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Original Article

Isolated vs. Concomitant ACL Reconstruction in Meniscus Repair: Failure and Clinical Outcomes

ÖZDEMİR and AKAR. Meniscus Repair Outcomes: Isolated vs. ACLR

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Aim: The healing rates between isolated and concomitant anterior cruciate ligament reconstruction of the meniscus repair is still a debate. This study aimed to compare the failure rates and clinical outcomes between isolated meniscus repair and simultaneous anterior cruciate ligament reconstruction.

Methods: This retrospective analysis included 59 patients aged < 40 years who underwent arthroscopic meniscus repair. Of these, 32 patients underwent isolated meniscal repair, whereas 27 underwent simultaneous anterior cruciate ligament reconstruction. Patients were followed up at 1, 3, and 6 months postoperatively and then at 6-month intervals for a minimum of 2 years.

Results: There were no statistically significant differences in terms of tear type, tear length, or affected meniscus. Although the distribution of tear zones was higher in the isolated group, favoring zone 2, this difference was not statistically significant ($p=0,095$). The preoperative Lachman test was significantly more positive in patients who underwent simultaneous anterior cruciate ligament reconstruction ($p<0,001$). When functional scores were evaluated, the preoperative ($p=0,006$) and postoperative ($p=0,032$) Tegner activity scores were significantly higher in the simultaneous anterior cruciate ligament reconstruction group. The revision surgery rate, an indicator of clinical failure, was higher in isolated group; however, this difference did not reach statistical significance ($p=0,060$).

Conclusion: This study demonstrated that the clinical efficacy of meniscus repair is high regardless of anterior cruciate ligament reconstruction, but anterior cruciate ligament reconstruction may show more favorable trends in some clinical parameters because of its biological and mechanical advantages.

Keywords: Anterior Cruciate Ligament (ACL), Meniscus Injury, Repair Technique

INTRODUCTION

The menisci are fibrocartilaginous structures that enhance joint congruence and play a key role in load transmission and shock absorption in the knee joint. With increasing participation in sports, the incidence of meniscal injury has increased. Loss of meniscal integrity is associated with knee instability¹ and early degenerative changes.²⁻⁴

Especially with advancements in arthroscopic techniques and implant technology, meniscus repair is increasingly used in clinical practice to restore the meniscus's joint-protective function and prevent the development of secondary lesions and joint degeneration.³ Among the various repair methods, the inside-out and

all-inside techniques are most commonly used and have demonstrated comparable healing outcomes and long-term failure rates.⁵ Repair failure, often assessed by reoperation rates, occurs in approximately 23% of cases and is influenced by factors such as patient age, tear characteristics, vascularity, and chronicity.⁶

Meniscus tears resulting from sports injuries are frequently associated with anterior cruciate ligament (ACL) injuries and significantly impact patient outcomes. Biomechanical data and early clinical reports suggest that isolated meniscus repair is unsuitable for knees with ACL insufficiency. Whether healing rates differ between isolated and simultaneous anterior cruciate ligament reconstruction (ACLR) of the meniscus remains a subject of debate. The primary aim of this study was to compare the clinical failure rates of meniscus repairs performed with isolated meniscus repair and simultaneous ACLR. The secondary aim was to evaluate whether there are differences in clinical failure rates between meniscus repair techniques (inside-out and all-inside) and to examine the effect of ACLR on the relationship between the repair technique and clinical failure.

MATERIAL AND METHOD

Patient Selection

After obtaining ethics committee approval (E-67961857-050.04-2500075936), a retrospective study was conducted between June 2022 and January 2025. The study included 59 patients aged <40 years who were diagnosed with meniscal tears and had a normal mechanical axis. Horizontal and longitudinal tears greater than 1 cm, observed in zones 1 and 2 and not chronic degenerative, were defined as the criteria for repair. A total of 59 patients (30 women and 29 men) underwent arthroscopic meniscus repair. Thirty patients underwent the inside-out technique, while 29 underwent the all-inside repair technique. Thirty-two patients underwent isolated meniscus repair, and 27 underwent simultaneous ACLR. Patients were followed up at 1, 3, and 6 months postoperatively and then at 6-month intervals for a minimum of 2 years.

