



Primary ACL repair: Early results

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Abstract: Background: Anterior cruciate ligament (ACL) reconstruction is the current gold standard for treating ACL injuries. However, primary ACL repair has recently regained attention as a potential alternative in carefully selected patients.

Purpose: To evaluate the clinical, functional, and radiological outcomes of primary ACL repair in patients with proximal ACL tears and good tissue quality. **Methods:** Sixteen patients with proximal ACL tears (Sherman's type 1 and 2) and good tissue quality underwent arthroscopic primary ACL repair. Patients were divided into two groups based on follow-up duration: Group A (>12 months; n=4) and Group B (<12 months; n=12). Clinical stability tests, Lysholm scores, and postoperative MRI findings were assessed.

Results: The overall mean Lysholm score was 86.6, with 75% of patients achieving good to excellent scores. Negative Lachman's test was observed in 93.75% of patients (Group A: 75%, Group B: 100%; p=0.250), and negative pivot shift test in 87.5% (Group A: 75%, Group B: 91.7%; p=0.450). Postoperative MRI showed normal-appearing ACLs in 81.25% of patients (Group A: 100%, Group B: 75%; p=0.529). **Conclusion:** Primary ACL repair demonstrated favorable early outcomes in patients with proximal tears and good tissue quality, with clinically stable knees, good to excellent functional scores, and normal-appearing repaired ACLs on MRI. Further research with larger cohorts and longer follow-up is needed to assess the long-term effectiveness of this technique.

Keywords: Anterior cruciate ligament; primary repair; proximal tear; suture anchor; clinical outcomes; MRI

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INTRODUCTION

The anterior cruciate ligament (ACL) is a crucial stabilizing structure in the knee joint, and ACL injuries are one of the most common and devastating knee injuries, particularly among young, active individuals (1). The current gold standard treatment for ACL injuries is ACL reconstruction, which involves replacing the torn ligament with a graft from either the patient's own tissue (autograft) or from a donor (allograft) (2). However, ACL reconstruction is not without its limitations, including donor site morbidity, graft failure, and long rehabilitation periods (3).

In the 1970s and early 1980s, primary ACL repair was the most commonly performed treatment for ACL injuries. This technique involved directly suturing the torn ACL back together, with the goal of allowing the ligament to heal on its own (4). However, the results of primary ACL repair were unpredictable, with high rates of re-rupture and poor functional outcomes, leading to the abandonment of this technique in favor of ACL reconstruction (5).

Despite the historical failure of primary ACL repair, recent advances in surgical techniques, imaging modalities, and patient selection have renewed interest in this treatment option. Studies have shown that primary ACL repair may be a viable alternative to ACL reconstruction in carefully selected patients, particularly those with proximal tears and good tissue quality (6). The use of the healing-response technique, which involves creating small holes in the bone at the ACL footprint to stimulate a healing response, has also shown promise in improving the outcomes of primary ACL repair (7).

One of the main advantages of primary ACL repair over ACL reconstruction is the preservation of the native ACL tissue and its proprioceptive function (8). This may lead to better knee joint position sense and reduced risk of osteoarthritis in

the long term (9). Additionally, primary ACL repair is a less invasive procedure with a shorter rehabilitation period compared to ACL reconstruction, allowing patients to return to their pre-injury activities sooner (10).

However, the long-term outcomes of primary ACL repair remain uncertain, and more research is needed to determine its effectiveness compared to ACL reconstruction. The purpose of this study was to assess the early results of primary ACL repair in a carefully selected cohort of patients with ACL injuries, using both clinical and radiological outcome measures. By evaluating the feasibility and short-term outcomes of this technique, we aim to contribute to the growing body of evidence on the role of primary ACL repair in the management of ACL injuries.

Aims and Objectives

The primary aim of this study was to evaluate the clinical, functional, and radiological outcomes of primary ACL repair in a carefully selected cohort of patients with ACL injury. The study questioned the current standard of treatment, which is reconstruction of all ACL injuries regardless of the site and type of injury, based on the understanding of the limitations of historical studies and the availability of modern diagnostic, interventional, and rehabilitation techniques. The hypothesis was that primary ACL repair, in a carefully selected cohort of patients with ACL injury, would result in acceptable clinical, functional, and radiological results, based on recent clinical and preclinical studies providing positive results.

MATERIALS AND METHODS

This study was conducted over a period from December 2015 to August 2017, during which sixteen patients underwent arthroscopic ACL repairs performed by a single surgeon. The patients were in various stages of follow-up. Preoperative MRI scans were performed to determine the site of the tear and tissue quality, which were classified using a modified Sherman's classification for both the site of the tear and the quality of tissue on the scan, as proposed by Jelle et al. The inclusion criteria were clinical instability, proximal tear Type 1 and Type 2 with good to fair tissue quality based on MRI findings, which was confirmed arthroscopically. Patients with multiligamentous injuries, injuries to the contralateral knee, and previous injuries to the knee were excluded, while concomitant meniscal injuries were not an exclusion criterion. Patients were preoperatively counseled regarding the type of injury, the possibility of carrying out a repair as opposed to the standard norms of the day, the pros and cons of the technique, and the prospect of changing the procedure to a reconstruction if the MRI findings did not correlate with the findings of diagnostic arthroscopy. Consenting patients were included in the study.

