Avulsion of the Anterior Lateral Meniscal Root Secondary to Tibial Eminence Fracture

Publish date: May 8, 2018
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Author Affiliation | **Disclosures**

Authors' Disclosure Statement: Dr. LaPrade reports that he receives royalties and is a paid consultant for Smith and Nephew, Arthrex, and Össur. Dr. Menge reports that he is a paid consultant for Smith and Nephew. Dr. Mitchell reports that he has received educational and grant support from Arthrex, Smith and Nephew, and DJO, LLC. The other authors report no actual or potential conflict of interest in relation to this article.

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Am J Orthop. 2018;47(5).

Take-Home Points

- Root tears of all meniscal attachments have been described. A comprehensive anatomic understanding of the meniscal roots is of utmost importance to suspect root lesions.
- A detailed physical examination along with imaging methods should be performed to make the correct diagnosis. In cases of evident injuries, such as a tibial spine fracture, additional soft tissue pathology should also be assessed.
- It is important to restore all torn root attachments to restore joint loading and contact areas. An anatomical root repair is needed to yield optimal results.
- Progressive rehabilitation with early ROM starting on postoperative day 1 can help avoid loss of knee motion and arthrofibrosis.

The lateral tibial eminence is intimately associated with the root attachment of the anterior horn of the lateral meniscus.[1-3] Previous studies have demonstrated both the close proximity of the anterior cruciate ligament (ACL) insertion to the meniscal roots and the potential for disruption in surgical interventions, such as tibial tunnel drilling in ACL reconstruction or placement of intramedullary tibial nails.[4-6] The meniscal roots play a crucial role in force distribution, and disruption of these structures has been shown to significantly increase joint contact

forces. Despite the deleterious effects of this injury, limited studies have reported on traumatic injury to the meniscal roots in the setting of tibial eminence fractures.

Reported rates of occurrence of concomitant meniscal and chondral injuries occurring with tibial eminence fractures vary widely, ranging from <5% to 40%.[7,8] Although fractures to the tibial eminence are more common in children, an association between these injuries and concomitant soft tissue injuries, including meniscal, chondral, and collateral ligament injuries, in the adult population has been reported.[7] Monto and Cameron-Donaldson[8] used magnetic resonance imaging (MRI) to evaluate tibial eminence fractures in adults and found that 23% of study subjects had associated medial meniscus tears and 18% had lateral meniscus tears. In a similar study, Ishibashi and colleagues[9] found that 25% of tibial eminence fractures were associated with lateral meniscus tears and 16% with medial meniscus tears.

These studies demonstrate the potential for meniscus injuries during tibial eminence fractures. However, the authors are unaware of any reports of complete tearing of the anterior horn of the lateral meniscus in association with this injury. This is an important injury to recognize and identify intraoperatively because an injury of this nature could potentially compromise the mechanical loading patterns and health of the articular cartilage of the lateral compartment of the knee. The purpose of this article is to describe a complete avulsion of the anterolateral meniscal root due to a tibial eminence fracture with resultant malunion and displacement of the root in a nonanatomical position. The patient provided written informed consent for print and electronic publication of this case report.

Case

A 28-year-old active woman presented to our clinic 22 months after sustaining a right knee tibial eminence fracture that was initially treated with extension immobilization, which resulted in a fibrous malunion. She subsequently sustained a second injury resulting in displacement of the malunion fracture fragment, and was treated at another institution 10 months prior to presentation at our clinic with arthroscopic reduction and internal fixation with a cannulated screw and washer of the tibial eminence fracture. This was followed by hardware removal 6 months prior to her office visit at our clinic. At presentation, she reported worsening right knee pain, mechanical symptoms, and loss of both flexion and extension compared with her uninjured knee. Conservative management, including activity modification, extensive physical therapy, and anti-inflammatory medication following her most recent procedure, had not resulted in improvement of her symptoms.

