Clinical Outcomes of Arthroscopic Primary Repair of Proximal Anterior Cruciate Ligament Tears Are Maintained at Mid-term Follow-up

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Purpose: To assess the mid-term clinical outcomes in patients with proximal avulsion anterior cruciate ligament (ACL) tears undergoing arthroscopic primary repair with suture anchors. **Methods:** The first 11 consecutive patients with proximal avulsion tears treated with arthroscopic primary repair were evaluated at mid-term (minimum 5-year) follow-up. Physical examination was performed; laxity examination consisting of the Lachman, pivot-shift, and anterior drawer tests was performed; and patients were asked to complete the Lysholm, modified Cincinnati, Single Assessment Numeric Evaluation, and International Knee Documentation Committee (IKDC) questionnaires. **Results:** Of the 11 patients, 10 were seen at a mean follow-up of 6.0 ± 1.5 years (range, 4.8-9.2 years). One patient was lost to follow-up, in whom failure had already occurred at short-term follow-up. One additional patient underwent reoperation for a medial meniscus tear and also had a partial ACL tear; this patient was clinically stable at last follow-up. All patients had full range of motion. Nine patients had negative Lachman and negative pivot-shift examination findings (IKDC score of A), and 1 patient had a 1A Lachman result and 1+ pivot-shift result (IKDC score of B). The mean Lysholm score was 96.0 ± 4.5 (range, 88-100); modified Cincinnati score, 95.6 ± 7.4 (range, 80-100); Single Assessment Numeric Evaluation score, 95.4 ± 5.4 (range, 85-100); preinjury Tegner score, 7.2 ± 1.2 (range, 5-9); postoperative Tegner score, 6.6 ± 1.8 (range, 3-9); and IKDC subjective score, 92.3 ± 11.3 (range, 64-100). **Conclusions:** The clinical outcomes of arthroscopic primary repair of proximal ACL tears with suture anchors are excellent and are maintained at mid-term follow-up in a carefully selected subset of patients with proximal tears and excellent tissue quality. **Level of Evidence:** Level IV, therapeutic case series.

Primary repair of the anterior cruciate ligament (ACL) was a commonly performed technique in the twentieth century.[1-11] Initially, several authors reported good outcomes of open primary repair at short-term (2-year) follow-up,[5,6,10,12-14] but these outcomes were reported to deteriorate at mid-term (5-year) follow-up.[9,11,15-18] This led to a shift toward augmented repair and, ultimately, primary reconstruction, which is now the current gold standard in surgically treating ACL injuries.[19-21]

Regarding the historical outcomes of open primary repair, however, several factors can be identified that may have negatively influenced these outcomes. First, patients with all tear types were historically treated, whereas, in hindsight, outcomes were significantly better in patients with proximal tears.[18,19,22] Second, surgery consisted of an invasive arthrotomy, although it is known that significantly fewer complications and better results can be achieved with arthroscopic surgery.[23] Third, postoperative rehabilitation historically consisted of joint immobilization for 4 to 6 weeks, whereas modern-day rehabilitation with early range of motion (ROM) decreases the risk of pain, stiffness, and decreased function.[24,25] Finally, sutures were tied over bone and even absorbable sutures were used,[5,15] whereas modern-day suture anchors and non-absorbable sutures can be used for more direct tensioning of the repair to the femoral wall.

With the implementation of modern-day technology, such as magnetic resonance imaging (MRI) for patient selection, arthroscopy for minimally invasive surgery,

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The authors report the following potential conflict of interest or source of funding: G.S.D. receives support from Arthrex. Research grant. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received April 24, 2017; accepted October 10, 2017.

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0749-8063/17586/$36.00

https://doi.org/10.1016/j.arthro.2017.10.028

advanced rehabilitation programs for stiffness prevention, and suture anchors for direct tensioning, it can be expected that outcomes of arthroscopic primary repair in patients with proximal tears will be significantly better.[19,20,26,27] Indeed, DiFelice et al.[28] were the first authors to report outcomes in 11 consecutive patients with proximal tears undergoing arthroscopic primary repair with suture anchors, noting only 1 failure (9%) and excellent clinical outcomes at short-term follow-up, which was recently confirmed by other authors.[29-31] Mid-term outcomes, however, are currently lacking and are necessary to assess whether deterioration of outcomes occurs with this arthroscopic technique.[32,33]

Therefore, the purpose of this study was to assess the mid-term clinical outcomes in patients with proximal avulsion ACL tears undergoing arthroscopic primary repair with suture anchors. The hypothesis was that the clinical outcomes would be maintained in this select group of patients with regard to revision rates and functional and patient-reported outcomes.

