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Original Article

Time from Injury to Surgery in Anterior Cruciate Ligament (ACL) Reconstruction and Its Impact on Meniscal and Chondral Damage at Arthroscopy: A Retrospective Study from a Tertiary Care Hospital in Pakistan

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Abstract

Objective: To determine whether the Interval Between Anterior Cruciate Ligament (ACL) injury and Reconstruction is associated with Increased Prevalence and Severity of Meniscal Tears and Chondral Lesions Identified during Arthroscopy.

Methodology: This Retrospective Study was conducted in the Department of Orthopedics and Spine Surgery, Hayatabad Medical Complex (HMC), Peshawar, from January to March 2026. We reviewed medical records and arthroscopic operative reports of patients who underwent ACL reconstruction at HMC Peshawar during a defined historical period. We divided patients into two groups based on the interval from ACL injury to surgical reconstruction: An Early Surgery Group (≤ 3 months) and a Delayed Surgery Group (> 3 months). We analyzed the data using SPSS version 23.

Results: This study examined 84 individuals undergoing ACL reconstruction. We categorized participants into an early reconstruction group (≤ 3 months, $n=42$) and a delayed reconstruction group (> 3 months, $n=42$). We observed medial meniscal tears in 10 (23.8%) patients in the early group compared with 20 (47.6%) in the delayed group. Any meniscal injury was present in 16 (38.1%) early patients and 27 (64.3%) delayed patients. Chondral damage was identified in 7 (16.7%) early patients and 18 (42.9%) delayed patients. High-grade chondral lesions were also more frequent in the delayed group, occurring in 2 (4.8%) early versus 8 (19.0%) delayed patients.

Conclusion: The present study concluded that ACL reconstruction done more than 6 months after injury was associated with higher rates of chondral damage, overall meniscal injury, high-grade chondral lesions, and medial meniscal tears.

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Introduction

Anterior cruciate ligament (ACL) rupture is one of the most prevalent and functionally life-threatening knee injuries seen in orthopedic procedures, affecting sports, manual labor workers, and physically active individuals overall.¹ In Pakistan, ACL injuries are becoming more common in urban as well as rural communities, notably among players in cricket, football, and wrestling activities that place substantial rotational and pivot-shift demands on the knee.² Arthroscopic ACL reconstruction is the final surgical procedure for ACL-deficient knees in active persons. The goal is to restore joint stability, avoid further intra-articular damage, and promote return to pre-injury activity levels.¹ A well-known but sometimes overlooked result of untreated ACL deficit is the gradual disintegration of secondary intra-articular structures, notably the medial and lateral menisci and articular cartilage. The ACL-deficient knee endures recurrent bouts of aberrant tibiofemoral translation & rotatory instability during weight-bearing tasks, exposing the menisci & chondral surfaces to pathological loading stresses with every step.³ As time passes, this biomechanical impairment emerges as meniscal tears & chondral lesions, which independently or synergistically accelerate the development of posttraumatic osteoarthritis.⁴ Therefore, a crucial clinical issue is the correlation between ACL deficit duration and subsequent intra-articular injury. Identifying a clear, time-dependent injury threshold would provide strong evidence to accelerate surgical referral and reconstruction, especially in healthcare settings where procedures are often delayed due to resource constraints, diagnostic delays, or limited patient awareness. Patients with ACL injuries in Pakistan's KPK area commonly face significant delays between injury and surgical reconstruction. These delays stem from system- and patient-level factors, including delayed diagnosis in primary care and long waiting lists at tertiary centers. One is HMC Peshawar; others include financial constraints that impede timely access to specialists and cultural tendencies to seek non-surgical or traditional treatment first. Despite this well-recognized clinical reality, no published data from Pakistan quantify the magnitude of these delays or their specific impact on meniscal and chondral integrity at the time of arthroscopic reconstruction. Surgeons at HMC Peshawar routinely encounter advanced intra-articular damage at arthroscopy in patients with prolonged ACL deficiency, yet no institutional or national data substantiates this clinical observation. Therefore, the present study was

conducted to determine whether the duration between ACL injury and reconstruction is associated with increased prevalence and severity of meniscal tears and chondral lesions identified during arthroscopy.

