11-3-2022

Injury to the Posterior Horn of the Lateral Meniscus from a Misplaced Tibial Tunnel for Anterior Cruciate Ligament Reconstruction: A Case Report

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American Journal of Case Reports

e-ISSN 1941-5923
© Am J Case Rep, 2022; 23: e937581
DOI: 10.12659/AJCR.937581

Received: 2022.06.21
Accepted: 2022.08.23
Available online: 2022.09.26
Published: 2022.11.03

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Financial support: None declared
Conflict of interest: ASV, JL, HS, SG, and KNK have no conflicts of interest. NNV reports being Board or committee member of American Orthopaedic Society for Sports Medicine, American Shoulder and Elbow Surgeons, Arthroscopy Association of North America; research support from Arthrex, Inc., Breg, Ossur, Wright Medical Technology, Inc., Smith & Nephew; publishing royalties from Arthroscopy, Vindico Medical-Orthopedics Hyperguide; editorial or governing board of Knee, SLACK Incorporated; stock or stock options for Cymedica, Minivasive, Omeros; and paid consultant for Minivasive, Orthospace. JC reports personal fees from Arthrex, personal fees from CONMED Linvatec, personal fees from Ossur, and personal fees from Smith & Nephew, outside the submitted work

Patient: Male, 32-year-old
Final Diagnosis: Iatrogenic lateral meniscal posterior root tear
Symptoms: Tenderness over the joint line of the knee along with a palpable subluxated medial meniscus
Medication: —
Clinical Procedure: Lateral meniscus root repair and medial femoral chondroplasty
Specialty: Orthopedics and Traumatology
Objective: Rare disease
Background: Posterior meniscal root avulsions can cause meniscal extrusion, joint space narrowing, and progressive knee arthritis. Iatrogenic posterior meniscal root avulsions after malpositioning of the transtibial tunnels during anterior cruciate ligament (ACL) reconstruction can account for poor long-term outcomes seen in some patients following ACL reconstruction. Therefore, correct transtibial tunnel placement during ACL reconstruction is essential to avoid iatrogenic meniscal damage.
Case Report: A 32-year-old man presented with 1 year of right knee pain and instability following a non-contact twisting injury sustained while playing soccer. An ACL tear with no meniscal involvement was diagnosed at an outside institution. A double-bundle reconstruction was performed at that time. Three months after surgery, a medial partial meniscectomy was performed after a medial meniscal tear and failure to reduce initial symptoms during the index procedure. Advanced imaging at our institution 6 months later demonstrated an iatrogenic lateral posterior meniscal root avulsions after malpositioning of the transtibial tunnels. Given the ACL graft integrity upon arthroscopic evaluation, the root tear was repaired using a 2-tunnel transtibial pull-out technique. Advanced imaging 1 year after surgery showed a well-maintained meniscal repair with no extrusion.
Conclusions: Accurate transtibial tunnel placement during ACL reconstructive surgery is vital to avoid meniscal root detachment and the associated complications resulting in poor patient outcomes from this iatrogenic injury. Clinicians treating patients with a history of cruciate ligament reconstruction presenting with postoperative pain and instability should consider this pathology in their differential diagnosis.

Keywords: Iatrogenic • Anterior Cruciate Ligament • Meniscal Root • Anterior Cruciate Ligament Reconstruction • Lateral Meniscus

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/937581

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Background

Meniscal root tears are radial tears within 10 mm of the meniscal insertion or a bony root avulsion and have gained attention in recent years with advancements in clinical and radiographic diagnostic modalities [1-4]. Meniscal root tears have been reported to account for 10% to 21% of all meniscal tears and affect an estimated 100 000 patients annually [5]. Importantly, meniscal root injuries can result in meniscal extrusion, joint space narrowing, and inadequate conversion of axial loads into hoop stresses within the joint [6,7]. Furthermore, they have been demonstrated to be an independent predictor of tibiofemoral cartilage degradation and osteoarthritis, equivalent to those experienced after a total meniscectomy [1,8-12]. Meniscal repair techniques have been shown to successfully restore knee kinematics, highlighting the importance of diagnosing and appropriately treating these injuries [1]. However, there is still much controversy regarding the management and ideal surgical technique to treat meniscal tears, specifically regarding the location and type of tear and the assessment of methods of evaluation after repair [13].

The anatomy and injury mechanisms of the attachment sites of the menisci have been elucidated by recent quantitative and qualitative anatomic investigations [14]. The relative proximity of the posterior root of the lateral meniscus to the tibial footprint of the anterior cruciate ligament (ACL) can place the lateral posterior root attachment at risk while drilling the tibial tunnel during an ACL reconstruction. This relationship is critical to consider when treating ACL injuries to avoid such iatrogenic detachments of the meniscal root, as this represents an avoidable complication of this procedure that otherwise can compromise long-term outcomes [15-17].