Methods

This retrospective study is a follow-up study of the previously reported short-term outcomes of the same group of patients.[28] After institutional review board approval was obtained, all patients treated with arthroscopic primary repair of proximal ACL tears between April 2008 and June 2012 were identified. A total of 190 operative ACL treatments were performed during this period. The surgical indications for arthroscopic primary repair consisted of (1) preoperative clinical instability (Lachman, anterior drawer, and/or pivot-shift testing), (2) the desire to return to the previous level of activities, (3) a proximal avulsion (type I) ACL tear characterized by the possibility of reapproximating the torn distal remnant toward the femoral footprint, and (4) excellent tissue quality characterized by the ability to withstand suture passage.[34] Patients were included if they had undergone arthroscopic primary repair of proximal ACL tears; they were excluded from this retrospective chart review if they had (1) insufficient tissue length and/or tissue quality and were thus treated with ACL reconstruction (n = 133) or (2) multiligamentous injuries (>2 ligaments) (n = 46). Ultimately, 11 of 144 patients (7.6%) had isolated ACL tears that underwent arthroscopic primary ACL repair between April 2008 and June 2012, and these 11 consecutive patients were included in this mid-term follow-up study.

Surgical Technique

Preoperative MRI confirmed complete proximal tears in all 11 patients. All patients consented to the following preoperative treatment plan: Arthroscopic primary repair would be performed if sufficient tissue length and tissue quality were present at surgery; if not, patients would undergo ACL reconstruction. All patients underwent surgery performed by the senior author (G.S.D.). Standard knee arthroscopy was first performed to assess whether sufficient tissue length and tissue quality were present for the primary repair technique. The surgical technique of arthroscopic primary ACL repair with suture anchors has been previously described.[28,35,36] In brief, after the anteromedial and posterolateral bundles are identified, suturing is started at the intact distal end, and a Scorpion suture passer (Arthrex, Naples, FL) is used to pass No. 2 TigerWire sutures (Arthrex) proximally in the anteromedial bundle in an alternating, interlocking Bunnel-type pattern. The same process is repeated for the posterolateral bundle using No. 2 FiberWire (Arthrex). Then, through an accessory inferomedial portal, a hole is drilled, tapped, or punched, depending on bone quality, into the origin of the anteromedial femoral footprint. The TigerWire sutures in the anteromedial bundle are retrieved and passed through the eyelet of a 4.75-mm vented BioComposite SwiveLock suture anchor (Arthrex). With the knee at 90° of flexion, the suture anchor is deployed in the anteromedial footprint hole, while the ligament is tensioned to the femoral wall to prevent gap formation.[37] The same technique is then repeated for the posterolateral bundle with the knee at 115° of flexion. The knee is flexed during suture anchor deployment to avoid posterior blowout of the suture anchors. The repair is then complete; the knee is cycled through its ROM to test for impingement; and with a probe, the tension and stiffness of the repaired ligament remnant are tested. An intraoperative Lachman test is performed to confirm minimal anteroposterior translation.

Rehabilitation

The rehabilitation goals were to control swelling and regain early ROM as this has been shown to be safe after this technique.[37,38] A brace was worn in the first month. During weight bearing, the brace was locked in extension until quadriceps control returned, at which point the brace was unlocked for ambulation. Patients were motivated to start ROM exercises without the brace and without weight bearing in the initial days after surgery.[28,35] Patients were weaned off using the brace after 1 month and were advanced to gentle strengthening and standard ACL rehabilitation protocols.[39,40]

Outcome Measures

Patients were routinely seen in the clinic at 1 week, 1 month, 3 months, 6 months, 1 year, 2 years, and 5 years postoperatively. Data collected from medical records included age, body mass index, delay from injury to surgery, sex, injury mechanism, concomitant injuries, and radiologic follow-up.