Materials and method

This Retrospective Comparative Study was conducted at the Department of Orthopedics and Spine Surgery, Hayatabad Medical Complex (HMC), Peshawar, Khyber Pakhtunkhwa, Pakistan, over 3 months. Medical records and arthroscopic operative reports of patients who underwent ACL reconstruction at HMC Peshawar during a defined historical period were reviewed. Patients were divided into two groups based on the duration from ACL injury to surgical reconstruction: an Early Surgery Group (≤ 3 months) and a Delayed Surgery Group (> 3 months). We included physically active patients aged 16 to 50 years who underwent primary arthroscopic ACL reconstruction, with Unilateral ACL reconstruction and complete medical and Arthroscopic operative records. We excluded individuals with revision ACL reconstruction, multi-ligamentous knee reconstruction, contralateral ACL injury, and incomplete records. Based on published literature reporting meniscal damage prevalence of approximately 50% in delayed ACL reconstruction versus 25% in early reconstruction ^{5,6}, using an alpha of 0.05 and a power of 80%, the minimum sample size per group is calculated as follows, using the two-proportion z-test formula: $n = 42$ per group, giving a total of 84 patients.

Grouping

Group	Definition	Comparator
Group A - Early Surgery	ACL reconstruction performed ≤ 6 months from date of injury	Reference group
Group B - Delayed Surgery	ACL reconstruction performed > 6 months from date of injury	Study group

We collected data from inpatient surgical registers, anesthesia records, arthroscopic operative reports, outpatient consultation records, preoperative notes, and admission records; no direct patient contact was required. The primary exposure was time from injury to reconstruction in months, analyzed both continuously and categorically as ≤ 6 versus > 6

months. Outcomes included the presence of any meniscal tear, chondral damage, combined meniscal/chondral pathology, tear type, chondral grade and location, and concomitant meniscal treatment. Data were analyzed using SPSS version 23. We expressed categorical variables as frequencies and percentages, and continuous variables as mean ± standard deviation or median with interquartile range, depending on distribution. For categorical comparisons, we used the chi-square or Fisher's exact test. For continuous variables, we used an independent-samples t-test or Mann–Whitney U test. To assess the independent association between surgical delay and intra-articular damage, we used multivariable logistic regression.

Results

This study examined 84 individuals undergoing ACL reconstruction. We categorized participants into an early reconstruction group (≤6 months, n=42) and a delayed reconstruction group (>6 months, n=42). In both groups, males predominated, and gender distribution did not differ statistically (76.0% vs. 71.3%, p=0.63). In the early reconstruction group, the mean age was 28.9 ± 7.5 years, and in the delayed group it was 30.8 ± 8.2 years. In both groups, mechanism of injury and body mass index were comparable. In the early group, the mean interval from injury to reconstruction was significantly shorter (3.9 ± 1.5 months) than in the delayed group (14.7 ± 7.1 months) (p<0.001), as presented in Table 1. In the delayed reconstruction group, medial meniscal tears were most prevalent (47.5%) compared with the early reconstruction group (23.9%) (p=0.023). Partial meniscectomy was also more common in the delayed group, though this difference was not statistically significant (28.6% vs 11.9%, p=0.058). Chondral damage was much more prevalent after delayed reconstruction (42.9% vs 16.7%, p=0.008), and high-grade chondral lesions were found in 19.0% of delayed patients compared with 4.8% of early patients (p=0.042). Although lateral meniscus tears were more common in the delayed group, the variation was not statistically different (26.2% versus 19.0%, p=0.434). Additionally, 64.3% of delayed participants sustained meniscal damage, compared with 38.1% of early participants (p=0.016), as shown in Table 2. Delayed reconstruction was associated with roughly threefold increased risks of medial meniscal injury (p=0.024) and any meniscal damage (p=0.016). Patients who underwent delayed reconstruction had a 3.75-fold higher risk of chondral damage (p=0.008). Although partial

meniscectomy was nearly three times more prevalent in the delayed group, the correlation did not reach statistical significance (p=0.057), as shown in Table 3.

Table 1. Demographic features of the study participants

Variable	Early months (n=42)	≤6	Delayed months (n=42)	>6	p-value
Mean age in years	28.9 ± 7.5		30.8 ± 8.2		0.23
Male	32 (76.2%)		30 (71.4%)		0.63
Female	10 (23.8%)		12 (28.6%)		
Mean body mass index kg/m²	25.1 ± 3.2		25.8 ± 3.5		0.35
Injury related to sports	25 (59.5%)		22 (52.4%)		0.51
Injury due to road traffic	12 (28.6%)		14 (33.3%)		0.64
Other mechanism	5 (11.9%)		6 (14.3%)		0.76
Mean time from injury to surgery in months	3.9 ± 1.5		14.7 ± 7.1		<0.001

