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The hidden cost of delay: meniscal and osteochondral damage in neglected anterior cruciate ligament tears

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ABSTRACT

Background: Neglected anterior cruciate ligament (ACL) tears cause repeated incidences of giving-way and rotational-translational instability. The effects of untreated ACL tears and its impact on the meniscus and cartilage was evaluated in this study over a two year time period, especially those with high Tegner activity levels, results in more severe and complicated meniscal and osteochondral lesions with potential effect on the outcome. The study emphasized the importance of early treatment of ACL injury to prevent damage to the meniscal and cartilaginous tissue and secondary osteoarthritis.
Methods: This study examined 385 patients who underwent arthroscopic ACL reconstruction between 2022 and 2024. Researchers analyzed arthroscopic findings, MRI scans, and patient records from the time of surgery. The focus was on identifying severe meniscal and osteochondral lesions that could adversely impact patient outcomes. These lesions were classified as meniscal lesions affecting outcome (MLAO) and osteochondral lesions affecting outcome (OLAO). The study also investigated statistical correlations between MLAO, OLAO, time since injury, and Tegner activity levels.
Results: The occurrence of MLAO and OLAO increased significantly as the duration between injury and surgery lengthened ($p=0.001$, $p<0.05$). However, no statistically significant correlation was found between the Tegner activity score and the risk of MLAO or OLAO ($p=0.317$, $p=0.184$, $p>0.05$).
Conclusions: A delay in ACL reconstruction can result in a higher occurrence of meniscal and osteochondral lesions, negatively influencing surgical results.

Keywords: Anterior cruciate ligament, Arthroscopy, Meniscal injury, Neglected, Osteochondral defects, Tegner

INTRODUCTION

An unrepaired anterior cruciate ligament (ACL) tear leads to instability and a sense of insecurity during movement. If surgical reconstruction is delayed or intense sports activity occurs during conservative treatment, recurrent episodes of knee instability may arise. These repeated instances of instability, along with chronic rotational-translational dysfunction, are direct effects of ACL deficiency and can contribute to additional knee conditions. Such complications include meniscal tears, osteochondral damage, and ligament injuries. Consequently, not only individuals requiring ACL reconstruction but also those with sedentary lifestyles undergoing conservative treatment may be at risk of developing associated knee issues.

Numerous studies have explored the occurrence of meniscal tears and osteochondral lesions as a consequence of chronic ACL deficiency.[1-4] These investigations analyze various factors, including the time elapsed since injury, patient activity levels, types of meniscal and osteochondral

damage, and clinical outcomes, to establish potential correlations.

Table 1: Criteria for meniscal lesions affecting the outcome.

S. no.	Criteria
1.	Criteria for meniscal lesions affecting the outcome
2.	Flap or radial tears extending to menisco synovial junction
3.	Flap or radial tears complicated by horizontal tears
4.	The handle part of bucket handle tears ruptured or degenerated
5.	The corpus part of bucket handle tears complicated with horizontal tears or degenerated

Table 2: Criteria for osteochondral lesions affecting the outcome.

S. no.	Criteria
1.	Criteria for osteochondral lesions affecting the outcome
2.	Osteochondral lesions; Grade 4 and larger than 4 cm^2 or deeper than 7-8 mm
3.	Osteochondral lesions; Grade 4 involving 2-3 compartments

However, upon close examination of their hypotheses, objectives, research designs, and collected data, individual studies reveal certain limitations. A major issue is the inability to accurately assess the outcomes in individuals with ACL tears who do not undergo medical treatment.[5] Another less frequently discussed concern is the ambiguity regarding whether meniscal and osteochondral damage stems from the initial trauma that caused the ACL tear or from subsequent instability due to ACL deficiency.

Our observations indicate that postponing surgery leads to additional meniscal damage and osteochondral lesions, negatively impacting the success of ACL reconstruction. We hypothesized that delaying surgical intervention in patients with ACL rupture, particularly those engaged in high Tegner activity levels, could result in further meniscal and osteochondral injuries, potentially affecting outcomes.[6] To examine this hypothesis, we classified meniscal and osteochondral lesions that negatively influence surgical results as meniscal lesions affecting outcome (MLAO) and osteochondral lesions affecting outcome (OLAO) (Tables 1 and 2).