The primary outcomes of surgery were clinical failure (defined as a 2+ Lachman result, 2+ pivot-shift result, patient complaint of instability, and/or radiologically shown discontinuity of the repaired ligament) and reoperation. The secondary outcomes were examination findings showing clinical stability (Lachman, anterior drawer, and pivot-shift tests) and functional and patient-reported outcomes. Lysholm scores[41] and modified Cincinnati scores[42,43] were collected to assess the patient-reported impact of knee function and symptoms on daily activities. Tegner scores were collected to assess the level of activity both before injury and at mid-term follow-up.[44] By use of the Single Assessment Numeric Evaluation (SANE),[45] patients were asked to grade their knee function on a scale of 0 to 100 (with 100 being the best score). The objective International Knee Documentation Committee (IKDC) score was completed by the surgeon who performed the initial operation to assess the objective outcomes of surgery. Finally, patients completed the subjective IKDC score to assess the subjective outcome after surgery.[46] Data were reported as mean ± standard deviation and range.

Statistical Analysis

All data were collected using SPSS software (version 21; SPSS, Armonk, NY). Descriptive statistics were used to assess patient demographic characteristics and outcomes.

Results

The mean age of the 11 patients was 37 ± 12 years (range, 17-57 years), the mean body mass index was 25 ± 4 (range, 21-35), and there were 10 male patients and 1 female patient. The mean delay from injury to surgery was 39 ± 28 days (range, 10-93 days). The mean follow-up period was 6.0 ± 1.5 years (range, 4.8-9.2 years).

Failures and Reoperations

In 1 patient (9%, patient 9), an atraumatic rerupture of the ACL occurred when descending stairs 3 months postoperatively while admittedly being noncompliant with brace use and physical therapy. This patient moved out of state and could not be seen for mid-term follow-up evaluation. At 2-year follow-up, this patient had an IKDC objective score of C (1A Lachman and 2+ pivot shift results), a KT-1000 (MEDmetric) leg difference of 6 mm, and fair functional outcome scores.

A new twisting injury occurred in 1 patient (9%, patient 7) while playing football 2.5 years postoperatively; he complained of medial joint-line tenderness but no instability. MRI showed a medial meniscus tear, and intraoperatively, this patient had a complex parrot-beak medial meniscus tear, for which partial meniscectomy was performed. A partial ACL tear of a large part of the anteromedial bundle was noted during surgery; and this was left untreated because the knee was intraoperatively stable. At the final visit 2.5 years later, this patient had a stable knee and excellent outcome scores (Table 1).

Clinical Assessment

All patients had knee extension of 0° and a minimum 135° of flexion at the most recent follow-up visit. Of the 10 patients who returned for the follow-up visit, 9 had an IKDC score of A with negative Lachman and negative pivot-shift examination findings and 1 had an IKDC score of B with 1A Lachman and 1+ pivot-shift results. The mean Lysholm score was 96.0 ± 4.5 (range, 88-100); mean modified Cincinnati score, 95.6 ± 7.4 (range, 80-100); mean SANE score, 95.4 ± 5.4 (range, 85-100); and mean subjective IKDC score, 92.3 ± 11.3 (range, 64.4-100). The mean preinjury Tegner score was 7.2 ± 1.2 (range, 5-9), and the mean postoperative Tegner score was 6.6 ± 1.8 (range, 3-9). No deterioration (clinically relevant difference) was noted in any of the outcome scores between the 2- and 5-year outcomes (Table 1, Fig 1). The outcomes of the individual patients at short-term and mid-term follow-up are displayed in Table 1.

One patient (patient 8) reported only fair functional outcome scores and a decrease in the Tegner score (from 6 to 4). This patient was a female patient aged 55 years at the time of latest follow-up and was mainly limited by osteoarthritis of both hips and the lumbar spine. MRI of the knee showed continuity of the ACL, and the knee was noted to be stable on examination (IKDC score of A).

Two other patients had decreases in the Tegner score. Patient 10 reported excellent functional outcomes but a decrease in the Tegner score (from 9 to 7). He finished college, where he played rugby and football, and subsequently stopped playing these sports at a high level. He reported playing recreational pivoting and cutting sports without any problems. Patient 2 had a decrease in the Tegner score (from 5 to 3) and was less active without any reason attributed to knee problems, although he reported occasional pain with weather changes.