Patients with meniscal root tears, ramp lesions, multiple ligament injuries, concomitant microfractures or mosaicplasty due to cartilage damage, knee pathologies such as osteoarthritis, avascular necrosis, osteochondritis dissecans, or rheumatoid arthritis, a history of smoking, skeletally immature patients, previous ipsilateral knee surgery, and long bone alignment deformity were excluded.

Clinical Evaluation

Each patient was clinically evaluated for the presence of knee effusion, meniscal injury, and ACL injury, and all findings were recorded preoperatively and postoperatively. The Lachman test was used to assess ACL function, and the McMurray test was used to assess meniscal pathologies. Visual Analog Score (VAS), Lysholm, and Tegner activity scores were used in the preoperative and postoperative clinical evaluations of the patients. In our study, clinical failure was defined as the requirement for revision surgery. Revision surgery criteria were defined as a postoperative VAS score >3, the presence of knee effusion, and positive McMurray test results. Meniscus repair success was compared between groups that underwent isolated meniscus repair and those who underwent simultaneous ACLR. In addition, variables such as age, side, time between symptom onset and surgery, follow-up period, and duration of revision surgery were recorded for all patients.

Radiological Evaluation

All patients underwent preoperative knee radiography (anteroposterior [AP] and lateral views in the standing position), lower extremity orthoradiography, and magnetic resonance imaging (MRI). Preoperative knee radiographs were used to assess additional pathologies such as osteoarthritis and cartilage damage. In patients who underwent ACLR, tunnel placement and implant position were assessed using knee radiographs obtained at the final follow-up. The preoperative mechanical axis of each patient was evaluated using lower extremity radiography. Meniscal and ACL injuries were diagnosed based on the evaluation of physical examination findings and preoperative MRI.

Surgical Technique

All surgical procedures were performed under a tourniquet using a standard knee arthroscopy approach. Each patient was evaluated arthroscopically for additional joint pathologies. In meniscus tears that met the repair criteria, the tear ends were debrided with a shaver to increase the healing potential. In patients who underwent simultaneous ACLR, meniscal repair was performed after harvesting gracilis and semitendinosus tendon autografts required for ACLR and creating bone tunnels. Following meniscus repair, the tendon autograft loaded onto the Endobutton system was passed through the prepared tunnels and fixed in the tibial tunnel with a bioabsorbable screw to complete the ACLR (ACL-PCL set; Doratek Medical, Ostim/Ankara, Türkiye). In the all-inside group, meniscus repair was performed using the TrustKnot All-Inside Meniscal Repair System (Doratek Medical, Ostim/Ankara, Türkiye) according to the manufacturer's technical guide. During the knot placement procedure, a knot pusher was used to ensure sufficient compression of the tear area. In the inside-out group, meniscal needles carrying reinforced threads were passed through the meniscus using cannulas (Inside-Out Meniscal Repair System; Doratek Medical, Ostim/Ankara, Türkiye). An additional surgical incision was made at the needle exit site, and the threads were knotted to the capsule. Meniscus repair was performed without damaging the knee joint cartilage. Depending on the length and stability of the tear, 1-4 implants were used. For each patient, data such as the location of the tear in the meniscus, zone, length, type, and number of sutures

used for repair were recorded. The length and zone of the tear were assessed using distance-scaled probes. The zone of the tear (distance from the periphery) was defined according to the Cooper zone classification system.