Table 2. Outcomes of Arthroscopic meniscal and chondral

Arthroscopic results	Early months (n=42)	≤6	Delayed months (n=42)	>6	p-value
Medial meniscal tear	10 (23.8%)		20 (47.5%)		0.023
Lateral meniscal tear	8 (19.0%)		11 (26.2%)		0.434
Any meniscal injury	16 (38.1%)		27 (64.3%)		0.017
Meniscal repair performed	7 (16.7%)		11 (26.2%)		0.287
Partial meniscectomy	5 (11.9%)		12 (28.6%)		0.058
Any chondral damage	7 (16.7%)		18 (42.9%)		0.008
Low-grade chondral lesion	5 (11.9%)		10 (23.8%)		0.171
High-grade chondral lesion	2 (4.8%)		8 (19.0%)		0.042
Medial femoral condyle lesion	4 (9.5%)		11 (26.2%)		0.049
Patellofemoral lesion	3 (7.1%)		7 (16.7%)		0.180

Table 3. Correlation between delayed ACL reconstruction and intra-articular disease.

Outcome	Early group	Delayed group	Approximate OR	p-value
Medial meniscal tear	23.8%	47.6%	2.92	0.024
Any meniscal injury	38.1%	64.3%	2.92	0.017
Any chondral damage	16.7%	42.9%	3.75	0.008

High-grade chondral lesion	4.8%	19.0%	4.71	0.043
Partial meniscectomy	11.9%	28.6%	2.96	0.057

Discussion

This study examined 84 individuals undergoing ACL reconstruction. We categorized participants into early and delayed reconstruction groups. Meniscal and chondral lesions were much more common in patients who had ACL reconstruction more than six months after injury than in those who had treatment within six months. These findings are similar to those of Prodromidis et al. They reported that ACL restoration completed more than six months after injury was associated with a considerably higher risk of medial meniscal tears than reconstruction within months.⁷ Our study's findings are similarly consistent with the meta-analysis done by Mehl et al. They found a strong correlation between a longer time after ACL rupture and subsequent meniscal or cartilage lesions. The authors specifically highlighted a delay of more than six months as an essential interval for subsequent medial meniscus damage.⁸ Another meta-analysis revealed no substantial distinction in meniscal or chondral lesions when relatively small intervals, such as 3-6 weeks, were used to differentiate early and delayed surgery.⁹ The current study contrasts ≤6 months to >6 months, which represents a significantly longer time of ACL deficit; therefore, these conclusions do not always contradict the current results. In the delayed reconstruction group, medial meniscal tears were more prevalent than in the early reconstruction group in the present study. These findings are similar to the previous study.¹⁰ In our study, the frequency of meniscectomy was similarly greater in the delayed group, although the difference was not statistically significant. This tendency is clinically noteworthy since growing chronicity may not only raise the likelihood of meniscal tears but may also diminish the potential of meniscus preservation or healing. Mehl et al. found that the chance of meniscal healing decreases as time since ACL rupture increases.⁸ Thus, early therapy may potentially boost chances of meniscus preservation. Our study found that delayed reconstruction was associated with roughly a threefold increase in the risk of medial meniscal injury and any meniscal damage. Patients who underwent delayed reconstruction had a 3.75-fold higher risk of chondral damage. Although partial meniscectomy was nearly three times more prevalent in the delayed

group, the correlation was not statistically significant. Overall, these results align with the strongest current observational data and systematic reviews indicating that prolonged ACL-deficient intervals are particularly associated with medial meniscal injury, including progressive chondral damage.⁷ This study demonstrated that a longer interval between ACL injury and reconstruction may be related to medial meniscal tears, overall meniscal pathological changes, and chondral damage

Conclusion

The present study concluded that ACL reconstruction performed more than 6 months after injury was associated with higher rates of chondral damage, overall meniscal injury, high-grade chondral lesions, and medial meniscal tears.

Authors' Contributions

Muhammad Shabir: Conceptualization, study design, data collection, clinical assessment, data analysis, interpretation of findings, manuscript drafting, and critical revision.

Wasim Anwar: Conceptualization, supervision, methodological guidance, clinical assessment, interpretation of findings, critical revision of the manuscript, and final approval.

Muhammad Waqar: Data collection, clinical assessment, literature review, data analysis, manuscript revision, and reference verification.

Uzair Ul Islam: Literature review, data collection, data organization, manuscript drafting and revision, and reference verification.

All authors: Made substantial contributions to the work, approved the final version for publication, and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Conflict of Interest: Nil

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Ethical Approval: Ethical approval was obtained from the Hospital Research and Ethical Committee (IREB), MTL-Hayatabad Medical Complex, under Doc. No. 2632, dated 07 August 2023, before commencement of the study.

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