Discussion

The main finding of this study was that excellent short-term clinical outcomes of arthroscopic primary repair in patients with proximal ACL tears and excellent tissue quality were maintained at mid-term follow-up. In this study the clinical outcomes in 10 of 11 patients were good with stable knees (i.e., Lachman and pivot-shift tests), excellent patient-reported outcomes, and high return-to-activity levels. Although MRI confirmation of ligament continuity was not assessed in this study, all patients were clinically stable (as opposed to

Table 1. Objective and Subjective Clinical Outcomes of 10 Patients Who Could Be Evaluated at Mid-term Follow-up*

					Lachman		Pivot		Lysholm		Modified Cincinnati		SANE		Tegner			IKDC Subjective		IKDC Objective	
	Age, yr	Sex	Concomitant Injuries	Final FU, yr	2 yr	5 yr	2 yr	5 yr	2 yr	5 yr	2 yr	5 yr	2 yr	5 yr	Pre	2 yr	5 yr	2 yr	5 yr	2 yr	5 yr
Patient No. (chronological)																					
1	37	Male	Chondromalacia, MCL, MM tear	9.2	Neg	1A	Neg	1+	100	91	100	89	90	90	7	8	7	100	92	A	B
2	38	Male		7.3	Neg	Neg	Neg	Neg	90	92	92	87	95	90	5	5	3	91	82	A	A
3	22	Male		7.3	Neg	Neg	Neg	Neg	95	95	92	100	95	99	7	8	7	91	94	A	A
4	57	Male	Chondromalacia, LM tear	6.0	Neg	Neg	1+	Neg	83	100	63	100	90	100	7	6	7	95	99	B	A
5	47	Male	MM tear	6.1	Neg	Neg	Neg	Neg	94	100	96	100	95	100	8	7	8	84	100	A	A
6	23	Male		4.7	Neg	Neg	Neg	Neg	100	100	100	100	95	100	9	9	9	100	100	A	A
7	41	Male		5.2	Neg	Neg	Neg	Neg	100	95	100	100	95	95	7	7	7	87	95	A	A
8	50	Female	Chondromalacia, MCL	5.0	Neg	Neg	Neg	Neg	79	88	77	80	75	85	6	5	4	52	64	A	A
10	17	Male	MCL	4.8	Neg	Neg	Neg	Neg	100	100	100	100	100	100	9	9	7	91	100	A	A
11	37	Male	MCL	4.8	Neg	Neg	Neg	Neg	94	99	95	100	95	95	7	6	7	74	97	A	A
Mean ± SD	37 ± 13			6.0 ± 1.5					93.5 ± 7.5	96.0 ± 4.5	91.5 ± 12.2	95.6 ± 7.4	92.5 ± 6.8	95.4 ± 5.4	7.2 ± 1.2	7.0 ± 1.5	6.6 ± 1.8	86.4 ± 14.5	92.3 ± 11.3		

FU, follow-up; IKDC, International Knee Documentation Committee; LM, lateral meniscus tear; MCL, medial collateral ligament grade 3 tear conservatively treated; MM, medial meniscus tears; Neg, negative; SANE, Single Assessment Numeric Evaluation (question asking how patients rate their knee, with 0 being completely abnormal and 100 being completely normal); SD, standard deviation.

*Patient 9 moved out of state and was lost to follow-up; this case was deemed a clinical failure.

