRI-UTE T2* mapping of the right knee joint only once. T2* values of the reconstructed and normal ACLs were measured at the distal, middle, and proximal sites. The regions of interest of each site were measured at the areas unaffected by artifacts using a 10-mm circle. The mean T2* values measured at the three sites were defined as the T2* values of the entire tissue. The T2* values of the reconstructed ACL at 6, 9, and 12 months postoperatively and the normal ACL were compared using a one-way analysis of variance. Result The UTE-T2* values of the reconstructed ACLs were 13.1 ± 1.9 ms, 11.7 ± 1.5 ms, and 11.1 ± 1.3 ms, respectively, at 6, 9, and 12 months postoperatively, and the UTE-T2* value at 6 months postoperatively was significantly higher than those at 9 and 12 months (P < 0.01 vs. 9 months; P < 0.01 vs. 12 months). The UTE-T2* value of the normal ACL was 11.9 ± 2.4 ms, which differed significantly from the value obtained 6 months postoperatively of the reconstructed ACL (P < 0.01). Conclusion The T2* value of the entire reconstructed ACL at 6 months postoperatively was significantly higher than that of the entire reconstructed ACL at 9 and 12 months and the normal ACL. This indicates that the quality of the reconstructed ACL 6 months after ACLR did not reach that of the normal ACL.

Category: Knee - Other

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Summary:
The healing process of the reconstructed anterior cruciate ligament (ACL) was evaluated using magnetic resonance imaging-ultrashort echo time T2* mapping. The T2* value of the entire reconstructed ACL at 6 months postoperatively was significantly higher than that of the entire reconstructed ACL at 9 and 12 months and the normal ACL. This indicates that the quality of the reconstructed ACL 6 months postoperatively was significantly higher than that of the entire reconstructed ACL at 9 and 12 months and the normal ACL. This indicates that the quality of the reconstructed ACL after ACLR reconstruction using modern surgical techniques and technology. Existing literature is promising but relatively limited. Data: Background: Tears of the anterior cruciate ligament (ACL) offer the possibility of direct repair, with the benefit of maintaining native tissue and anatomy. There has been a recent resurgence in this approach using modern surgical techniques and technology. Existing literature is promising but relatively limited (Achtnich et al, 2016; Murray et al, 2020). Aim: To report the patient-reported outcome measures (PROMs), clinician-measured outcomes and MRI signal noise quotient (SNQ) (Oshima et al, 2020) of a primary ACL repair cohort and compare this with a matched cohort of ACL reconstructions by the same surgeon. Methods: A post-hoc analysis was performed on prospectively collected data from 20 consecutive patients who underwent primary ACL repair by the senior author from 2017 to 2020. This was compared to an age and sex-matched cohort of ACL reconstruction by the same surgeon, using PROMs, objective return to sport (RTS) testing, and MRI analysis. Results: ACL repairs demonstrated equivalent post-operative PROMs to reconstructions as measured by IKDC subjective score (78.5 ± 17.1 versus 83.7 ± 13.3, p = 0.333), Tegner Activity Scale (5.9 ± 1.8 versus 6.1 ± 2.6, p = 0.646) and Lysholm score (89.8 ± 10.0 versus 89.6 ± 10.4, p = 0.762). RTS assessment of repairs was conducted earlier than reconstructions (8.2 ± 2.8 months versus 10.6 ± 1.4 months, p = 0.020). There was no difference between groups in proportion passing quadriceps strength criteria (50% repairs versus 53% reconstructions, p = 0.097), hop testing and Y-balance testing. There was a significant difference in proportion passing hamstrings strength criteria (86% repairs passed versus 60% reconstructions, p = 0.023) and hamstrings to quadriceps ratio (71%