SVOA Orthopaedics

ISSN: 2752-9576

ScienceVolks Open Access

Case Report

Insights into the Management of Lateral Meniscus Tears with Concomitant ACL Injuries: A Case-Based Approach

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Abstract

The objective of this case study is to explore the pathology of lateral meniscus injuries associated with anterior cruciate ligament (ACL) injuries. The discussion delves into the prevalence and types of meniscal injuries, with a particular focus on lateral meniscal tear patterns in ACL-deficient knees. Additionally, it examines surgical techniques employed for meniscal repair and their integration with ACL reconstruction (ACLR), as well as the impact of these interventions on clinical outcomes, including joint biomechanics, stability, and long-term preservation of knee function.

Keywords: *ACL Injuries; Osteoarthritis; Lateral Meniscus Tears.*

Introduction

The ACL is a key stabilizer that limits anterior tibial translation and rotational instability of the knee [1]. It consists of two functional bundles—the anteromedial and posterolateral—that work synergistically across the range of motion to stabilize the joint. When the ACL is injured, the loss of this primary restraint leads to increased anterior-posterior translation, rotational instability, and altered joint kinematics. These changes predispose the knee to secondary injuries, including meniscal tears and chondral damage, and accelerate degenerative processes such as osteoarthritis [2].

The menisci—crescent-shaped fibrocartilaginous structures—serve as secondary stabilizers of the knee by distributing axial loads, absorbing shock, and enhancing joint congruity. The medial meniscus primarily functions as a restraint against anterior tibial translation, helping to limit excessive forward movement of the tibia, particularly in ACL-deficient knees. This role is essential in maintaining joint stability and preventing further damage[3]. The lateral meniscus, on the other hand, plays a crucial role in stabilizing the knee, mainly by resisting internal rotation and to a slight degree by limiting anterior tibial translation. This function is especially evident in ACL-deficient knees, where the lateral meniscus helps control instability during movements like the pivot-shift test. The posterior root of the lateral meniscus is particularly important in limiting internal rotation at higher flexion angles. When this root is torn, knee translation and rotation increase significantly, leading to a more pronounced pivot shift and greater instability in ACL-deficient knees [4].

These biomechanical disturbances underscore the critical importance of addressing both ACL and meniscal injuries in a coordinated manner. Surgical interventions, such as ACL reconstruction (ACLR) combined with meniscal repair, aim to restore the knee's native biomechanics by reestablishing ligamentous and meniscal integrity. Preserving or repairing the meniscus during ACLR is essential, as its removal or loss of function can exacerbate joint instability, impair shock absorption, and accelerate osteoarthritic changes [5,6,7,8].

This case-based discussion explores the intricate biomechanical relationship between the ACL and the lateral meniscus, emphasizing the importance of recognizing and addressing concomitant injuries. It highlights their critical role in restoring joint stability, optimizing surgical and functional outcomes, and preserving knee function over the long term.

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https://doi.org/10.58624/SVOAOR.2025.05.005

Received: December 23, 2024

Published: March 14, 2025

Citation: Elabdullah A. Insights into the Management of Lateral Meniscus Tears with Concomitant ACL Injuries: A Case-Based Approach. *SVOA Orthopaedics 2025*, 5:2, 30-37. doi: 10.58624/SVOAOR.2025.05.005

Clinical Presentation and Initial Assessment

A 29-year-old female competitive handball player sustained a knee injury while landing from a jump with a twisting rotation on her right knee. She has a history of ACL reconstruction (ACLR) on the same knee 4 years ago. She has no significant medical history, takes no medications, and has no history of other surgeries.

She initially presented to the emergency room with:

Effusion and swelling over the anterolateral right knee. Restricted range of motion (ROM): 0-10-80°. Moderate pain. Clinical tests: Varus-Valgus test stable without laxity. Lachman test positive (Grade II). Pivot shift test Grade II. Steinmann test positive laterally. McMurray shows pain but no snapping or palpable click. Tegner Lysholm 50.

Imaging:

X-rays ruled out fractures. Tibial and femoral canal widening after ACLR, correct positioning of the end-button.