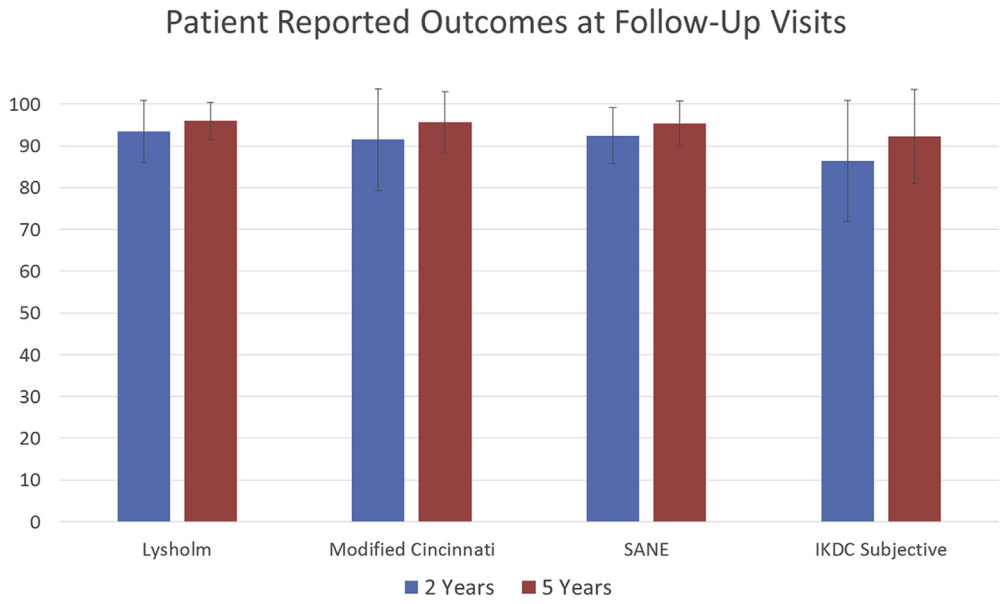

Fig 1. Histogram showing functional outcomes of patients at minimum 2-year and minimum 5-year follow-up visits. No differences were seen in any of the scores at the different follow-up visits. (IKDC, International Knee Documentation Committee; SANE, Single Assessment Numeric Evaluation.)

preoperatively) and could participate in activities up to 5 years postoperatively in which they could not participate preoperatively. Arthroscopic primary repair of the proximal ACL is an excellent minimally invasive treatment in carefully selected patients with proximal tears and excellent tissue quality, the results of which are maintained at mid-term follow-up.

Recently, promising short-term outcomes of arthroscopic primary repair of proximal tears have been reported,[28,29] which has increased the enthusiasm for this procedure.[28,29,32,33,47] In the historical literature, however, outcomes of open primary repair were also promising at short-term follow-up[5,6,10,12-14] but deteriorated at mid-term (5-year) follow-up.[9,11,15,16,18] When we compared the results of this study with the outcomes of these patients at 2-year follow-up, no deterioration or differences were noted in any of the outcomes between the 2- and 5-year assessments. Several factors could play a role in the finding of this study that the results were maintained at mid-term follow-up, as opposed to the findings of many historical studies.[9,11,15,16,18] First, in the historical studies, primary repair was performed for all tear types, and sutures were often placed in both the femoral and tibial remnant stumps, after which they were guided through drill holes in the tibia and femur and tied over bone.[7,13] Sherman et al.[18] showed in their extensive subgroup analysis, however, that better outcomes were noted in patients with proximal avulsion tears. In our study only patients with proximal avulsion tear types underwent repair and reattachment to the femoral wall. Several experimental studies have shown that healing of the midsubstance of the ACL is limited because the synovial fluid washes away the fibrin clot that is necessary for ligament healing.[48,49] In contrast, other studies have shown that the proximal part of the ACL has significant healing capacity[50,51]; this explains the previously described phenomena of ACL reattachment to the posterior cruciate ligament or femoral notch[52,53] and observed healing[54-56] of proximal tears. Indeed, some studies in the historical literature reported mid-term outcomes of open primary repair of only proximal tears and showed excellent outcomes.[22,57,58] Genelin et al.[22] reported outcomes in 42 of 49 patients treated with open primary repair of proximal tears. They noted that 86% of patients were satisfied and that 81% of patients had a negative or 1+ Lachman result, a negative pivot-shift result, and a leg difference of less than 3 mm compared with the contralateral side on KT-1000 testing. Furthermore, they noted that 95% of patients returned to sports and 66% returned to the previous level of sports participation. In the historical studies on open primary repair and the more recent experimental studies, tear location seems to be a critical predictor for the success of primary repair.[27,59] It is proximal tears that can be repaired and heal to the femur, and this likely explains why our results were maintained at mid-term follow-up, as opposed to many of the historical primary-repair studies.