Physical examination revealed significantly reduced knee flexion and extension (+15°-120° on the affected side compared with 5° of hyperextension to 130° flexion of the contralateral knee). Ligamentous examination demonstrated no laxity with varus or valgus stress at 0° to 30° of flexion, negative posterior drawer, and a Grade 2 Lachman and positive pivot shift. She also exhibited pain with attempted right knee terminal extension. Radiographs and computed tomography scans were obtained and reviewed. They revealed a malunited tibial eminence fracture (**Figures 1A-1D**). The fragment was located anterior and lateral to its native location, which created a mechanical block during knee motion. Additionally, MRI demonstrated that the anterior horn of the lateral meniscus was displaced and attached to the malunited fragment (**Figures 2A, 2B**) as well as to nonfunctional ACL fibers. On the basis of the mechanical block restricting extension and the displaced anterior horn of the lateral meniscus compromising meniscal function, we recommended arthroscopic surgery. After discussion of the risks and benefits of the procedure with the patient, she provided informed consent, and it was decided that the patient would undergo arthroscopic fragment excision followed by anatomic repair of the anterior root of the lateral meniscus, and that we would proceed with ACL reconstruction in the future given her subjective instability and physical examination findings of ACL insufficiency.

Arthroscopic assessment of the right knee demonstrated the large osseous fragment located in the anterolateral aspect of the joint with the displaced anterior horn of the lateral meniscus attached as well as significant anterior impingement limiting knee extension. Probing of the anterolateral meniscal root in the lateral compartment showed abundant surrounding scar tissue with an abnormal attachment, representing a chronic root avulsion. A mechanical shaver was used to débride the scar tissue and expose the malunited fragment, followed by complete osseous fragment excision with a high-speed burr (**Figure 3**). The knee was taken through full range of motion (ROM) from 5° of hyperextension to 130° of flexion with arthroscopic confirmation of no further anterior impingement.

A soft tissue anterolateral meniscal root repair was performed by creating a 2-cm to 3-cm incision on the anterolateral tibia, just distal to the medial aspect of the Gerdy tubercle. To best restore the footprint of the repair and increase the potential for biologic healing, 2 transtibial tunnels were created at the location of the root attachment. An ACL aiming device with a cannulated sleeve was used to drill 2 bony tunnels approximately 5 mm apart, exiting at the anatomic root footprint. The drill pins were removed, leaving the 2 cannulas in place for later suture passage. A suture-passing device was used to pass 2 separate sutures through the detached meniscal root. A looped passing wire was directed up the previously placed cannulas, and 1 suture was shuttled down each tunnel. The sutures were securely tied down over a bony bridge with a cortical fixation button on the anterolateral tibia. This was visualized arthroscopically to ensure proper positioning and tension of the root to its native footprint (**Figure 4**). A comparison of preoperative and postoperative anteroposterior and lateral knee radiographs is shown in **Figures 5A, 5B**.

Postoperatively, the patient was placed on a non-weight-bearing protocol for her operative lower extremity for 6 weeks. A brace locked in extension was used for the same period of time (being removed only for physical therapy exercises). Enoxaparin was used for the first 2 weeks for deep vein thrombosis prophylaxis, followed by aspirin for an additional 4 weeks. Physical therapy was started on postoperative day 1 to begin working on early passive ROM exercises. Knee flexion was limited to 0° to 90° of flexion for the first 2 weeks and then progressed as tolerated.

