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Original Research Article

Long-term clinical outcomes of arthroscopic meniscal repair combined with anterior cruciate ligament reconstruction in young patients

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ABSTRACT

Background: Meniscal tears commonly accompany anterior cruciate ligament (ACL) injuries, occurring in approximately 50% of primary ACL ruptures. Meniscal preservation through repair is important for long-term knee function and osteoarthritis prevention, particularly in young, active patients. Aim of the study was to evaluate the long-term clinical outcomes of arthroscopic meniscal repair performed concomitantly with ACL reconstruction in young patients.

Methods: This observational study was conducted at, National Institute of Traumatology and Orthopedic Rehabilitation, Dhaka, from July 2022 to August 2025 among 29 young patients with ACL rupture and repairable meniscal tears. All underwent simultaneous arthroscopic ACL reconstruction and meniscal repair followed by structured rehabilitation. Outcomes were assessed serially using Lysholm, International Knee Documentation Committee (IKDC), visual analog scale (VAS), and objective stability measures, as well as meniscal healing, complications, graft failure, and return to activity. Statistical significance was set at $p<0.05$.

Results: The mean age was 23.8±4.1 years, and 65.5% were male. Medial meniscal tears predominated (65.6%). At final follow-up, Lysholm and IKDC scores improved from 56.4±8.9 to 92.0±5.5 and from 52.8±9.4 to 90.6±5.9, respectively, while VAS decreased from 4.0±1.2 to 0.5±0.6 (all $p<0.001$). Good-to-excellent outcomes occurred in 92.9%, meniscal repair success in 85.7%, and 82.1% returned to previous or near-previous activity.

Conclusions: Combined arthroscopic meniscal repair and ACL reconstruction provides excellent functional outcomes, substantial pain relief, and acceptable long-term meniscal survivorship, supporting meniscal preservation in young patients with ACL-meniscus injuries.

Keywords: ACL reconstruction, Meniscal repair, Meniscal preservation, Long-term outcomes, Young patients

INTRODUCTION

Among young and physically active individuals, anterior cruciate ligament (ACL) rupture represents one of the most clinically important traumatic knee injuries because it can result in persistent instability, impaired athletic performance, secondary intra-articular damage, and premature osteoarthritis. Across sporting populations, the burden is particularly substantial in activities involving rapid deceleration, pivoting, cutting, and landing movements.[1,2] In adolescent athletes, a systematic review identified 1,235 ACL injuries across more than 17.8 million athlete-exposures, with a pooled incidence of 0.069 per 1,000 exposures and a higher overall rate among females.[3] Similarly, evidence from team sports indicates that female athletes experience approximately twice the ACL injury rate of male athletes in comparable settings.[4] Among young patients who return to high-risk sports after ACL reconstruction, secondary ACL injury remains an additional concern, with reported reinjury rates approaching 23%.[5]

