

Isolated Posterior Medial Meniscal Root Avulsion in a Skeletally Immature Athlete: A Case Report

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Abstract

Posterior medial meniscal root (PMMR) tears compromise meniscal hoop stresses and can accelerate joint degeneration if untreated. While common in older adults and often linked to ligament injuries in youth, isolated PMMR tears in skeletally immature athletes are rare. We report a 15-year-old baseball player who sustained an acute, isolated PMMR avulsion during a hyperflexion injury while sliding into base. Examination revealed pain with deep flexion and a positive McMurray test without instability. MRI confirmed a full-thickness PMMR avulsion with mild extrusion. Arthroscopic transtibial pullout repair and deep MCL imbrication were performed. Rehabilitation was uneventful, and the patient returned to competitive baseball. This case highlights the importance of maintaining a high index of suspicion for PMMR tears in adolescents with deep flexion pain, as early diagnosis and repair may prevent premature osteoarthritis and optimize functional outcomes.

Keywords: Posterior medial meniscal root tear; Meniscal root repair; Skeletally immature athlete; Adolescent knee injury; Arthroscopic transtibial pullout repair

Introduction

The meniscal roots are insertional ligaments attaching the meniscal body to the tibia and are essential in maintaining hoop stress, allowing the meniscus to function [1]. When the roots are torn/damaged, the mechanical properties are disrupted, and the meniscus is likely to be non-functioning [2]. This accelerates cartilage wear and joint degeneration leading to irreversible osteoarthritis [3].

Posterior medial meniscal root (PMMR) tears usually occur in adults in their fifth decade of life or later. PMMR tears in young patients have been associated with traumatic collisions and typically present with a concurrent ligament injury [2]. From a study of 314 knee arthroscopies (ages 10.5–19.6 years), 2.9% were found to have a PMMR tear, but almost all of these were associated with anterior cruciate ligament (ACL) injuries [1].

There are limited reports of isolated PMMR tears in skeletally immature patients, which highlights the rarity of this injury. Additionally, arthroscopic studies have shown that lesions involving the posterior horn are frequently underdiagnosed unless the posteromedial compartment is inspected, with a substantial proportion of “hidden” lesions only being identified after soft-tissue debridement [4]. The authors present a case of an isolated posterior medial meniscus root (PMMR) tear in a 15-year-old athlete, to highlight the importance of recognizing and addressing it early, as missed diagnoses can lead to the development of premature osteoarthritis.

Case Presentation

A 15-year-old male presented with right knee pain following a baseball-related injury. The patient sustained the injury while sliding into second base. He reported that his knee was hyperflexed during the slide and experienced immediate pain and instability upon standing.

The patient, accompanied by his parents, presented to the clinic two days post-injury. On physical examination, he demonstrated full knee range of motion with 3° hyperextension and flexion to 140°, with pain elicited upon hyperflexion. He had no effusion or tenderness to palpation but exhibited joint line pain with flexion-circumduction and a positive McMurray test. Ligamentous testing was symmetric to the contralateral side, with no laxity to varus or valgus stress, and a stable Lachman exam.

MRI revealed an isolated full thickness PMMR avulsion off of the tibia with underlying bony edema (Figure 1). Full length radiographs showed that the lower extremity was in 4 degrees of valgus (Figure 2). The patient was diagnosed with an isolated posterior medial meniscal root tear. Given his young age, athletic level and risk of further joint degeneration, surgical repair was recommended and subsequently performed 9 days after injury.

Surgical Technique

Under general anesthesia, standard anteromedial and anterolateral arthroscopy portals were established. Diagnostic arthroscopy revealed an isolated posterior root avulsion of the medial meniscus (Figure 3). All other intra-articular structures were intact, including the anterior and posterior cruciate ligaments, the lateral meniscus, and articular cartilage across all compartments.

The posterior root insertion site on the tibia was debrided using a curved shaver and curette to create a bleeding bony bed for healing. A meniscal root guide (Arthrex; Naples, Florida, USA) was positioned over the site. An anteromedial tibial incision was made, and a 2.3 mm guidewire was drilled into the joint just proximal to the pes and medial to the tibial tubercle. A flip cutter was drilled along the same path, and a FiberStick (Arthrex) was inserted. Sutures were shuttled through a passport cannula in the anteromedial portal.

Using a knee scorpion device, two sutures were passed through the thicker, more substantial medial meniscus tissue, in luggage tag fashion, to optimize cut-out strength. These were pulled through the tibial tunnel and fixed on the anteromedial tibia using a metal post screw. Arthroscopic confirmation showed successful reduction and restoration of tension to the medial meniscus (Figure 3).



Figure 1: Coronal MRI of the right knee demonstrating a complete posterior medial meniscus root tear with loss of attachment to the tibial plateau and associated bony edema.



Figure 2: Standing anteroposterior radiograph of both knees used to assess coronal alignment.