Rehabilitation Protocol

All patients were referred to physiotherapists. Isometric quadriceps-strengthening exercises, such as quadriceps contractions and straight-leg raises, were initiated on day 1 post-surgery. The patients wore an angle-adjustable knee brace for 4 weeks, allowing for full extension and 90 ° flexion. Patients were instructed on the use of crutches and allowed to walk without bearing weight on the operated side for 4 weeks postoperatively. At the end of the 4th week, the angle-adjustable knee brace was discontinued and range-of-motion exercises were initiated. Simultaneously, they were allowed to bear weight at a level they could tolerate, and weight bearing was gradually increased. Full weight-bearing was achieved at the end of the 6th week, and crutches were discontinued at the end of the 8th week. Squatting was not permitted for the first three months after surgery. At 4 months post-surgery, if patients had achieved a functional range of motion, muscle strength, and stability, light sports activities were initiated. Patients were not allowed to return to normal sports activities until after 6 months. Simultaneous ACLR did not alter the rehabilitation protocols.

Statistical Analysis

Statistical analysis of the data obtained in the study was performed using IBM Statistical Package for the Social Sciences (SPSS) for MacOS version 30.0 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as numbers and percentages (n [%]), while continuous variables are presented as mean ± standard deviation (SD). The distribution characteristics of continuous variables were evaluated using the Kolmogorov–Smirnov normality test. In addition, skewness and kurtosis values within the ±2 range were considered to support the normality assumption. For intergroup comparisons, the Student's t-test was used for continuous variables showing normal distribution, and Welch's t-test was used when homogeneity of variance was not achieved. Pearson's chi-square test was used to compare categorical variables; Fisher's exact test was preferred when the expected cell counts were insufficient. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the effect sizes associated with clinical failure (revision surgery). Results were considered statistically significant when p was less than 0,05. A post hoc power analysis was performed based on the primary outcome (clinical failure/revision surgery) to assess the adequacy of the sample size.

RESULTS

Table 1 summarizes the demographic and surgical characteristics according to the surgical methods. Of the 59 patients included, 32 (54,2%) underwent isolated meniscal repair, and 27 (45,8%) underwent simultaneous ACL reconstruction. The mean postoperative follow-up duration was 29.4 months (range, 24–31 months), and the mean time from symptom onset to surgery was 7.3 weeks (range, 1–12 weeks). No significant differences were observed between the groups regarding age, sex, operated side, follow-up duration, or time from injury to surgery ($p>0,05$). The distribution of meniscal repair techniques (all-inside vs. inside-out) was similar between the groups ($p=0,887$). Likewise, tear type, tear length, affected meniscus, tear zone distribution, and the number of sutures used did not differ significantly between the groups ($p>0,05$ for all).

Table 2 presents the clinical evaluations and functional outcomes. Postoperative effusion and McMurray test positivity were more frequent in the isolated group, but the differences were not statistically significant ($p>0,05$). In patients with minimal effusion, the postoperative McMurray test became negative and VAS scores decreased to <3 ; therefore, no revision surgery was required in these patients. In contrast, 8 patients (13.6%) with severe effusion accompanied by a positive postoperative McMurray test were considered to have clinical failure. Of these, 7 patients (21.9%) were in the isolated repair group, whereas 1 patient (3.7%) was in the concomitant ACLR group. Although revision surgery rates were higher in the isolated group, this difference was not statistically significant ($p=0,060$). These patients underwent arthroscopic partial meniscectomy at a mean of 8 months, and complete resolution of symptoms was observed at the final follow-up.

Preoperative Lachman test positivity was observed in 23 patients, and was significantly higher in patients who underwent simultaneous ACLR ($p<0,001$). In the postoperative period, no residual anterior instability was identified based on postoperative Lachman test findings. The simultaneous ACLR group also demonstrated significantly higher preoperative and postoperative Tegner activity scores ($p=0,006$ and $p=0,032$, respectively); however, the amount of improvement (Δ Tegner) did not differ between the groups ($p=0,317$). Both groups showed significant postoperative improvements in Lysholm and VAS scores, with no significant differences in postoperative values or change scores (Δ Lysholm and Δ VAS) ($p>0,05$).