Patients with isolated ACL ruptures were identified through MRI scans and arthroscopic surgery video footage from the time of initial injury. Our goal was to assess the relationship between the time elapsed since injury, patients' activity levels, and the development of meniscal and osteochondral complications.

METHODS

This retrospective study examined 385 patients who underwent arthroscopic ACL reconstruction at Apollo Institute of Medical Sciences, Department of Orthopaedics and Traumatology between 2022 and 20024. Among these patients, those diagnosed with an isolated ACL tear following trauma and who developed additional meniscal or osteochondral lesions before undergoing reconstruction were included in the analysis. To confirm the singularity of the ACL rupture, assessments were based on physical examinations, patient history, early post-traumatic MRI scans, and diagnostic arthroscopy conducted at the time of injury. Patients presenting with additional ligamentous, meniscal, or osteochondral injuries were excluded to ensure that MLAO and OLAO developed specifically during the period between the ACL tear and surgical reconstruction

To identify new meniscal and chondral lesions, patient files, preoperative MRI scans, and arthroscopic video recordings were thoroughly examined. A single radiologist within our institution reviewed all MRI images. The interval between injury and surgical reconstruction was documented, and patients were assessed using the Tegner activity score.[5,6] Lesions were categorized as MLAO or OLAO based on the criteria outlined in Tables 1 and 2. These classifications were determined by whether a reliable treatment method existed for the observed lesions. Lesions that were unsuitable for surgical intervention, posed challenges during rehabilitation, or required complex treatments such as meniscal transplantation or autologous chondrocyte implantation were classified as lesions affecting outcome.[7] Outerbridge Grade 1, 2, and 3 lesions were considered superficial, while Grade 4 lesions were defined as deep defects.[8]

For statistical analysis, Mann-Whitney U and logistic regression tests were used.[9,10] Relations between OLAO, MLAO, time since injury and Tegner activity levels were statistically analyzed.

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RESULTS

At the time of diagnosis, none of the patients presented with either MLAO or OLAO. However, during surgery, 49 out of the 385 patients were identified as having both an ACL tear and a chondral or meniscal lesion. The average patient age was 28±1 years, ranging from 17 to 47 years. Among the subjects, 353 (91.7%) were male, while 32 (8.3%) were female (Table 3). The mean duration between injury and surgery was 28±6 months, with a range of 2 to 24 months. The mean Tegner activity score was 5.8±0.2, ranging from 2 to 9.

Table 3: Demographic characteristics (n=385).

Category	Subcategory	Count	Percentage (%)
Age (years)	Mean ± SD (Range)	28.9±7 (18-45)	
Gender	Male	353	91.7
	Female	32	8.3
Injured knee side	Right	252	65.4
	Left	133	34.6
Mechanism of injury	Direct trauma	202	52.5
	Falling down	130	33.8
	Knee torsion	53	13.7

Table 4: Types of meniscal lesions.

Types of meniscal lesions	Meniscal lesions (N)
Radial	31
Flap	27
Longitudinal	14
MLAO	16

Table 5: Types of osteochondral lesions.

Osteochondral lesions	Osteochondral lesions (N)
Superficial (Outerbridge 1-2-3)	15
Deep (Outerbridge 4)	8
OLAO	4

Tables 4 and 5 provide an overview of the various types of meniscal tears and osteochondral lesions observed. Of the meniscal injuries, 16 were classified as MLAO, while 8 osteochondral lesions were categorized as OLAO.

The incidences of MLAO and OLAO grew statistically higher as time elapsed between the injury and surgery increased (p=0.001, p0.05).

DISCUSSION

This retrospective observational study revealed that a longer interval between injury and surgery is associated with a higher incidence of meniscal and osteochondral lesions, potentially impacting treatment outcomes. One limitation of the study was the exclusion of patients with ACL tears who did not seek medical attention.

Decisions regarding ACL reconstruction should be tailored to each individual, taking into account various factors such as occupation, concurrent injuries, and the frequency of recurrent instability. A patient's suitability for reconstruction depends on their compliance and progress throughout treatment. Delayed surgery, misdiagnosis, and lack of adherence to medical recommendations may contribute to additional knee pathologies, including MLAO and OLAO.