Alongside ligament disruption, meniscal injury frequently accompanies ACL rupture and has major implications for knee function and long-term joint preservation. Because the menisci contribute to load distribution, shock absorption, proprioception, and rotational stability, loss of functional meniscal tissue can accelerate articular cartilage degeneration. Following ACL injury, recurrent episodes of instability have been associated particularly with an increased risk of medial meniscal damage.[6] Moreover, evidence concerning post-traumatic knee osteoarthritis indicates that concomitant meniscal injury and meniscectomy substantially increase the risk of structural osteoarthritis after ACL reconstruction.[7] At longer follow-up, meniscal and chondral pathology has also been associated with poorer patient-reported outcomes, emphasizing the clinical importance of preserving viable meniscal tissue whenever possible.[8] Within contemporary arthroscopic practice, meniscal preservation through repair is therefore increasingly favored over meniscectomy in young patients with repairable traumatic tears. In pediatric and adolescent populations, arthroscopic meniscal repair has yielded favorable functional outcomes, with postoperative Lysholm scores generally ranging from 85.4 to 96.3; notably, more than half of repairs in the reviewed studies were performed concurrently with ACL reconstruction.[9] When ACL reconstruction and meniscal surgery are performed simultaneously, substantial postoperative improvements in Lysholm and other patient-reported outcomes can be achieved, although residual differences relative to isolated ACL reconstruction may remain.[10] Additionally, satisfactory healing has been reported following repair of complex tears, with one cohort demonstrating an 83.3% clinical healing rate and favorable pain and functional outcomes after bucket-handle meniscal repair.[11] Despite these benefits, long-term meniscal repair is not uniformly successful. With increasing follow-up duration, repair failures become more apparent, and medial meniscal repairs may carry greater failure risk than lateral repairs.[12] Nevertheless, successful meniscal preservation is clinically important because it helps maintain joint biomechanics and potentially limits subsequent degenerative changes. In young patients, these considerations are especially relevant because of higher activity demands, longer lifetime exposure to recurrent knee loading, and the potential consequences of repeat surgery. Within Bangladesh and the wider South Asian region, ACL injuries are frequently encountered among young individuals involved in sports, physically demanding occupations, road traffic trauma, and recreational activities; however, robust longitudinal evidence regarding simultaneous ACL reconstruction and meniscal repair remains limited. Compared with the expanding international literature, locally generated data concerning long-term functional recovery, pain, objective stability, meniscal healing, repair failure, and return to activity are particularly scarce. Such information is important because differences in injury patterns, treatment delays, rehabilitation access, socioeconomic circumstances, and postoperative follow-up may influence outcomes in resource-constrained settings. Therefore, this study aimed to evaluate the long-term clinical outcomes of arthroscopic meniscal repair performed simultaneously with ACL reconstruction in young patients, focusing on functional improvement, pain reduction, objective knee stability, meniscal repair success and failure, postoperative complications, and return to activity.

METHODS

This observational study was conducted in the Department of Orthopaedic Surgery at the National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh, from July 2022 to August 2025. A total of 29 young patients with ACL rupture associated with a repairable meniscal tear were included. Patients of either sex who had clinically and radiologically confirmed ACL rupture with concomitant medial, lateral, or combined meniscal injury suitable for arthroscopic repair were eligible. Patients with irreparable meniscal tears requiring meniscectomy, previous surgery on the affected knee, multiligamentous knee injury, advanced osteoarthritis, major chondral lesions, or inadequate follow-up were excluded.

Before surgery, demographic and clinical information, including age, sex, affected knee, mechanism of injury, and duration from injury to surgery, was recorded. Clinical evaluation included the Lachman test, anterior drawer test, and pivot-shift test. Functional status was assessed using the Lysholm knee scoring scale and International Knee Documentation Committee (IKDC) subjective score, while pain intensity was evaluated using the visual analog scale (VAS).

During arthroscopy, the involved meniscus, tear location, tear pattern, and vascular zone were documented. Meniscal repair was performed using all-inside, inside-out,

or combined techniques according to tear characteristics and accessibility. In the same operative session, arthroscopic ACL reconstruction was performed using a standard anatomical technique. Following surgery, all patients underwent a structured rehabilitation protocol that included progressive range-of-motion exercises, muscle strengthening, weight-bearing progression, and a gradual return to activity.

Postoperative assessment was performed at approximately 3, 6, and 12 months, and at final follow-up. Changes in Lysholm, IKDC, and VAS scores were evaluated, together with objective knee stability, meniscal healing, recurrent symptoms, re-tear, revision arthroscopy, ACL graft failure, postoperative complications, and return to activity. Long-term functional outcomes were categorized according to the Lysholm score.

Data were analyzed using statistical package for the social sciences (SPSS) (V. 26.0). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Pre-operative and postoperative outcomes were compared using appropriate paired statistical tests, with a p value <0.05 considered statistically significant. Ethical approval was obtained from the appropriate institutional authority, and informed consent was obtained from all participants before inclusion.

