

Determining the prevalence and distribution of meniscal tears in relation to complete vs partial anterior cruciate ligament (ACL) injury

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ABSTRACT

Aim: The aim of the present study was to investigate the incidence and location of meniscal tears in relation to complete vs partial anterior cruciate ligament (ACL) injury.

Methods: This comparative observational study was carried out in the department of Orthopedics. With a follow-up period ranging from three months to two years after knee injury, we gathered magnetic resonance imaging (MRI) data from one hundred patients, each of whom had been diagnosed with a combined anterior cruciate ligament (ACL) and meniscal damage.

Results: There were 23 knees with a medial meniscal tear, 21 knees with a lateral meniscal tear, and 6 knees with bilateral meniscal tears in the group of 50 knees that had a partial anterior cruciate ligament damage. In the case of full anterior cruciate ligament (ACL) damage, which affected fifty knees, the medial meniscal tear was discovered in thirty knees, the lateral meniscal tear was only identified in fifteen knees, and the bilateral meniscal tears, which included both the medial and lateral meniscal tears, were found in five knees.

Conclusion: Medial meniscus tears were above 50% in total ACL tears. Lateral meniscus injury was linked to partial ACL tear more than total. In total ACL tears, medial meniscus tears were more prevalent in posterior horn than middle horn, whereas lateral tears were virtually equal in anterior and posterior horn.

Keywords: Anterior Cruciate Ligament (ACL), Meniscal tear, Magnetic resonance Imaging (MRI)

1. INTRODUCTION

The anterior cruciate ligament (ACL) regulates anterior translation of the knee and stabilizes frontal and sagittal rotation.¹Pivoting and cutting sports are the primary causes of ACL injury in young athletes.²Due to inadequate healing and functional outcomes associated with ACL surgery, Anterior Cruciate Ligament Reconstruction (ACLR) is regarded as the gold standard treatment for a swift return to pre-injury athletic performance. ACL injuries constitute 25% to 50% of knee ligament injuries, whereas partial ACL injuries represent 10% to 27%. Clinical

assessments such as the Lachman and Pivot Shift tests, together with imaging modalities like MRI, provide a preliminary diagnosis; nevertheless, diagnostic arthroscopy is required for a definitive diagnosis.³

The existence of ruptured ACL fibers contributes to biomechanical stability, enhanced vascularity, and proprioception, facilitating the healing process. When athletes cannot attain an ideal fitness level to return to pre-injury sports, therapy relies on knee instability, functional restrictions, and laxity.⁴ Meniscus tears are associated with anterior cruciate ligament injury.⁵ The incidence of meniscus tears in whole ACL injuries ranges from 51.9% to 63%, whereas the prevalence in partial ACL injuries remains undetermined.^{6,7} Biomechanical kinematic imbalance, which leads to meniscus damage, has been demonstrated in cases of total ACL tears. In partial ACL injuries, residual fibers provide inherent stability against frictional forces during various loading conditions, such as pivoting and cutting in sports. Consequently, fewer meniscal injuries are expected to occur in partial ACL tears compared to complete tears.⁸ As the intricacy of meniscus tears escalates in the chronic phase, the feasibility of healing diminishes over time.^{9,10} Tears of the lateral meniscus, particularly those diagnosed in the early posttraumatic period, may be most amenable to repair. The significance of lateral meniscus repair is underscored by the association of lateral meniscectomy with an elevated risk of osteoarthritis relative to medial meniscectomy.^{11,12} The pattern of lateral meniscus tears in people with ACL injuries varies significantly and influences future therapy. Certain tear patterns, such as partial longitudinal tears or full stable longitudinal tears, have no impact on knee joint health and may remain in place.¹³⁻¹⁵

The objective of this study was to examine the prevalence and localization of meniscal tears in relation to total vs partial anterior cruciate ligament (ACL) injuries.

2. MATERIALS AND METHODS

This comparative observational study was carried out in the department of Orthopedics. With a follow-up period ranging from three months to two years after knee injury, we gathered magnetic resonance imaging (MRI) data from one hundred patients, each of whom had been diagnosed with a combined anterior cruciate ligament (ACL) and meniscal damage.

Methodology

We compared the two groups with respect to the location of tear. In documenting the location of the tear, we used the classification system described by Cooper et al.¹⁶ This system divides each meniscus into thirds radially. The radial zones are denoted as A, B, and C (A being the posterior third) for the medial meniscus and D, E, and F (F being the posterior third) for the lateral meniscus.