The aim of this case report is to describe the presentation and treatment of a patient with an iatrogenic posterior lateral meniscus root tear due to malpositioned tibial tunnels during a prior ACL reconstruction. Additionally, the authors present this case to increase awareness and understanding of posterior lateral meniscal root anatomy and recognize this uncommon injury. The patient was informed that data concerning his case would be submitted for publication, and he provided consent.

Case Report

A 32-year-old man presented with persistent right knee pain and instability. The original injury occurred 21 months prior to presentation when the patient sustained a non-contact twisting injury to his knee during a soccer game. The diagnosis of an ACL tear was made, and he subsequently underwent a single-bundle ACL reconstruction. At that time, no concomitant knee injuries were diagnosed with magnetic resonance imaging (MRI) and no meniscal surgery was indicated. Nine months after the reconstruction, he reported instability and swelling along with joint line pain. A medial meniscal tear was diagnosed. This was subsequently treated with a partial meniscectomy. Six months after the meniscectomy, the patient presented to our clinic with chronic knee instability and sharp, constant medial-sided pain. Symptoms were aggravated by standing, walking, and lifting. On physical examination, the patient walked with

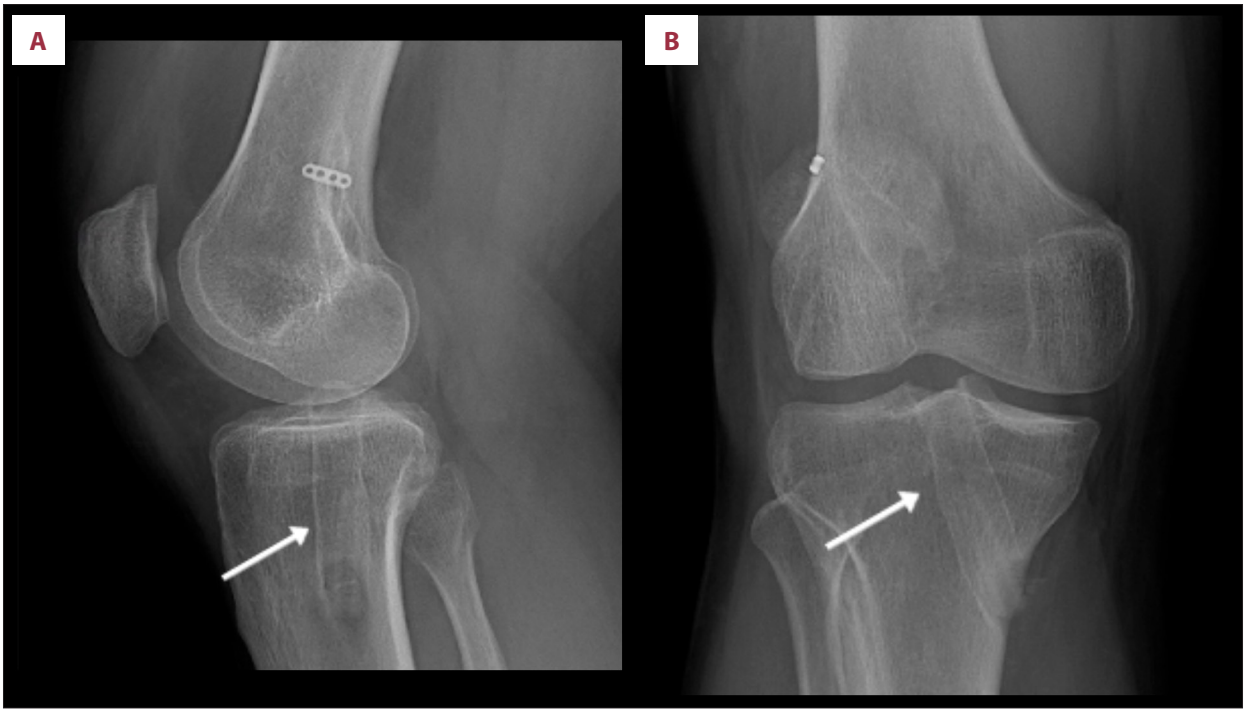

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Figure 1. Preoperative imaging of the right knee. (**A**) Lateral and standing (**B**) anteroposterior radiographs demonstrate a malpositioned tibial anterior cruciate ligament reconstruction tunnel (*white arrows*). This was confirmed to be in a non-anatomic position on (**C**) axial and (**D**) sagittal computed tomography. (**E**) Axial and (**F**) sagittal magnetic resonance imaging show the posterior location of the tunnel, blunting the lateral posterior meniscal root.

an antalgic gait and had tenderness over the medial joint line of the knee, along with a palpable subluxated medial meniscus. On provocative testing, there was a lax anterior drawer and Lachman test. In addition, he displayed normal strength and side-to-side symmetry in his range of motion, with motion limited from 1^0 to 110^0 of flexion compared with the uninjured left knee, which demonstrated 0^0 to 135^0 flexion.