In this study, MRI scans and diagnostic arthroscopy were utilized to identify patients with isolated ACL tears. MRI has a sensitivity rate of 95% for detecting meniscal lesions, which may lead to certain pathologies being misdiagnosed.[9] However, it is highly unlikely that these misdiagnosed cases involve MLAO. Osteochondral lesions that are suitable for surgical intervention require a detailed evaluation based on Outerbridge classification, lesion size, and location, but they do not negatively impact ACL reconstruction outcomes.[10,11] Similarly, meniscal lesions that can be managed through partial meniscectomy or suturing do not adversely affect recovery.[12-14]

In this research, we introduced a new classification system for meniscal and osteochondral lesions. Our hypothesis suggested that, when meeting specific criteria outlined in our definition, these lesions could influence treatment results. Additional studies are needed to further explore the impact of these lesions on patient outcomes, and we plan to publish long-term findings on subjects with MTAO and OLAO in future research.

Multiple studies have attempted to determine the mechanisms behind concurrent meniscal and chondral lesions by analyzing their location and characteristics.[15,16] In a cross-sectional study, Murrell et al investigated the prevalence of these lesions in cases of delayed ACL reconstruction, finding that postponing surgery increased their occurrence.[17] Similarly, research by Papastergiou et al and Church et al categorized patients based on the duration since injury and concluded that meniscal lesion rates were lower in those who underwent early surgical intervention.[1,3,18] Their findings emphasized that timely ACL reconstruction reduces the likelihood of developing additional knee pathologies.

Numerous studies on the relationship between ACL injuries and concurrent meniscal tears rely on MRI assessments. Yoo et al. conducted serial MRI scans on patients with ACL deficiency and determined that delaying surgical reconstruction significantly increases the likelihood of meniscal tears.[19] Similarly, Naranje et al carried out a prospective trial utilizing MRI, combining arthroscopic evaluations to assess meniscal pathology in ACL-deficient individuals.[20] Their findings indicated a

higher incidence of posterior horn medial meniscal tears in patients with ACL deficiency.

Existing literature suggests that early post-traumatic MRIs and diagnostic arthroscopies confirm that ACL tears are initially isolated, with subsequent meniscal and chondral injuries developing post-injury. De Roeck et al emphasized a strong correlation between ACL ruptures and meniscal tears, which can negatively influence reconstruction outcomes.[21] Delays in diagnosis and prolonged waiting periods before surgery may exacerbate complications in ACL-deficient knees. Tayton et al examined 2,205 patients diagnosed via MRI or arthroscopy before undergoing ACL reconstruction.[22-24] Their analysis demonstrated that extended wait times before surgery were linked to an increased prevalence of meniscal tears.

Diagnosing intrasubstance or partial ACL tears such as isolated anteromedial or posterolateral band injuries is more challenging compared to complete ACL ruptures. If left untreated surgically, these lesions significantly heighten the risk of recurrent instability, potentially leading to further knee pathologies. It is crucial that patients understand the potential risks of additional complications if surgery is avoided.

Postponing surgery leads to notable anatomical alterations, including prominent intercondylar eminences, diminished or unclear anatomical landmarks, and a widened notch base that becomes shallower. These changes, observed in our study, can complicate the surgical procedure.

Patient adherence and the timing of surgery play a critical role in achieving successful results. If surgical intervention is required in the acute phase, early reconstruction should be prioritized. However, if surgery is postponed for any reason, a comprehensive assessment using advanced imaging techniques or diagnostic arthroscopy is essential to identify any associated lesions. Additionally, patients should undergo a structured rehabilitation program to minimize the risk of developing further knee pathologies. Nevertheless, the best outcomes are generally achieved during the subacute or subchronic phase, emphasizing the importance of achieving full extension before surgery.

CONCLUSION

Our findings indicate that delaying ACL reconstruction contributes to the development of meniscal and osteochondral lesions, which may negatively impact surgical outcomes. However, further prospective and long-term studies are necessary to validate this effect. Importantly, these lesions did not occur at the time of injury but rather during the period between ACL damage and surgical intervention. In cases where surgery is not performed during the acute phase, associated lesions must be carefully assessed, making diagnostic arthroscopy a crucial step. Once diagnosed, a clearly defined treatment strategy is essential.

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