Table 3 presents the effect size analysis for clinical failure. Clinical failure rates were higher in the isolated group; however, this difference was not statistically significant. Although the effect size analysis suggested a trend toward a higher probability of clinical failure in the isolated group, this increase did not reach statistical significance. Analysis of the meniscus repair technique revealed no significant difference in clinical failure rates and no significant effect on the development of clinical failures.

DISCUSSION

When evaluating the baseline characteristics and surgical details of the patient groups in our study, it can be stated that the two groups were well-balanced for clinical and surgical comparison. Most studies in which meniscus repair with simultaneous ACLR is performed report no significant differences between groups in terms of age and sex; however, such homogeneity is not always achieved for tear characteristics and zone distribution.⁷ In the present study, no differences were found between groups in tear characteristics or zone distribution, allowing for a more accurate and reliable assessment of repair success. No statistically significant difference was observed between the groups regarding tear zone distribution ($p=0.095$). However, the numerically higher frequency of zone 2 tears in the isolated repair group, together with the p value being close to the significance threshold, was considered a borderline trend. No significant difference in suture numbers indicates that tears of similar length and complexity were repaired in both groups, increasing the comparability of the results. In this study, the all-inside and inside-out techniques were used in similar proportions in both groups, with no significant difference. In the literature, the choice of repair technique is mainly influenced by tear localization, surgeon preference, and concomitant ACLR.⁸ The similarity in the distribution of repair techniques across both groups suggests that surgeons' preferences are independent of ACLR. This is important for interpreting the results because, in some studies, it is still debated whether all-inside techniques are used more frequently with ACLR due to shorter operating time, less soft-tissue dissection, and potentially different complication profiles, which may affect the results of the study.⁹

In our study, the similar postoperative clinical findings and functional outcomes between the two groups indicated that both groups generally exhibited comparable healing profiles. Although effusion and McMurray test positivity were higher in the isolated group, these differences were not statistically significant, which is consistent with the literature. Many studies have reported that meniscus repair with simultaneous ACLR supports biological healing by increasing intra-articular blood flow; therefore, less tenderness and mechanical symptoms may be observed in the early period.¹⁰ Shelbourne et al.¹¹ reported lower early postoperative effusion rates with ACLR, whereas Paxton et al.¹² noted a higher frequency of early mechanical symptoms after isolated meniscus repair. In this context, the difference in our study, which was not statistically significant but showed a clinical trend, is consistent with the biological healing advantage theory. The higher postoperative Tegner scores in the ACLR group were consistent with the higher activity level. However, the similarity in the Δ Tegner values suggests that the two groups were equivalent in terms of recovery. Nepple et al.¹³ reported that patients who underwent meniscus repair in conjunction with ACLR returned to higher activity levels, but their functional recovery rates were similar to those with isolated meniscus repair. The significant postoperative improvement in Lysholm and VAS scores in both groups strongly supports the clinical effectiveness of meniscus repair. The lack of a significant difference between groups has been frequently reported in the literature. Noyes and Barber-Westin¹⁴ emphasized that the functional outcomes of meniscus repair are good, regardless of ACLR. Chahla et al.¹⁵ showed that pain and function scores were similar in the long-term follow-up of patients who underwent isolated meniscus repair and repair with ACLR. Choi et al.¹⁶ reported that ACLR did not significantly alter pain scores after meniscal repair. This study showed that patients who underwent isolated meniscus repair had a higher rate of clinical failure, but this difference did not reach statistical significance. This finding is consistent with trends reported in the literature. Many studies have shown lower revision rates in meniscus repairs concurrent with ACLR. This can be explained by an improved biological healing environment, more stable knee biomechanics, and a younger, less degenerative tear profile that responds better to repair. For example, Nepple et al.¹³ reported failure rates of 20–25% for isolated meniscus repairs and 10–12% for repairs with concomitant ACLR. Similarly, Paxton et al.¹² showed that the failure rate of repair was significantly lower with ACLR. Although the long-term results of isolated meniscus repairs are well defined in the literature, better clinical outcomes have been reported in patients who undergo concurrent ACLR. Westermann et al.¹⁷ reported a 14% failure rate for meniscus repairs performed with ACLR at the 6-year follow-up. The lack of significance in our study is likely due to the small sample size. The $p=0,060$ value suggests that the statistical power hampered the clinically significant trend. The lack of a significant difference in clinical failure between the all-inside and inside-out techniques is consistent with the results of large-scale meta-analyses. Various studies have shown that technique choice depends on factors such as tear localization, surgeon's experience, and concomitant pathologies, but is not a determining factor in long-term clinical success. For example, Chahla et al.¹⁵ reported that the success rates of the all-inside and inside-out techniques were very similar, but their complication profiles differed. A systematic review by Grant et al.¹⁸ found no significant difference in success between the two techniques; however, the inside-out technique provided stronger fixation, whereas the all-inside technique required less soft tissue dissection. The effect size analysis in our study also supports this finding, confirming that the choice of technique is not a determining factor in clinical failure.