Long-leg radiographs demonstrated a neutral alignment bilaterally. There was concern that his tibial reconstruction tunnel,

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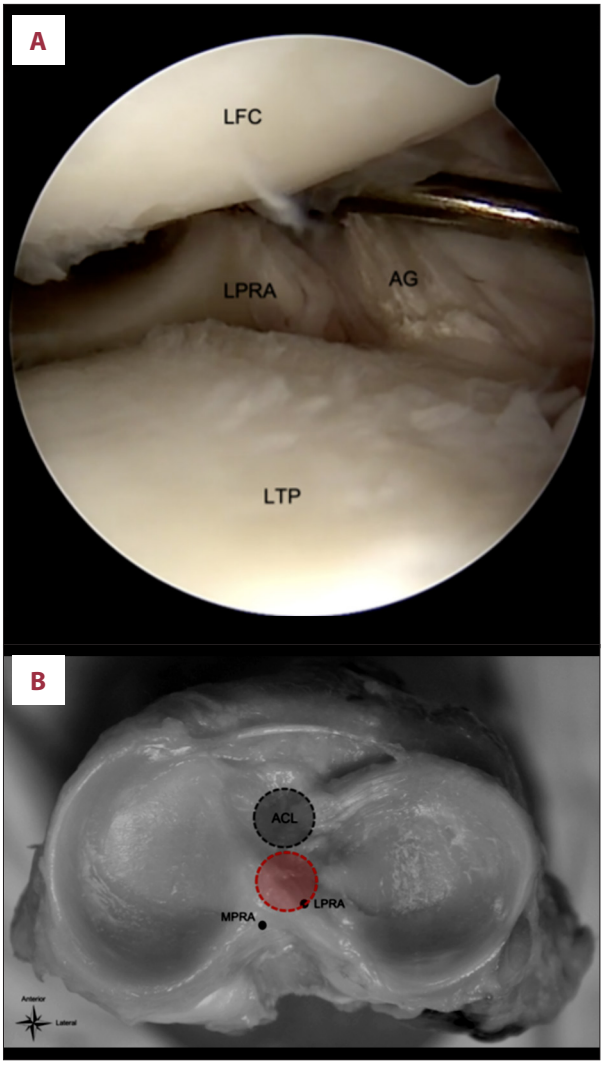

Figure 2. Arthroscopic photographs of a lateral posterior root tear (right knee). (**A**) Evidence of a significant root tear due to the non-anatomic, posterior position of the anterior cruciate ligament (ACL) tibial tunnel. (**B**) Cadaveric image demonstrating the position of the lateral and medial meniscus posterior root attachment (MPRA and LPRA) in relation to the anatomic ACL location (*black circle*) and current tunnel location (*red circle*). (**C**) Repair of the posterior horn of the lateral meniscus using a transtibial pull-out technique. LFC – lateral femoral condyle; LTP – lateral tibial plateau; AG – ACL graft.

measuring 10.23 mm in diameter, was located too far posteriorly on the lateral radiograph (**Figure 1**). Two weeks after initial presentation to our clinic, while walking with a knee brace, the patient felt significant sharp pain and buckling, which caused him to collapse. Repeat physical examination demonstrated additional lateral joint line and posterior knee pain. New MRI and a computed tomography (CT) scan showed notable non-anatomic posterior placement of the tibial reconstruction tunnels, blunting of the lateral meniscus concerning for a root tear, a medial femoral condyle defect, and significant posterolateral edema out of proportion in the absence of trauma (**Figure 1**).

The patient was indicated for a lateral meniscus root repair and medial femoral chondroplasty. On arthroscopic evaluation, the articular cartilage in the weight-bearing zone of the medial femoral condyle had Outerbridge grade II chondromalacia, which was debrided to stabilize the borders of the defect. The graft was appreciated and noted to be vertical and posterior relative to its native anatomical position, violating the lateral posterior horn root attachment. Given the well-maintained anteroposterior stability and graft integrity of the ACL, a revision reconstruction was not performed, as drilling additional tunnels can cause tunnel convergence [18]. A full lateral meniscus posterior root tear was then confirmed directly adjacent to the graft tunnel (**Figure 2**). A curette was used to prepare the footprint of the lateral meniscal root on the posterolateral tibia for the 2-tunnel transtibial pull-out tunnels, and a grasper was used to position the torn meniscal root back into its anatomical site. Two ultrabraided sutures (Smith & Nephew, Andover, MD, USA) were passed through the posterior horn of the lateral meniscus utilizing a suture passer (Smith & Nephew). These were then passed through the tunnels into the body of the meniscal root, which was reduced to its native anatomical position, similar to the transtibial pull-out technique previously reported for lateral posterior root repairs [19]. The suture repair was then secured over an Endobutton fixation device (Smith & Nephew) at 90° of knee flexion through each tunnel into its native anatomical position while confirming its adequate tension by viewing arthroscopically. The ACL graft integrity was confirmed following the root

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Figure 3. Postoperative follow-up (**A**) 6-month and (**B**) 12-month coronal magnetic resonance imaging views demonstrating an intact lateral meniscal repair without a sign of meniscal extrusion.

repair, which was believed to have a stabilizing effect on the ligament (**Figure 2**) [20,21].