RESULTS

Among the 29 participants, the mean age was 23.8±4.1 years, with the largest proportion (41.4%) belonging to the 21–25-year age group. Regarding sex distribution, males predominated, accounting for 65.5% of the participants. Concerning the affected side, the right knee was involved in 58.6% of cases. Sports-related injury represented the most common mechanism, occurring in 62.1% of patients. On average, surgery was performed 5.8±3.4 months after injury, while the mean follow-up duration was 30.6±8.7 months (Table 1).

Regarding meniscal involvement, isolated medial meniscal injury was most frequent, occurring in 62.1% of patients, while 10.3% had injuries involving both menisci. Among the 32 repaired meniscal tears, medial meniscal tears accounted for 65.6%. In terms of tear location, the posterior horn was most commonly affected, representing 65.6% of tears. Concerning tear morphology, longitudinal or vertical tears were the predominant pattern at 46.9%, followed by bucket-handle tears at 28.1%. Most tears (62.5%) were located in the red-red vascular zone, and the all-inside technique was the most frequently used repair method, accounting for 68.8% of procedures (Table 2).

Across the follow-up period, substantial improvement was observed in both functional scores, together with a marked reduction in pain. From a pre-operative mean of 56.4±8.9, the Lysholm score increased progressively to 92.0±5.5 at final follow-up. Similarly, the mean IKDC score improved from 52.8±9.4 pre-operatively to 90.6±5.9 at final follow-up. In contrast, the mean VAS pain score declined from 4.0±1.2 before surgery to 0.8±0.7 at 6 months and further to 0.5±0.6 at final follow-up. For all three outcome measures, the changes were statistically significant (p<0.001) (Table 3).

Table 1: Baseline demographic and clinical characteristics of the study participants.

Variables	Category	N (%)/ mean±SD
Age (years)	Mean±SD	23.8±4.1
	≤20	7 (24.1)
	21–25	12 (41.4)
	26–30	10 (34.5)
Sex	Male	19 (65.5)
	Female	10 (34.5)
Affected knee	Right	17 (58.6)
	Left	12 (41.4)
Mechanism of injury	Sports-related injury	18 (62.1)
	Road traffic accident	7 (24.1)
	Fall/other trauma	4 (13.8)
Duration from injury to surgery (months)	Mean±SD	5.8±3.4
Follow-up duration (months)	Mean±SD	30.6±8.7

Table 2: Pattern and characteristics of meniscal injuries and repair techniques.

Variables	Category	N (%)
Meniscus involved (n=29)	Medial meniscus only	18 (62.1)
	Lateral meniscus only	8 (27.6)
	Both menisci	3 (10.3)
Total repaired tears (n=32)	Medial meniscus	21 (65.6)
	Lateral meniscus	11 (34.4)
Tear location (n=32)	Posterior horn	21 (65.6)
	Body	8 (25.0)
	Anterior horn	3 (9.4)
Tear pattern (n=32)	Longitudinal/vertical	15 (46.9)
	Bucket-handle	9 (28.1)
	Radial	4 (12.5)
	Oblique/flap	4 (12.5)
Vascular zone (n=32)	Red-red	20 (62.5)
	Red-white	12 (37.5)
Repair technique (n=32)	All-inside	22 (68.8)
	Inside-out	7 (21.9)
	Combined technique	3 (9.4)

Following combined ACL reconstruction and meniscal repair, marked improvement in objective knee stability was observed. At final follow-up, 92.9% of patients demonstrated Lachman grade 0/I compared with none pre-

operatively, while a negative pivot-shift test was present in 92.9% compared with 3.6% before surgery. Similarly, 96.4% of patients had a negative or grade I anterior drawer test at final follow-up. Mean side-to-side laxity also decreased substantially from 6.7±1.5 mm pre-operatively to 1.8±0.7 mm at final assessment. These improvements were statistically significant (p<0.001) (Table 4).

At final follow-up, favorable long-term clinical outcomes were observed in most patients. Based on the Lysholm classification, 71.4% achieved an excellent outcome, and 21.4% achieved a good outcome, resulting in a combined good-to-excellent outcome rate of 92.9%. Clinically successful meniscal repair was observed in 85.7%, with a repair failure or retear rate of 14.3%. Revision arthroscopy was required in 10.7%, whereas ACL graft re-rupture or failure occurred in only 3.6%.