The patient was initially treated with a knee brace and crutches, NSAIDs, and physiotherapy.

MRI revealed a ruptured ACL graft and a radial tear of the posterior horn of the lateral meniscus (Fig. 1).

First stage Operation (4 weeks post-injury)

Knee arthroscopy confirmed a lateral meniscus tear classified as LMORT (Type 3) with injury to the ACL graft. (Fig. 2) The
procedure included:

- Meniscus repair: using two all-inside meniscus repair systems, one in the middle third (red-white zone) and one in the inner third (white-white zone), to preserve meniscal function and restore hoop stresses. (Fig. 3)

-ACL graft debridement: Thorough inspection of the notch revealed remnants of the previous ACL graft. Remaining ACL tissue was carefully debrided using a motorized shaver, exposing the lateral notch wall and tibial footprint. Tunnel positions and sizes on both the femur and tibia were assessed, confirming significant tunnel widening as the primary indication for a two-stage revision.

- Infection exclusion: Synovial and ACL tissue biopsies were taken for culture to exclude infection, which was subsequently ruled out.

- Tunnel preparation: Femoral and tibial tunnels were debrided to healthy, bleeding cancellous bone using shavers, curettes, and angled instruments. Bone grafting was performed to restore tunnel integrity and prepare for the second-stage ACL reconstruction.

Rehabilitation protocol

- Hinged knee brace set at 0-0-60° for four weeks, followed by 0-0-90° for two weeks.- PRICE and cryotherapy: 5–7 times per day with compression.

- Partial weight-bearing (20 kg) using crutches, then progress to full weight-bearing by weeks 6–8 with brace support.

- Rehabilitation with light active ROM exercises: Heel slides, straight leg raises, quadriceps activation, patellar mobilizations, proximal hip strengthening, and gait training with crutches. Active-assisted flexion/extension, wall slides, hamstring isometric exercises, squats, step-ups and step-downs, resistance band exercises for quads, hamstrings, and glutes, single-leg balance training, and lateral movements. Progressive strengthening of hamstrings and quadriceps.

Follow-Up (12 weeks post-stage 1):

Symptoms: No pain or effusion reported. Feeling of giving way.

ROM: Improved to extension/flexion 0-0-110°.

Lachman test (Grade II), Pivot shift test: Positive Grade I, indicating residual rotational instability.

Steinmann test: Negative.

Second stage surgery (Approximately 4 Months Post-First Stage)

ACL reconstruction using a tripled semitendinosus graft. Fixation: Femoral fixation with ACL TightRope with end-button and tibial fixation with TightRope with a suture button.

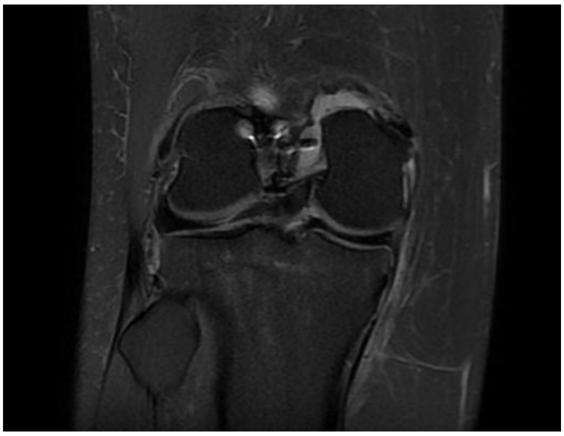

Fig 1: *MRI shows a radial tear of the posterior horn of the lateral meniscus.*

Fig 2. *Radial tear of the posterior horn of the lateral meniscus LMORT Type 3.*

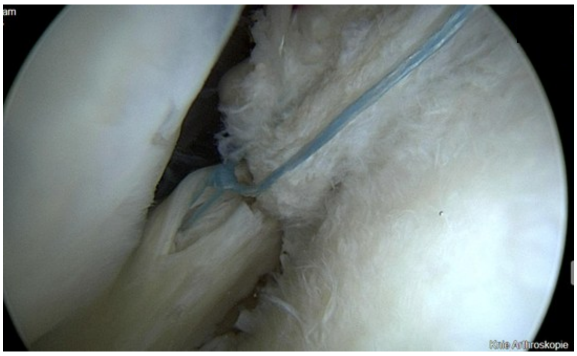

Fig 3. *Refixation of the tear was performed using two all-inside repairs: one in the middle third (red -white zone) and one in the inner third (white-white zone). The image shows only the suture in the inner third.*