Another factor that seems to explain the lack of deterioration is the arthroscopic approach to surgery. Historically, primary repair was performed through an arthrotomy, which is invasive and likely contributed to the high incidence of stiffness and patellofemoral pain that was reported.[15,60] In 2005 Strand et al.[23] reported their long-term (>15 years) results of open primary repair and also noted the invasiveness of the old procedure. They suggested that the use of arthroscopy in

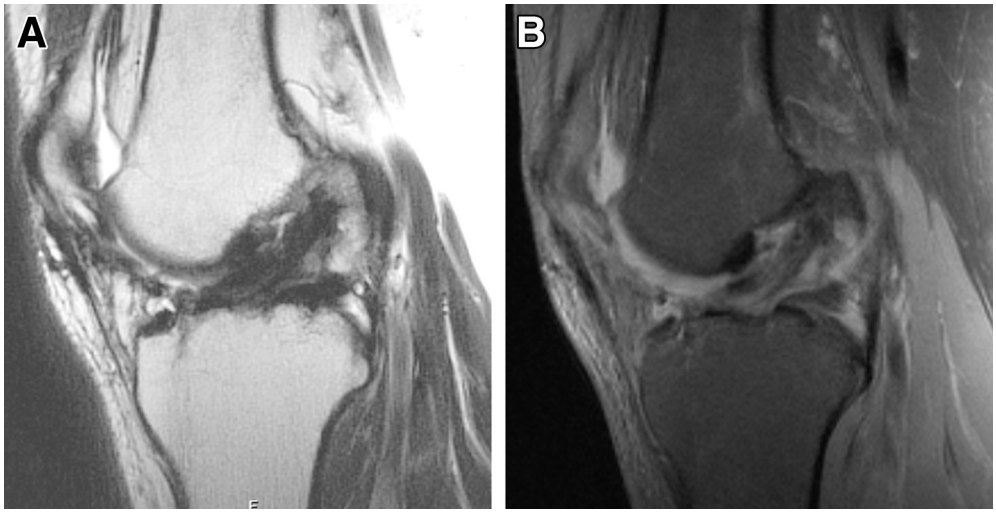

Fig 2. Postoperative magnetic resonance imaging scans of patient 8 at 4.9 years' follow-up. The sagittal T1 (A) and T2 (B) images show a homogeneous signal in the ligament with continuity of the fibers from the tibial footprint to the femoral footprint. This patient had stable Lachman and pivot-shift examination findings.

primary repair might reduce the number of patients needing later reconstructions because this changes the risk-benefit ratio for patients.[23] Indeed, with the development of arthroscopy, primary repair can be performed in a minimally invasive manner,[35,38] and we believe this may also explain why our results were maintained at mid-term follow-up. In this study, nearly all patients reported their knee felt normal and 4 patients reported their knee felt completely normal (SANE score of 100), 1 of whom could not recall which knee had undergone the operation.

In this study, rehabilitation focused on regaining early ROM and controlling swelling, whereas historical studies focused on joint immobilization with a cast or brace for several weeks.[10,22] Modern rehabilitation protocols, however, focus on regaining early ROM to prevent postoperative stiffness, which was reported in up to 71% of patients in the historical studies.[15,16] Genelin et al.[22] also noted the role of joint immobilization in their mid-term study in which they showed excellent results when only treating proximal tears.

In our study, only 11 of 144 ACL tears (7.6%) were found to have sufficient tissue length (i.e., distal remnant can be approximated toward femoral footprint) and tissue quality (i.e., tissue can withstand sutures) for this surgical technique. This finding can be explained by the fact that the senior author applied strict patient selection criteria because this was the first time that the arthroscopic primary repair technique was performed. A recent study assessed the prevalence of proximal tears using MRI and found, however, that 16% of patients had tears located in the most proximal 10% of the ligament (type I) and fully 43% had tears in the most proximal 25% of the ligament (type I tears in 16% and type II tears [tears in proximal 10%-25% of ligament] in 27%).[34] It has also been shown that 90% of the type I tears and approximately 50% of the type II tears can be treated by arthroscopic primary repair.[61] Combining the numbers of these studies indicates that a larger share (approximately 28%) of all ACL tears could potentially be treated with arthroscopic primary ACL repair. Further studies are necessary to exactly define which percentage of patients can undergo repair and which patient characteristics are associated with proximal avulsion tears. In our practice, patients are recommended to undergo primary repair if the tear type and tissue quality are sufficient for repair, because we believe the risk-benefit ratio has changed.[19,21,36] Arthroscopic primary repair is a safe and quick procedure with a low complication rate and quick return of ROM.[37,38] Furthermore, in our practice, patients have had no graft-harvesting complications[38] and a low incidence of quadriceps atrophy, and this allows them to go through the rehabilitation milestones quickly. Finally, if primary repair fails, they can still undergo primary ACL reconstruction (tunnels or grafts). ACL reconstruction is only performed when primary repair is not possible.