Discussion

This article describes a rare case of a patient with lateral meniscal anterior root avulsion in the setting of a tibial eminence fracture with subsequent malunion and root displacement. In a case such as this, delineation of the true extent of the injury is difficult because the anterior meniscal root can be torn, displaced, and nonanatomically scarred to surrounding soft tissues, making MRI interpretation challenging. Clinically, patients can present with a wide range of symptoms, including pain, mechanical symptoms, instability, and loss of knee motion.[10]

The anterior root of the lateral meniscus has been reported to be attached anterior to the lateral tibial eminence and adjacent to the insertion of the ACL. Fibrous connections extending from the anterior horn of the lateral meniscus attachment to the lateral tibial eminence are constant.[11] Furumatsu and colleagues[12] demonstrated the existence of dense fibers linking the anterior root of the lateral meniscus with the lateral aspect of the ACL tibial insertion. Acknowledging the close relationship of these structures is key to comprehending the importance of evaluating the anterior horn of the lateral meniscus in cases of tibial eminence fractures at the initial time of injury. Failure to diagnose this pathology can lead to poor clinical outcomes and early degenerative changes of the knee.

Tibial intercondylar eminence avulsion fractures are most likely to occur in children and adolescents, and are equivalent to an ACL tear in adults.[13] When tibial eminence fractures occur in an older cohort, they are often

combined with lesions of the menisci, capsule, or collateral ligaments.[14] The initial injury in our patient demonstrated concomitant anterior root injury that progressed with time to nonanatomical healing of the root, leading to altered biomechanics. Surgical techniques available for meniscal root repair are broadly divided into transosseous suture repairs and suture anchor repairs.[10] The transtibial pullout technique using 2 transtibial bone tunnels as described in this report is the senior author's (RFL) preference because it provides a strong construct with minimal displacement of the repaired meniscus.[15-17]

This article describes a complete avulsion of the anterolateral meniscal root caused by a tibial eminence fracture with resultant malunion and displacement of the root in a nonanatomic position. Anterior meniscal root tears have been reported to result in altered biomechanics and force transmission across the knee, and therefore, anatomic repair of the anterior root is indicated.

Key Info

Figures/Tables

Figures / Tables:

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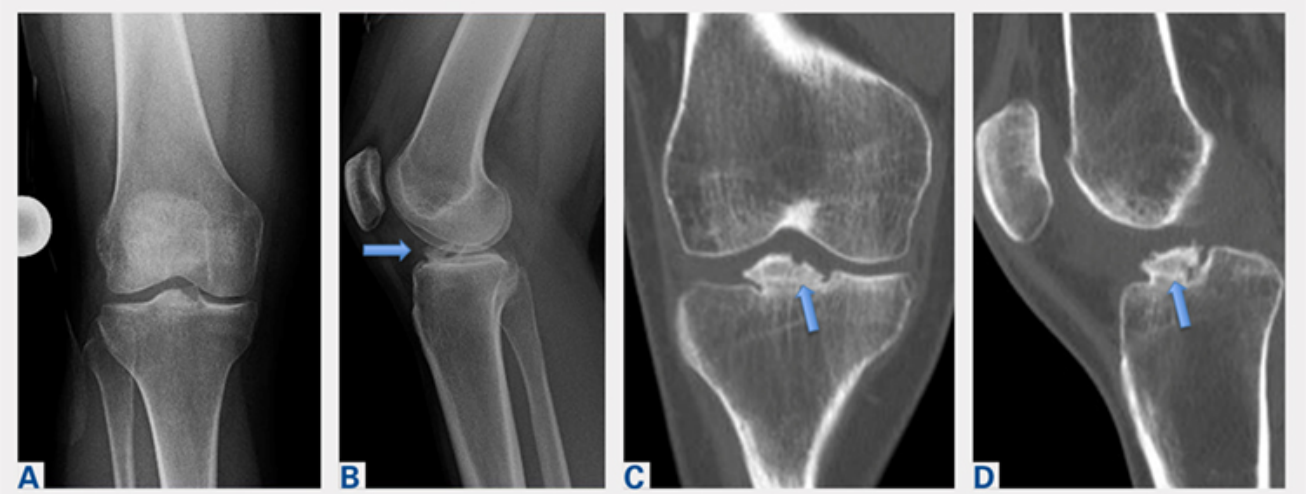

Figure 1. (A) Anteroposterior and (B) lateral radiographs demonstrating evidence of a malunited lateral tibial eminence fracture. (C, D) Computed tomography confirming displacement of the fragment in an anterior and lateral position (arrows).