Postoperative knee stiffness and superficial portal-site infection occurred in 7.1% and 3.6% of patients, respectively, with no deep infection or neurovascular complications. Importantly, 82.1% of patients returned to their previous or near-previous activity level (Table 5).

Table 3: Changes in Lysholm, IKDC, and VAS scores during follow-up.

Follow-up period	Lysholm score	IKDC score	VAS score
	Mean±SD		
Pre-operative	56.4±8.9	52.8±9.4	4.0±1.2
3 months	75.8±7.6	70.6±8.3	2.0±0.9
6 months	86.7±6.8	82.9±7.2	0.8±0.7
12 months	90.3±5.8	88.3±6.3	0.6±0.6
Final follow-up	92.0±5.5	90.6±5.9	0.5±0.6
P value	<0.001	<0.001	<0.001

Table 4: Objective knee stability before surgery and at final follow-up (n=28).

Stability parameters	Pre-operative	Final follow-up	P value
	N (%)/mean±SD		
Lachman grade 0/I	0 (0.0)	26 (92.9)	<0.001
Lachman grade II/III	28 (100.0)	2 (7.1)	
Pivot-shift negative	1 (3.6)	26 (92.9)	<0.001
Pivot-shift positive	27 (96.4)	2 (7.1)	
Anterior drawer negative/grade I	2 (7.1)	27 (96.4)	<0.001
Anterior drawer grade II/III	26 (92.9)	1 (3.6)	
Side-to-side laxity (mm)	6.7±1.5	1.8±0.7	<0.001

Table 5: Long-term functional outcomes, meniscal healing, complications, and treatment failure (n=28).

Outcomes	N (%)
Excellent Lysholm outcome	20 (71.4)
Good Lysholm outcome	6 (21.4)
Fair Lysholm outcome	2 (7.1)
Poor Lysholm outcome	0 (0.0)
Good-to-excellent functional outcome	26 (92.9)
Clinically successful meniscal repair	24 (85.7)
Meniscal repair failure/re-tear	4 (14.3)
Persistent/recurrent joint-line symptoms	5 (17.9)
Revision arthroscopy required	3 (10.7)
ACL graft re-rupture/failure	1 (3.6)
Postoperative knee stiffness	2 (7.1)
Superficial portal-site infection	1 (3.6)
Deep infection	0 (0.0)
Neurovascular complication	0 (0.0)
Returned to previous or near-previous activity level	23 (82.1)

DISCUSSION

In this study, simultaneous arthroscopic ACL reconstruction and meniscal repair produced substantial improvement in young patients, with mean Lysholm score increasing from 56.4±8.9 preoperatively to 92.0±5.5 at final follow-up, IKDC increasing from 52.8±9.4 to 90.6±5.9, and VAS pain decreasing from 4.0±1.2 to 0.5±0.6. These findings are consistent with the meta-analysis by Sarraj et al, which reported favorable long-term outcomes after ACL reconstruction with meniscal repair.[13] Similarly, the study by Liau et al reported a postoperative Lysholm score of 93.8, close to the present 92.0.[10] In a recent South Asian cohort, Gupta et al demonstrated improvements in Lysholm score from 66.0 to 94.0 and VAS from 4.0 to 0 at six months.[14] Potentially, the slightly lower Lysholm score here may reflect a longer follow-up period and the inclusion of patients with repair failure. Regarding functional recovery, 71.4% achieved an excellent Lysholm outcome, and 92.9% achieved good-to-excellent outcomes. Comparable results were reported in a systematic review of young patients, where postoperative Lysholm scores ranged from 85.4 to 96.3.[9] Likewise, the