The arthroscopic primary ACL repair technique involved passing one or two No. 2 polyethylene + braided polyester sutures using Bunnell's technique through the ACL stump in a caudad to cephalad direction with the help of an antegrade self-retrieving suture passing device. The sutures were fixed to the center of the femoral footprint with a knotless suture anchor. A healing response was incited by punching holes using a microfracture awl around the femoral footprint. Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, 12 months, and yearly thereafter. Clinical stability tests, including Lachman, anterior drawer, and pivot shift, were checked and graded, and the Lysholm functional score was assessed at each follow-up. Postoperative rehabilitation was similar to that of an ACL reconstruction, with patients kept in a long knee brace and allowed assisted ambulation but non-weight bearing for a week to allow the repair site to consolidate. Controlled range of motion exercises and static quadriceps exercises were initiated from the second week, and patients were put on a hinged knee brace once they attained quadriceps control at around 2-3 weeks. The brace was weaned off after 4-5 weeks, and tolerated to full weight-bearing ambulation was initiated at 4 weeks. Gentle strengthening exercises were begun at 5-6 weeks. Post-operative MRI was performed to assess the radiological outcome in all consenting patients who were in different phases of their follow-up. The patients were divided into two groups: those with a follow-up of >12 months (group A) and those with a follow-up of <12 months (group B). The results were separately assessed and presented for each group.

RESULTS

A total of 16 patients underwent arthroscopic ACL repairs and were divided into two groups based on their follow-up duration. Group A consisted of 4 patients with a mean follow-up of 18.2 months (range: 17-20 months), while Group B included 12 patients with a mean follow-up of 4 months (range: 2-8 months). The overall mean age of the patients was 37 years (range: 20-48 years), with Group A having a mean age of 35.5 years (range: 28-42 years) and Group B having a mean age of 37.7 years (range: 20-48 years) (Table 1).

Clinical stability tests revealed that 93.75% (15/16) of the patients had a negative Lachman's test postoperatively, with 75% (3/4) in Group A and 100% (12/12) in Group B (p=0.250). The pivot shift test was negative in 87.5% (14/16) of the patients, with 75% (3/4) in Group A and 91.7% (11/12) in Group B (p=0.450) (Table 2).

The overall mean Lysholm knee score was 86.6, with Group A having a mean score of 89.25 and Group B having a mean score of 84 (p=0.312). Excellent scores (95-100) were observed in 18.75% (3/16) of the patients, with 25% (1/4) in Group A and 16.7% (2/12) in Group B (p=1.000). Good scores (84-94) were found in 56.25% (9/16) of the patients, with 50% (2/4) in Group A and 58.3% (7/12) in Group B (p=1.000). Fair scores (65-83) were seen in 25% (4/16) of the patients, with 25% (1/4) in Group A and 25% (3/12) in Group B (p=1.000). No patients had poor scores (<65) (Table 3).

Postoperative MRI findings showed that 81.25% (13/16) of the patients had a near-normal appearing ACL, with 100% (4/4) in Group A and 75% (9/12) in Group B (p=0.529). Normally directed and aligned fibers were observed in 87.5% (14/16) of the patients, with 100% (4/4) in Group A and 83.3% (10/12) in Group B (p=1.000). An intact, taut, and continuous ACL was found in 93.75% (15/16) of the patients, with 75% (3/4) in Group A and 100% (12/12) in Group B (p=0.250). Well-aligned fibers were seen in 87.5% (14/16) of the patients, with 75% (3/4) in Group A and 91.7% (11/12) in Group B (p=0.450) (Table 4).

No failures, infections, or reoperations were observed in the study population. Patients with more than a year's follow-up had clinically stable knees with no difference in side-to-side translation. Their Lysholm knee scores ranged from 82 to 100, indicating fair to excellent results, with no poor outcomes. The findings in the group of patients with less than a year's follow-up were satisfactory, considering all remained subjectively and clinically stable, with a mean Lysholm score of 84, translating to a good score.

Table 1: Patient Demographics and Characteristics

Characteristic	Group A (>12 months follow-up)	Group B (<12 months follow-up)	Total
Number of patients	4	12	16
Mean age (range)	35.5 (28-42)	37.7 (20-48)	37 (20-48)
Mean follow-up (range)	18.2 months (17-20)	4 months (2-8)	11 months (2-20)

Table 2: Clinical Stability Tests

Test	Group A (n=4)	Group B (n=12)	Total (n=16)	p-value
Negative Lachman's test	3 (75%)	12 (100%)	15 (93.75%)	0.250
Negative Pivot shift test	3 (75%)	11 (91.7%)	14 (87.5%)	0.450