Limitations

One of the main limitations of this study is the relatively small sample size, which may have limited the ability to detect statistically significant differences between groups. Although the revision rates were numerically higher in the isolated repair group and consistent with previous literature, this difference did not reach statistical

significance. A post hoc power analysis based on the primary outcome (clinical failure/revision surgery) demonstrated that the study was underpowered (61.1% power at $\alpha=0.05$), and a larger sample size (approximately 92–93 patients in total) would be required to achieve adequate statistical power (80%). Therefore, the lack of statistical significance between groups should be interpreted with caution.

Nevertheless, strict inclusion and exclusion criteria were applied to establish a homogeneous patient population, thereby minimizing the influence of potential confounding variables. This methodological approach strengthens the internal validity of the study and supports a more reliable comparison between the groups despite the limited sample size.

CONCLUSION

This study demonstrated that the clinical efficacy of meniscus repair is high, regardless of the presence of ACLR; however, ACLR may show more favorable trends in some clinical parameters owing to its biological and mechanical advantages. Our findings are largely consistent with the existing literature and are supported by studies with larger sample sizes, particularly regarding revision rates and postoperative functional scores. Therefore, our results provide a framework consistent with the literature on biomechanics, biology, and clinical aspects. Further studies with larger sample sizes will help confirm the failure trend, especially in the isolated repair group.

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Ethical Declaration

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and the Declaration of Helsinki of 1975, as revised in 2008. Our institution has granted ethics committee approval on 24.11.2025, with protocol number E-67961857-050.04-2500075936.

Competing interests

The authors declare that they have no competing interests.

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AI Statement

The authors used AI and AI-assisted Technologies (Grammarly and MS Word Editor) in the writing process. These technologies improved the readability and language of the work. Still, they did not replace key authoring tasks such as producing scientific or medical insights, drawing scientific conclusions, or providing clinical recommendations. The authors are ultimately responsible and accountable for the contents of the whole work.

Consent for Publication

The original article is not under consideration by another publication, and its substance, tables, or figures have not been published previously and will only be published elsewhere.

Data Availability

The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Table 1. Demographic and surgical characteristics

Variables (N=59)	Total	Isolated (n=32)	Concomitant ACLR (n=27)	P value
	N (%) or Mean±SD	N (%) or Mean±SD	N (%) or Mean±SD	
Gender				0,703
Male	29 (49,2)	15 (46,9)	14 (51,9)	
Female	30 (50,8)	17 (53,1)	13 (48,1)	
Age (years)	26±6	26±6	25±5	0,879
Side				0,957
Right	26 (44,1)	14 (43,8)	12 (44,4)	
Left	33 (55,9)	18 (56,3)	15 (55,6)	