3. RESULTS

Table 1: Distribution of meniscal tears in ACL-deficient knees

	Partial ACL injury	Complete ACL injury
Bilateral meniscus	6	5
Lateral meniscus	21	15
Medial meniscus	23	30

In partial ACL injury (50 knees), medial meniscal tear was found in 23 knees, lateral meniscal tear in 21 knees, and bilateral meniscal tears in 6 knees. Regarding the locations of meniscal tears, in complete ACL injury (50 knees), medial meniscal tear was found in 30 knees, lateral

meniscal tear only in 15 knees and bilateral (including medial and lateral) meniscal tears in 5 knees.

Table 2: Zone distribution of meniscal tears in Partial ACL injury

Zone distribution of meniscal tears	N
A	14
A-B	2
A-B-C	1
B	5
B-C	2
C	1
D	5
D-E	2
D-E-F	1
E	5
E-F	2
F	10

When meniscal tear locations were classified according to Cooper, the tears in the partial ACL group were frequently located in zones E and F; that is, middle to posterior region of the lateral meniscus.

Table 3: Zone distribution of meniscal tears in complete ACL injury

Zone distribution of meniscal tears	N
A	16
A-B	2
A-B-C	1
B	4
B-C	2
C	1
D	6
D-E	2
D-E-F	1
E	2
E-F	1
F	12

In the complete ACL group, however, there was an increase of tears in zones A and B; that is, middle to posterior region of the medial meniscus.

4. DISCUSSION

The pattern of lateral meniscus rips in people with ACL injuries varies significantly and influences future therapy. Certain tear patterns, like partial longitudinal rips or full stable longitudinal tears, have minimal impact on knee joint health and may be left untreated. Sixteen to eighteen Conversely, alternative tear patterns, including root tears, full radial tears, and

bucket-handle rips, are linked to significant biomechanical repercussions and necessitate prompt treatment to avert swift joint deterioration.¹⁹⁻²³

In cases with partial ACL damage (50 knees), a medial meniscal tear was identified in 23 knees, a lateral meniscal tear in 21 knees, and bilateral meniscal tears in 6 knees. In cases with full ACL damage (50 knees), medial meniscal tears were observed in 30 knees, lateral meniscal tears in 15 knees, and bilateral meniscal tears (both medial and lateral) in 5 knees. Valgus displacement results in the impingement of the posterior or middle section of the lateral meniscus between the femur and tibia, potentially causing longitudinal meniscal tears. The mix of mechanisms certainly contributes to the occasionally complicated injuries of the knee. In 1997, a meta-analysis by Bellabarba et al.²⁴ found that meniscal tears were observed in 41-82% of acute ACL ruptures and 58-100% of chronic ACL injuries. It is hypothesized that most peripheral meniscal lesions are linked to a certain degree of ACL laxity. In our study, the incidence of medial meniscus tears exceeded 50% in cases with full ACL tears, likely due to primary meniscal tears occurring during the injury and secondary meniscal tears resulting from increased knee joint laxity, which leads to peripheral rips of the posterior horn of the medial meniscus. A lateral meniscus tear is more commonly associated with a partial ACL tear than with a total ACL rupture due to the nature of complicated knee injuries and reduced knee translation.

According to Cooper's classification of meniscal tear sites, rips in the partial ACL group were predominantly situated in zones E and F, namely in the middle to posterior portion of the lateral meniscus. In the whole ACL group, there was a rise in tears in zones A and B, namely in the middle to posterior area of the medial meniscus. In 2001, Smith and Barrete²⁵ delineated the meniscal tear patterns in ACL-deficient knees, based on the sites of 575 prospectively assessed ACL rips. No statistically significant difference was seen between medial and lateral rips. Tears of the medial meniscus predominantly affect the posterior horn and the peripheral meniscocapsular junction. Thompson and Fu²⁶, in their study of several studies, discovered that peripheral posterior horn tears constituted over fifty percent of meniscal tears observed in individuals with acute or chronic ACL injuries. Numerous studies have indicated that the peripheral placement of these lesions inside the vascularized region of the meniscus enhances their potential for healing, rendering them suitable for repair instead of excision.

5. CONCLUSION

The incidence of medial meniscus tears exceeded 50% in cases with total ACL tears. A lateral meniscus tear is more commonly connected with a partial ACL tear than with a total ACL rupture. Regarding total ACL tears, medial meniscus tears were more prevalent in the posterior horn than in the middle horn, although the frequency of lateral meniscus tears was about comparable in the anterior and posterior horns. Regarding partial ACL tears, medial meniscus tears were mostly located in the posterior and middle horns, whereas lateral meniscus tears occurred roughly equally in the anterior and middle horns, with a higher frequency in the posterior horn.

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