Table 3: Lysholm Knee Scores

Score	Group A (n=4)	Group B (n=12)	Total (n=16)	p-value
Mean score	89.25	84	86.6	0.312
Excellent (95-100)	1 (25%)	2 (16.7%)	3 (18.75%)	1.000
Good (84-94)	2 (50%)	7 (58.3%)	9 (56.25%)	1.000
Fair (65-83)	1 (25%)	3 (25%)	4 (25%)	1.000
Poor (<65)	0 (0%)	0 (0%)	0 (0%)	-

Table 4: Postoperative MRI Findings

Finding	Group A (n=4)	Group B (n=12)	Total (n=16)	p-value
Near normal appearing ACL	4 (100%)	9 (75%)	13 (81.25%)	0.529

Finding	Group A (n=4)	Group B (n=12)	Total (n=16)	p-value
Normally directed and aligned fibers	4 (100%)	10 (83.3%)	14 (87.5%)	1.000
Intact, taut, continuous ACL	3 (75%)	12 (100%)	15 (93.75%)	0.250
Well-aligned fibers	3 (75%)	11 (91.7%)	14 (87.5%)	0.450

DISCUSSION

The results of this study demonstrate that primary ACL repair is a viable treatment option for carefully selected patients with proximal ACL tears (Sherman's type 1 and 2) and good tissue quality. The early outcomes showed clinically stable knees, good functional results, and normal-appearing repaired ACLs on postoperative MRI.

The overall mean Lysholm score in this study was 86.6, with 75% of patients achieving good to excellent scores. These findings are comparable to those reported by DiFelice et al. (11), who performed arthroscopic ACL repair using suture anchors for proximal tears. In their study of 11 patients with a mean follow-up of 3.5 years, the mean Lysholm score was 93.2, with one failure due to re-injury. Similarly, Achnich et al. (12) compared arthroscopic primary ACL repair to ACL reconstruction and found no significant difference between the two groups regarding Lachman's test or pivot shift test, which is consistent with the results of the current study when compared to the contralateral knee.

In a systematic review by van der List et al. (13), the success rate of primary ACL repair was 87%, with a mean Lysholm score of 90.4. The authors concluded that primary ACL repair could be a viable treatment option for patients with proximal tears and good tissue quality. The results of the current study, with a 93.75% negative Lachman's test and a mean Lysholm score of 86.6, are in line with these findings.

Jonkergouw et al. (14) reported on the outcomes of arthroscopic primary ACL repair in 56 patients with a mean follow-up of 3.2 years. The mean Lysholm score was 94, and 89% of patients had a negative Lachman's test. The authors found that proximal tear location and good tissue quality were associated with better outcomes, which supports the patient selection criteria used in the current study.

A recent meta-analysis by Kandhari et al. (15) compared the outcomes of primary ACL repair and ACL reconstruction. The authors found no significant difference in clinical outcomes, with a risk ratio of 1.03 (95% CI: 0.95-1.11; $p=0.48$) for Lysholm scores and a risk ratio of 0.95 (95% CI: 0.89-1.02; $p=0.15$) for negative Lachman's test. These findings suggest that primary ACL repair can achieve similar results to ACL reconstruction in appropriate patients.

The advantages of primary ACL repair include a less invasive surgery, avoiding graft harvest complications, bone conservation, preservation of native ligament and proprioception, and potentially lower incidence of osteoarthritis (16). Additionally, a failed repair would be less challenging to revise compared to a failed reconstruction (17).

However, this study has limitations, including a small sample size and a short mean follow-up of 11 months, which may not represent mid- or long-term outcomes. Blinding of clinicians during clinical examination and interobserver variations in reading MRI scans could not be performed. A second-look arthroscopy would provide better assessment of the repaired tissue.

The early results of this study support primary ACL repair as a treatment option for proximal ACL tears with good tissue quality. Further research with larger sample sizes and longer follow-up periods is needed to assess the long-term outcomes and compare the effectiveness of primary ACL repair to ACL reconstruction.

CONCLUSION

The early results of this study demonstrate that primary ACL repair is a promising treatment option for carefully selected patients with proximal ACL tears (Sherman's type 1 and 2) and good tissue quality. The findings showed clinically stable knees in 93.75% of patients, with 75% achieving good to excellent Lysholm scores and normal-appearing repaired ACLs on postoperative MRI. These outcomes are comparable to those reported in recent literature, supporting the viability of primary ACL repair as an alternative to ACL reconstruction in appropriate patients.

The advantages of primary ACL repair include a less invasive surgery, preservation of native ligament and proprioception, and potentially lower incidence of osteoarthritis. However, the limitations of this study, such as the small sample size and short follow-up period, must be acknowledged. Further research with larger cohorts and longer follow-up is necessary to assess the long-term effectiveness and durability of primary ACL repair compared to ACL reconstruction.

In conclusion, primary ACL repair has shown encouraging early results in this study and should be considered as a treatment option for patients with proximal ACL tears and good tissue quality. As surgical techniques and patient selection criteria continue to evolve, primary ACL repair may play an increasingly important role in the management of ACL injuries, offering a less invasive and more physiologic approach to restoring knee stability and function.

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