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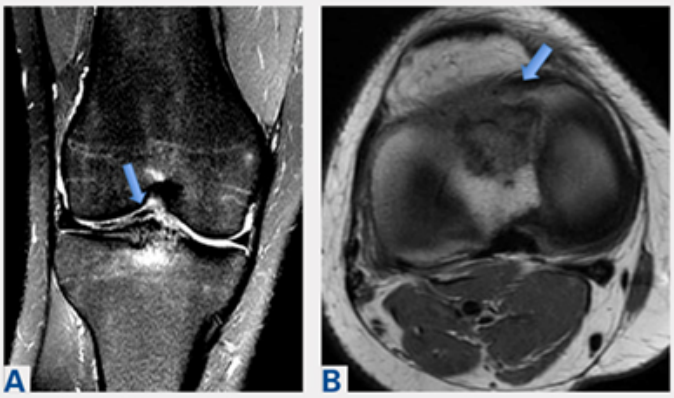

Figure 2. (A) Coronal and (B) axial magnetic resonance imaging demonstrating the anterior root of the lateral meniscus (arrows) attached to the displaced fracture fragment.

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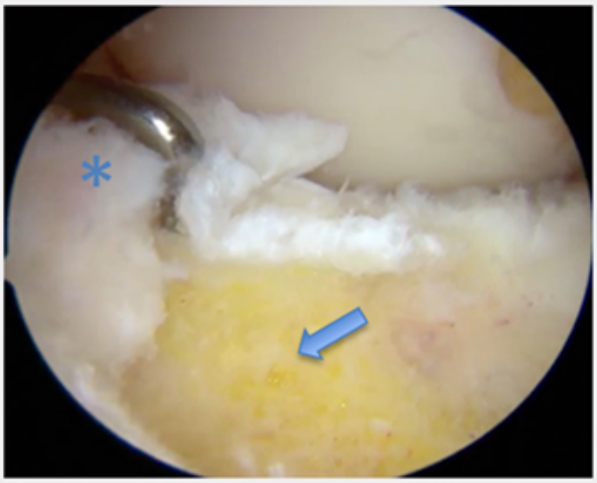

Figure 3. Probing of the torn anterior root (asterisk) following resection of the malunited tibial eminence fragment (arrow).

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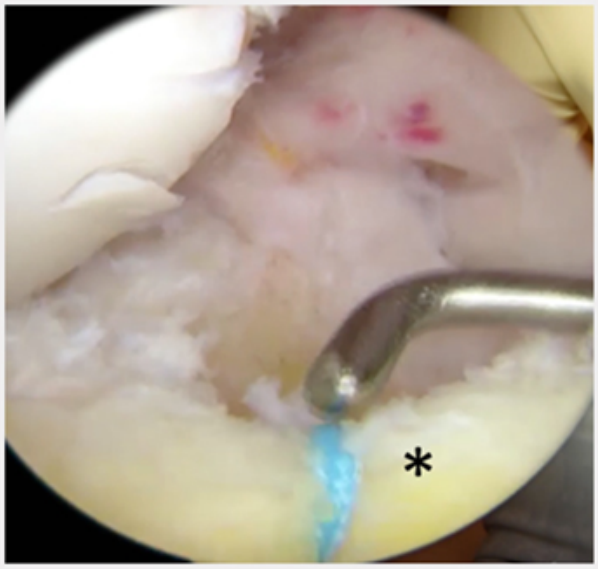

Figure 4. Confirmation of the repaired anterior lateral meniscal root (asterisk) in the correct anatomical footprint.

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Figure 5. (A) Preoperative and (B) postoperative anteroposterior and lateral radiographs of the knee demonstrating removal of the previous screw and placement of a cortical fixation button device on the anterolateral tibia.

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