Follow-up period	29,4±4,1	29,1±4	29,7±4,4	0,573
Time between tear and surgery (weeks)	7,3±3,3	7,8±3,5	6,6±3	0,135
Technique used				0,887
All-inside	29 (49,2)	16 (50)	13 (48,1)	
Inside-out	30 (50,8)	16 (50)	14 (51,9)	
Tear type				0,816
Horizontal	25 (42,4)	14 (43,8)	11 (40,7)	
Longitudinal	34 (57,6)	18 (56,3)	16 (59,3)	
Tear length (mm)	18,7±5,3	19,1±5,4	18,2±5,4	0,552
Which meniscus				0,739
Lateral	21 (35,6)	12 (37,5)	9 (33,3)	
Medial	38 (64,4)	20 (62,5)	18 (66,7)	
Tear zone				0,095
1	28 (47,5)	12 (37,5)	16 (59,3)	
2	31 (52,5)	20 (62,5)	11 (40,7)	
Number of stitches	2±0,7	2±0,8	1,9±0,7	0,468

† SD: Standard Deviation; ‡ ACLR: Anterior Cruciate Ligament Reconstruction

Table 2. Clinical evaluations and functional outcomes

Variables (N=59)	Total	Isolated (n=32)	Concomitant ACLR (n=27)	P value
	N (%) or Mean±SD	N (%) or Mean±SD	N (%) or Mean±SD	
Pre-op Effusion	59 (100)	32 (100)	27 (100)	NA
Post-op Effusion				0,127
None	47 (79,7)	23 (71,9)	24 (88,9)	
Mild	4 (6,8)	2 (6,3)	2 (7,4)	
Severe	8 (13,6)	7 (21,9)	1 (3,7)	
Pre-op McMurray (+)	59 (100)	32 (100)	27 (100)	NA
Post-op McMurray (+)	8 (13,6)	7 (21,9)	1 (3,7)	0,060
Pre-op Lachman	23 (39)	0 (0)	23 (85,2)	<0,001
Post-op Lachman	0 (0)	0 (0)	0 (0)	NA
Pre-op Tegner	4±1	3,7±1	4,4±0,8	0,006
Post-op Tegner	7±2	6,5±2	7,6±1,8	0,032
ΔTegner	3,0±1,5	2,8±1,6	3,2±1,5	0,317
Pre-op Lysholm	55,5±11,8	55,1±11,6	55,9±12,3	0,790
Post-op Lysholm	83,3±13,9	80,8±16,7	86,2±9,3	0,125
ΔLysholm	27,8±14,9	25,7±16,2	30,3±13	0,246
Pre-op VAS	5,9±1,6	5,8±1,7	5,9±1,5	0,785
Post-op VAS	1,7±2,1	2,2±2,5	1,2±1,4	0,063
ΔVAS	-4,1±2,7	-3,6±2,9	-4,7±2,3	0,126
Revision surgery	8 (13,6)	7 (21,9)	1 (3,7)	0,060
Time until revision (months)	7,9±5,5	8,6±5,6	3±0	0,387

NA: Not applicable; Δ values are calculated as preoperative–postoperative difference. † SD: Standard Deviation; ‡ ACLR: Anterior Cruciate Ligament Reconstruction

Table 3. Effect size analyses for clinical failure

Revision Surgery N (%)	OR (95% CI)	P value
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Surgical method			0,060
Isolated	7 (21,9)	7,30 (0,83-62,50)	
Simultaneous ACLR	1 (3,7)	Reference	
Technique used			1,000
All-inside	4 (13,8)	0,96 (0,22-4,27)	
Inside-out	4 (13,3)	Reference	

OR: odds ratio; GA: confidence interval. Reference groups were determined using simultaneous ACLR and inside-out techniques. P values were calculated using Fisher's exact test. † ACLR: Anterior Cruciate Ligament Reconstruction

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