Clinical Follow-Up

After surgery, the patient was made non-weight-bearing on his operative lower extremity for 4 weeks. A brace locked in extension was used during this time and removed only when the patient was performing physical therapy, which was started on postoperative day 1, to begin early passive range-of-motion exercises. Knee flexion was limited between 0° to 90° of flexion for the first 2 weeks and then progressed as tolerated. The patient was seen at 6, 9, and 12 months after surgery, with an intact lateral meniscal repair seen on imaging and the absence of symptoms (**Figure 3**).

Discussion

This case report describes an iatrogenic lateral meniscal posterior root tear that occurred secondary to a malpositioned tibial tunnel during primary ACL reconstruction. As such, this case report highlights the importance of anatomic tibial tunnel placement during an ACL reconstruction and raises awareness of the possibility of an iatrogenic injury to the meniscus during the procedure.

Meniscal root anatomy and ligamentous arthroscopic landmarks in the knee have been comprehensively studied through cadaveric analyses as guides for ACL tunnel placement. Fujishiro et al described the posterior horn of the lateral meniscus forming an anterolateral and posteromedial crura, which intertwined into the posterior margin of the ACL footprint [22]. Further, Ziegler et al reported that the posterior horn of the lateral meniscus was approximately 15.7 mm anteromedially from the tibial center of the ACL footprint, 4.8 mm posterior to the center of the anteromedial bundle, and 5.6 mm anterior to the center of the posterolateral bundle [23]. With an understanding of the fundamental anatomic relationships between the lateral meniscus posterior root attachment and the tibial-sided ACL footprint, treatment of concomitant posterior root lateral meniscal and ACL injuries has been well described [24]. In addition, previous case series have described iatrogenic anterior root lateral meniscus injury after ACL reconstruction and posterior root meniscal injury following PCL reconstruction, as well as their successful treatment [18,25]. Nevertheless, although a rare injury, this case report establishes the possibility of iatrogenic injury to the posterior root of the lateral meniscal during tibial tunnel drilling for an ACL reconstruction and further emphasizes the importance of its anatomic placement.

Lateral meniscal posterior root tears are commonly associated with ACL injury mechanisms, with a prevalence of 8% to 14% in patients presenting with an ACL tear [20,24,26]. This is plausible as the meniscus serves as a secondary stabilizer in anteroposterior translation and rotatory movement to the ACL [21,27]. Prior studies have investigated the biomechanical effects of lateral meniscal posterior root tears and repairs in both ACL-intact and ACL-deficient knees. Frank et al found the posterior root

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to be a significant stabilizer in the knee during anterior tibial translation at lower flexion angles and the primary stabilizer during internal rotation at higher flexion angles [20]. Therefore, the loss of the posterior root can contribute to increased strain on an ACL graft and subsequent failure, while preventing potential overload when repaired [20,21]. In our case, the decision to not revise the previously reconstructed ACL, which was far too posteriorly positioned, was based on the anteroposterior stability and good integrity of the graft confirmed during surgery. Nonetheless, in the presence of persistent symptoms and subjective laxity after ACL reconstruction, we recommend obtaining an MRI to promptly identify pathology either overlooked during surgery or that may have developed as the result of iatrogenic injury. However, there is still controversy regarding the proper treatment of posterior root tears, as well as regarding the assessment of methods of evaluation after repair [13]. Ultimately, future research is necessary to understand the specific outcomes and optimal treatment for iatrogenic damage to the meniscus following ligament reconstructive surgery.

This case report had limitations. The index surgery was performed at an outside institution. However, the authors are confident that the meniscal injury was iatrogenic in nature given the results noted from diagnostic imaging, utilizing a combination of MRI and CT scans, along with the assessment of intraoperative findings.

Conclusions

This case report describes a complication of primary ACL reconstruction consisting of an iatrogenic posterior horn lateral meniscal root tear due to non-anatomic tibial tunnel placement. The iatrogenic nature of this injury underscores the importance of an accurate tibial tunnel placement during ACL reconstruction to avoid posterior meniscal root injuries and other associated complications. Physicians should consider such pathology in the differential diagnosis of patients presenting with persistent pain and instability following a primary ACL reconstruction.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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