Although the average outcome scores were high in this study, 3 patients had a decrease in the Tegner score, 1 of whom also had suboptimal functional outcomes. This latter patient (patient 8) was a 50-year-old female patient (aged 55 years at follow-up) who had severe bilateral hip and lumbar spine osteoarthritis and beginning knee osteoarthritis that limited her activities. The 2 other patients had a decrease in the Tegner score alone. One patient (patient 10) was a 17-year-old male patient (aged 22 years at follow-up) who participated in high-level sports during college (Tegner score of 9), and his activity level decreased when he left college and started to play recreational sports, which was situational and unrelated to his knee function. The other patient (patient 2) was a 38-year-old man (aged 46 years at follow-up) who decreased his activities unrelated to his knee function, but he noticed some pain with weather changes.

In the early 1990s, some authors recognized the role of tear location in the outcomes of primary repair and reported good results of open primary repair of proximal tears.[22,27,57,58] As a result, some surgeons used a treatment algorithm in the early 1990s that was based on tear location and tissue quality: Proximal avulsion tears that could be reattached to the femoral wall were repaired, whereas tear types that were too short for reattachment or had insufficient tissue quality were reconstructed.[13,22,62-65] Because of several prospective studies in the early 1990s that showed more predictable outcomes with ACL reconstruction than with primary ACL repair, which is not surprising given that the role of tear location was not considered in these studies, ACL reconstruction became the gold standard for all tear types, rather than for only irreparable tears.[19] The results in this study show that good outcomes can be achieved in appropriately selected patients with a significantly less invasive surgical procedure than reconstruction surgery[38] and 1 in which no bridges are burned for future reconstruction surgery if it becomes necessary.

It should be noted that the average age in this study was 37 years at the time of the operation, which is higher than that in most of the ACL studies. This could be explained by the fact that the procedure was initially only performed in somewhat lower-demand patients. However, 3 male patients were young at the time of surgery and played competitive football and rugby (aged 17 years, Tegner score of 9), competitive rugby (aged 22 years, Tegner score of 9), or recreational basketball (aged 23 years, Tegner score of 7) before and after injury. These patients had stable knees at examination and reported their knee felt normal (SANE scores of 100, 99, and 100, respectively), and all returned to pivoting and/or high-impact (tackling) sports. The 2 patients who played rugby both endured valgus tackles several years after their return to sports and came to the clinic for evaluation. They both had grade 3+ medial collateral ligament injuries, and in both cases the ACL was intact (negative Lachman result, negative pivot-shift result, and IKDC objective score of A). These injuries were treated conservatively.

Limitations

Limitations are present in this study. First, this is a retrospective study with a small sample size, and selection bias cannot be excluded. Second, the patients in this study had a higher age than average studies reporting outcomes of ACL surgery. Outcomes in younger patients might be inferior because higher failure rates of ACL reconstruction surgery are also reported in younger patients (up to 30%).[66,67] However, the youngest patients in this study reported excellent outcomes and had among the highest outcome scores and activity levels. Third, this study consists of clinical outcomes and does not contain radiologic confirmation of the intact repaired ligament. Although this would have been beneficial for this recently developed treatment, MRI was not routinely performed in clinically stable patients because it generally has not been performed in the ACL literature.[68] Three patients had postoperative MRI scans at final follow-up in which a continuous ligament was seen with hypo-intense homogeneous signal (Fig 2). Finally, no objective return-to-sports assessment and no KT-1000 examinations were performed for logistic reasons, although at 2-year follow-up, KT-1000 examinations were performed and all tested patients had a less than 3-mm leg difference (except the patient in whom failure occurred).

Conclusions

The clinical outcomes of arthroscopic primary repair of proximal ACL tears with suture anchors are excellent and are maintained at mid-term follow-up in a carefully selected subset of patients with proximal tears and excellent tissue quality.

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