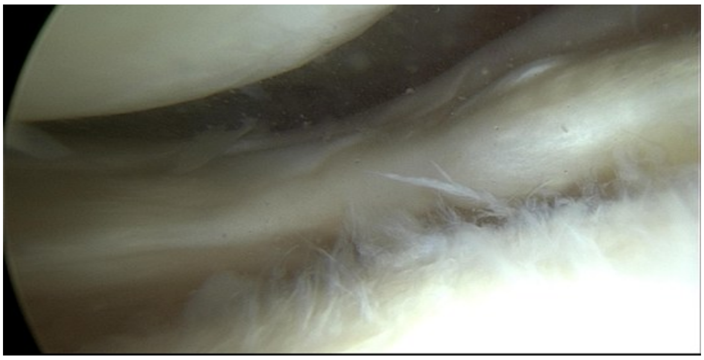

Fig 4. *The tear on the posterior root of the lateral meniscus shows significant healing approximately 4 months after the Refixation.*

The intraoperative findings revealed a healed tear on the posterior horn of the lateral meniscus with restored tissue continuity, stability, and no signs of re-tearing. A small amount of mature scar tissue was observed, indicating normal fibrous remodeling and integration with the surrounding meniscus. The repaired segment was firmly anchored, with no displacement or instability upon probing, and the meniscus demonstrated full structural and functional recovery (Fig. 4).

Postoperative protocol:

- PRICE with cryotherapy: 5–7 times per day with compression.

- Progressive full weight-bearing allowed, but no flexion with weight-bearing.

- Hinged knee brace ROM 0-120°.

- Physical therapy focused on extension and active quadriceps strengthening: Heel slides, passive knee extension (towel under ankle), patellar mobilizations, straight leg raises, wall slides, stationary cycling, seated assisted knee flexion, passive terminal extension (40°–0°) with heel prop, quadriceps re-education (E-stim/biofeedback), hamstring progressive resistance exercises, and ROM/stretching of all muscle groups.

Outcome

12-month follow-up after the second stage: ROM maintained at 0-0-130°. Discomfort with deep squats, no catching or locking sensation.

Clinical tests: Steinmann test negative. Lachman test negative (Grade I) with a firm endpoint. Pivot shift test negative (Grade 0). Single-leg stand stable. The patient has achieved good physical recovery, evidenced by a Lysholm score of 90, but has not returned to playing handball due to a combination of fear of reinjury and loss of motivation, highlighting psychological barriers as significant factors in her decision.

Discussion

Epidemiology

ACL injuries are the most common knee ligament injuries, with approximately 68.6 cases per 100,000 individuals annually in the United States [9]. Concomitant meniscal injuries are highly prevalent in ACL ruptures. Swedish National ACL Register: Involving nearly 18,000 ACLR cases, this study found that 53.9% of patients had intra-articular injuries. Medial meniscus tears were identified in 25.2%, while lateral meniscus tears were noted in 21.4% [10]. In The Norwegian Knee Ligament Registry: The study identified meniscal tears in 48.5% of primary ACLRs, with 30.6% involving the medial meniscus and 24.1% involving the lateral meniscus [11]. Slauterbeck et al. demonstrated a higher percentage of injury to the lateral meniscus (52%) in comparison to medial meniscus (22%) [12]

In paediatric populations, meniscal injuries are observed in 58% of cases undergoing ACLR. Age and BMI are considered independent risk factors [13]. Moreover, individuals aged over 30 years exhibit a higher incidence of concurrent ACL and medial meniscus injuries, along with reduced repairability of these tears [14].

Acute ACL injuries often involve lateral meniscus tears, whereas medial meniscus tears are predominantly associated with chronic ACL deficiency [15]. Hagmeijer et al. observed that ACLRs performed within six months of injury resulted in a significantly lower incidence of meniscal injuries (7%) compared to delayed surgical intervention (33%) or nonoperative management (19%) [16].