study by Chalatsis et al found mean Lysholm and IKDC scores of 90.5 and 80.6 at 13.2 years, with better outcomes after meniscal repair than meniscectomy.[15] Possibly, the higher present IKDC score (90.6), may reflect younger age and shorter follow-up, limiting degenerative change. Consistently, the study by Muench et al reported an IKDC score of 82.8, a VAS of 0.46, and a clinical healing rate of 83.3%.[11] Regarding meniscal healing, repair success was 85.7%, with failure in 14.3%. This closely matches the pooled 14.8% failure reported by Costa et al.[16] By contrast, the meta-analysis by Nepple et al reported an overall failure rate of 22.6% beyond 5 years and 19.5% with modern repairs.[17] Similarly, the study by Thaunat et al reported 19% failure after medial bucket-handle repair during ACL reconstruction.[18] whereas the study by Kalifis et al observed approximately 33% failure at nearly 10 years.[19] Most likely, the lower current rate reflects shorter follow-up, repairable vascular zone tears, restored ACL stability, and modern techniques. Supporting this, the study by Seo et al reported 82.1% complete healing and only 3.6% failure with suture repair, compared with 21.2% failure using fixation devices.[20] Moreover, the study by Malinowski et al showed that incomplete early healing did not necessarily progress to clinical failure when stability was restored.[21]

With respect to tear distribution, medial tears represented 65.6% and lateral tears 34.4%. This predominance is important because medial repairs carry a higher risk of failure. In the meta-analysis by Nepple et al, failure rates were 23.9% for medial and 12.6% for lateral repairs, while Costa et al found nearly twice the failure risk for medial bucket-handle tears.[16,17] Because the medial meniscus is less mobile and acts as a secondary stabilizer against anterior tibial translation, instability may increase its mechanical loading. Consistently, the systematic review by Sommerfeldt et al linked recurrent instability with increased odds of medial meniscal damage.[6]

Objectively, stability improved markedly, with 92.9% showing Lachman grade 0/I, 92.9% having a negative pivot shift, and side-to-side laxity decreasing from 6.7±1.5 mm to 1.8±0.7 mm. A comparable improvement was reported by Thaunat et al, in which laxity decreased from 6.77 to 1.02 mm.[18] In the meta-analysis by Sarraj et al, less anterior laxity was also reported after repair than resection, while Westermann et al found failure rates of 16% for all-inside and 10% for inside-out repairs with ACL reconstruction.[13,22]

Importantly, 82.1% returned to their previous or near-previous activity level, while ACL graft failure occurred in only 3.6%. Although encouraging, the meta-analysis by Wiggins et al reported a 23% rate of secondary ACL injuries among athletes younger than 25 years returning to sport.[5] Additionally, the OPTIKNEE review found increased structural osteoarthritis risk after ACL reconstruction with partial meniscectomy (OR 1.87), and total medial meniscectomy (OR 3.14).[7] Clinically, low postoperative morbidity further supported feasibility, with knee stiffness in 7.1%, superficial infection in 3.6%, and no deep infection or neurovascular complication, broadly consistent with the low short-term complication burden reported by Gupta et al.[14]

Limitations

Because of the small sample size, single-center design, and relatively limited follow-up, the findings may have restricted generalizability. The absence of routine postoperative imaging or second-look arthroscopy also limited objective assessment of meniscal healing.

CONCLUSION

Overall, simultaneous arthroscopic ACL reconstruction and meniscal repair produced favorable long-term clinical outcomes in young patients, with substantial improvement in knee function, pain, and objective stability. With high rates of good-to-excellent functional recovery, successful meniscal healing, and return to activity, the combined procedure appeared effective for restoring knee performance. Given the relatively low rates of meniscal repair failure, graft failure, and postoperative complications, the preservation of repairable meniscal tissue during ACL reconstruction should remain an important treatment strategy for young, active patients.

Recommendations

Meniscal repair should be prioritized during ACL reconstruction in young patients when feasible, with stable reconstruction, appropriate rehabilitation, and a gradual return to activity. Larger multicenter studies with longer follow-up periods are recommended to confirm the durability of long-term repair and functional outcomes.

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