

native ACL footprint while avoiding potential anteromedial portal complications.

Methods: Thirty-nine patients (24males, 15females; age 38.4 ± 9.9 years) that underwent single-bundle, TT ACLR by a single surgeon (1999-2015) were included. Radiographic evaluation ≥ 12 months following ACLR included radiographs, MRI, and CT scan. CT scan underwent 3D reconstruction to 0.625mm using the OsiriX program (Pixmeo, Geneva, Switzerland). The ratio of the posteroanterior and proximal-distal position for femoral footprints and medial-lateral and anteroposterior position for tibial tunnels were compared to normative cadaveric values using independent samples t-test ($p < 0.05$, corrected for multiple comparisons).

Results: Average femoral posteroanterior footprint position ($28.6 \pm 4.4\%$) was not statistically different from normative AM bundle footprint ($p = 0.0547$) but was from normative PL bundle footprint ($p = 0.0001$). Average femoral proximal-distal position ($39.8 \pm 9.0\%$) was statistically different from normative AM and PL bundle footprints ($p = 0.0044$, $p = 0.0001$). Average tibial medial-lateral footprint position ($47.3 \pm 2.0\%$) was not statistically different from normative AM or PL bundle footprints ($p = 0.4215$ and $p = 0.0909$). Average tibial proximal-distal position ($47.9 \pm 6.0\%$) was statistically different from normative AM bundle footprint ($p = 0.0001$) but not from normative PL bundle footprint ($p = 0.2041$).

Conclusion: The TT, single-bundle technique for ACLR yields a combined AM/PL bundle restoring anteroposterior and rotatory stability of the knee following ACL injury. These results suggest that the femoral footprint is similar to cadaveric values derived for the AM bundle on the femoral side and the PL bundle on the tibial side. This simple, easy to use program can aid all physicians in determining whether their anteromedial portal or TT technique successfully restores the anatomic ACL footprint.

The Relationship of Anterior Cruciate Ligament Insertion Sites to the Distal Femoral Growth Centers: an MRI study

SS-13

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Introduction: Anterior cruciate ligament (ACL) injury and reconstruction have become increasingly common in the pediatric and adolescent populations. The ACL is close to the distal femoral physis and posterior epiphysis, a growth center for the distal femur. We sought to explore the changes in the anatomic relationship of the two bundles of the ACL in order to provide guidelines for surgical reconstruction.

Methods: We reviewed knee MRIs in patients ages 6-18 (IRB approved), excluding patients with cruciate injury. Standardized measurements of anterior-medial (AM) and posterior-lateral (PL) bundle area, distance from physis

and posterior epiphysis to edge and center of each bundle were evaluated for each MRI.

Results: 154 studies were included. The footprints of each bundle increase predictably with age. The PL bundle footprint is larger than the AM bundle in both genders (16.2 ± 5.3 vs. 12.0 ± 4.1 mm², $p < 0.001$). The average distance across all groups from the center and edge of the AM bundle to the physis was 8.2 ± 1.9 mm and 7.0 ± 1.8 mm respectively (figure). The average distance of the PL bundle center and edge to the posterior epiphysis was 5.6 ± 1.9 mm and 4.4 ± 1.8 mm respectively. Patients had an increase in the average distance from the AM bundle to the physis with age, which was < 10 mm in skeletally immature patients. Males had consistent increase in distance of the PL bundle to the physis. Minimum distance increased gradually with age.

Conclusion: We demonstrated increase in area of each bundle footprint with age, with the PL bundle footprint being larger. We found that the AM bundle inserted < 10 mm from the distal femoral physis in patients under age 15, closer than previously recognized, while the PL bundle is adjacent to the posterior epiphysis. This should provide better guidelines for surgical reconstruction in the pediatric patient to avoid growth disturbance.

Thirty-year Experience with ACL reconstruction using Patellar Tendon: A Critical Evaluation of Revision and Reoperation

SS-14

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Introduction: To describe and analyze a single surgeon's experience with primary and revision single-bundle ACLR over a 30-year focusing on incidence and risk factors for revision and reoperation.

Methods: Patients who underwent ACLR from 1986 to 2016 were identified from a prospectively maintained database. Covariates of interest included age, sex, time, and graft selection. Outcomes of particular interests included reoperation rates after primary/revision ACLR, and rate of revision ACLR.