Biomechanics and Meniscal Contributions

The ACL is vital for stabilising anterior-posterior and rotational knee motion [1], while the menisci act as secondary stabilisers. The medial meniscus limits anterior tibial displacement, whereas the lateral meniscus resists rotational stress during pivoting movements [3,17].

In the absence of ACL function, the medial meniscus provides resistance to anterior-posterior translation of the femoral condyle. Lateral meniscus removal causes less anterior laxity compared to medial meniscus removal [18].

ACL deficiency disturbs normal kinematics, resulting in abnormal joint loading and increased susceptibility to meniscal injuries [19-22]. Sanders et al. found that Nonoperative management or delayed ACLR significantly raises the risk of secondary meniscal tears and accelerates the development of osteoarthritis, often culminating in total knee arthroplasty [22].

Tear Types and Patterns in Meniscus Injury

Meniscal tear patterns vary significantly in ACL injury cases compared to isolated meniscal injuries [23]. The common tear types include:

- Simple Tears
- Radial Tears
- Meniscal Root Tears
- Ramp Lesions

Lateral meniscus tears are notably more prevalent in acute ACL injuries [24,25,26]. The lateral meniscus oblique radial tear of the posterior horn (LMORT) is identified in 12–15% of cases as most common in the setting of ACL tear [24,27,28]. Krych et al. classified LMORT into four types:

Type 1: Partial-thickness radial oblique tear (<10 mm from the posterior root attachment).

Type 2: Full-thickness radial oblique tear (<10 mm from the root, without root involvement).

Type 3 : Incomplete radial oblique tear (≥10 mm from the root, extending toward the posterior rim without root involvement).

Type 4 : Complete radial oblique tear (≥10 mm from the root, extending to the meniscofemoral ligament).

Advanced LMORT lesions (Types 3 and 4) are linked to increased anterior laxity and meniscal extrusion, underscoring the importance of surgical intervention during ACLR [29]. Similarly, lateral meniscus posterior root tears (LMPRT) are found in 14% of ACL injury cases [26] and are associated with heightened rotational instability.

Clinical Outcomes and Meniscus Repair Techniques

Historically, meniscal tears were treated with meniscectomy, which led to adverse outcomes, including osteoarthritis and increased joint instability [5,6,7]. Meniscectomy can also significantly worsen anterior translation, pivot shift, and meniscal extrusion [29].

Recent advancements highlight the critical role of meniscus repair during ACLR. Surgical intervention at the time of reconstruction not only restores knee biomechanics but also mitigates the risk of degenerative changes like osteoarthritis. Recognising tear patterns is essential to effective management. Meniscal repairs adhere to fundamental principles: anatomic reduction, biologic augmentation, and circumferential compression. Emerging surgical methods now enable the preservation of tissue previously deemed irreparable, offering promising clinical results.

Repairing meniscal tissue during ACLR has since shown better outcomes: While meniscus resection ultimately leads to end stage osteoarthritis, meniscus repair has shown favourable long-term joint preservation. Long-term follow-up studies indicate that meniscus repair reduces the need for subsequent surgical interventions [30,31]. Clinical outcomes such as reduced anterior laxity, restored stability, and improved joint biomechanics were observed with repairs compared to meniscectomy [32].

Also Radiological assessments indicate that combined ACLR and meniscus repair can sometimes lead to increased cartilage deterioration [33]. However, these outcomes often reflect the severity of the initial injury rather than the intervention itself.

Improvements in Lysholm and IKDC clinical outcomes scores were appreciated following LMPR repair in the setting of ACLR in the included studies [34-38].

Conclusion

Lateral meniscus injuries are common in ACL-deficient knees and significantly impact joint stability and long-term outcomes. The lateral meniscus plays a key biomechanical role, complementing ACL function by resisting rotational and translational forces. Radial tears, particularly LMORT, are classified into four types, highlighting their complexity. Accurate diagnosis and proper fixation during ACLR are essential to restore biomechanics, improve outcomes, and protect against osteoarthritis.

Conflicts of Interest

The author declare no conflicts of interest.

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