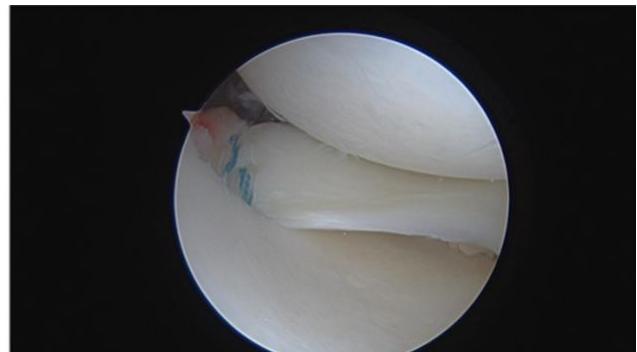
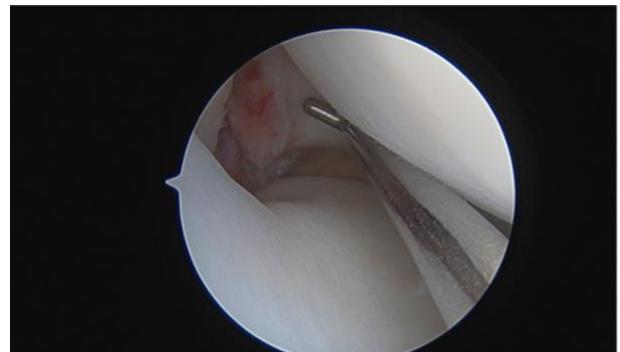


Figure 3: Arthroscopic views of the medial compartment demonstrating A) a complete posterior medial meniscus root avulsion with loss of attachment at the tibial footprint, and B) anatomic reduction of the posterior medial meniscus root to its native tibial footprint following transtibial pullout repair.

Additionally, a deep medial collateral ligament (dMCL) imbrication was performed to reinforce the meniscal root repair. A 4 cm longitudinal skin incision was made on the medial aspect of the knee centered at the joint line overlying the dMCL. Flaps were created anteriorly and posteriorly. The superficial MCL was split in line with its fibers, and the deep MCL was exposed. A suture anchor was used to repair the deep MCL back to its femoral origin with concurrent imbrication. This was done to address the meniscal extrusion and provide a stable environment for the root repair. The patient was then extubated and transferred to recovery in stable condition.

Post-op

The patient was placed into a brace and kept toe-touch weight bearing for six weeks. Immediate active and passive extension was encouraged immediately. For the first four weeks, flexion was limited to 60 degrees, then the following two weeks limited to 90 degrees. After six weeks the brace was discontinued and the patient gradually weaned off crutches. Jogging was initiated at the three-month mark after the patient demonstrated excellent single leg squats. Return to sport progression began four months post-op. The patient has returned to playing baseball without any issues.

Discussion

This case demonstrates a rare isolated PMMR tear in a 15-year-old baseball player and highlights the importance of early recognition and repair of this injury in young patients. The injury likely resulted from the hyperflexion and rotational forces sustained during the feet-first sliding maneuver in baseball. While isolated meniscus injuries occur less often in skeletally immature patients, this may be changing as there is an increase in sports participation in this population [5].

Isolated PMMR tears are more common in older population due likely to degeneration of the meniscus that occurs with age. Repetitive hyperflexion of the knee, while weightbearing, shifts the load to the posterior roots of the meniscus with more pressure being applied to the medial aspect [6]. Data on isolated PMMR tears in young patients is limited, but it is known that untreated root tears are likely to lead to accelerated osteoarthritis [3]. PMMR tears in young patients are more commonly seen after acute trauma and in conjunction with other ligamentous injuries. This makes the current case unique as there were no concomitant ligament injuries.

Identifying and treating a meniscal root tear in a skeletally immature patient is vital because of the severe long-term implications of leaving it untreated. Clinicians should keep a high suspicion of a PMMR tear if pain with deep flexion is experienced even with normal ligament exams. Identifying PMMR tears on MRI may be difficult, but it remains the gold standard for diagnosing these injuries. A gap in signal should be noticed within 1 cm of the root attachment. In addition, extrusion of the medial meniscus is a secondary sign of a root tear and signals that the meniscus is not functioning [7]. In this case 3 mm of extrusion was noted.

Conservative (nonoperative) treat offers limited benefit for complete root tears, especially in young, active patients, therefore surgical repair was selected to reestablish meniscal function and prevent progressive cartilage degeneration. Arthroscopic transtibial pullout repair was therefore undertaken as this technique reliably reattaches the meniscal root to its tibial footprint and has been shown restore pressure to the extruded meniscus, restoring hoop stresses to the meniscus [8].

This case demonstrates the need for greater awareness of meniscal root tears in the skeletally immature population. Prompt recognition and repair can mitigate the risk of long-term degenerative changes and optimize recovery, allowing young athletes to safely return to high-level activity.

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