Results: A total of 2450 ACL reconstructions (mean age, 29 years; 58% male) were reviewed. Among primary ACL reconstructions performed ($n = 2225$), 68% had BTB autograft and 30% had a BTB allograft. Patients undergoing autograft and allograft ACLR had an average age of 22 and 37 years, respectively ($P < .05$). The rate of personal ACLR revision was 1.8% ($n = 40$) for primary cases and 3.5% ($n = 7$) for revision cases. There was a higher revision rate among female (2.6%) than male patients (1.2%), particularly in patients under 20 years of age. There was a higher revision rate among primary allograft (2.7%) than autograft (1.3%) reconstruction, with a greater difference in patients under 30. Low dose irradiation for sterilization did not affect allograft revision



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rates. The non-revision reoperation rate following primary ACLR was 12.0%; the 5-year reoperation rate was 8.5%. The non-revision reoperation rate was lower for primary cases reconstructed with allograft versus autograft (9% vs 13%) ($P = 0.004$). Four-hundred twenty-four patients (19%) underwent concomitant meniscal repair and, among these, 13% required revision meniscal surgery. The rate of contralateral ACLR was 5.3%, predominantly in patients under 25.

Conclusion: This information is useful in the informed consent process, for perioperative decision making regarding graft choice, and for identifying patients who are at risk for injuring the uninvolved knee. Allograft ACLR can produce sustainable results with low complication rates in appropriately selected patients.

Arthroscopic Primary Repair of Proximal Anterior Cruciate Ligament Tears: No Deterioration at Mid-Term Follow-Up

SS-15

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Introduction: Open primary repair of the anterior cruciate ligament (ACL) was a popular surgical treatment for ACL injuries in the 1970s and 1980s. Although the short-term outcomes were excellent, the results deteriorated at mid-term follow-up, which ultimately led to the abandonment of open primary repair. Recently, however, excellent short-term outcomes of primary repair using arthroscopy in 11 patients with only proximal ACL tears have been reported with one failure (9%) and good clinical outcomes. Goal of this study was to assess the mid-term outcomes of these patients.

Methods: The first 11 consecutive patients with proximal avulsion tears and excellent tissue quality treated with arthroscopic primary repair were evaluated at mid-term follow-up. Physical examination and laxity examination were performed and patients completed several outcome questionnaires.

Results: Eleven patients were seen at mean follow-up of 5.6 years (range: 4.2–8.4 years). No patients had failure of the repair besides the earlier failure at short-term follow-up (9%). One additional patient (9%) underwent reoperation for a medial meniscus tear. The other ten patients had full range of motion, negative Lachman test, eight patients had a negative pivot shift and two patients +1 pivot shift. IKDC objective score was A in 8 patients and B in 2. Lysholm was 97 (range 92–100), modified Cincinnati 97 (range 87–100), mean SANE score 96 (range 90–100), preinjury Tegner 7.2 (range 5–9), and postoperative Tegner 6.8, (range 3–9) and IKDC subjective score 95 (range 82–100). Seven patients had a MRI that showed ligament continuity.

Conclusion: Historically, studies showed that the results of open primary repair deteriorated at mid-term follow-up. With appropriate patient selection (only treating patients

with proximal tears and excellent tissue quality) and arthroscopy, results in this study did not deteriorate at mid-term follow-up. Arthroscopic primary repair of proximal ACL tears is an excellent, minimally invasive treatment option in these patients.

Outcomes Following Single-Stage versus Two-Stage Revision Anterior Cruciate Ligament Reconstruction

SS-16

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Introduction: Revision anterior cruciate ligament reconstruction (ACLR) is becoming increasingly common as the number of primary ACLR cases continues to rise. Despite this, there is limited data discussing the outcomes of revision ACLR, and even less information addressing the differences in single stage revision reconstructions versus those performed in a two stage fashion.

Methods: Patients undergoing revision ACLR between 2010 and 2014 by a single surgeon were collected. Skeletally mature individuals over the age of 17 were included. Patients were excluded if they were skeletally immature, had a previous intraarticular infection in the ipsilateral knee, had prior alignment correction, cartilage repair or transplant procedure, meniscal allograft transplantation, or intraarticular fracture. Patients completed a questionnaire preoperatively and at a minimum two years postoperatively, which included the Lysholm score, Tegner activity scale, Western Ontario and McMaster Universities Arthritis Index (WOMAC), 12 item Short Form Health Survey (SF-12) Physical and Mental Component Summary (PCS/MCS), and patient satisfaction. Patient satisfaction was rated on a ten-point scale, with 1 equal to highly unsatisfied and 10 equal to highly satisfied.

Results: 88 patients were included: 39 patients in the single-stage revision surgery group (19 males, 20 females), and 49 patients in the staged revision surgery group (27 males, 22 females). In both groups, the SF-12 PCS, WOMAC score, Lysholm score, and Tegner activity scale significantly improved preoperatively to postoperatively. There was no significant difference in the SF-12 MCS score before and after surgery in either group, and no differences in outcome scores at any time point. Furthermore, there was no significant difference in failure rates or other demographic data between groups.

Conclusion: Overall, objective outcomes and subjective patient scores and satisfaction were not significantly different between one-stage and two-stage ACL revision surgeries. Both procedures resulted in significantly improved outcomes and patient subjective outcomes without notable differences in failure rates.