TECHNICAL NOTE

No Risk of Tunnel Convergence in Combined ACL Reconstruction and Transtibial Lateral Meniscus Posterior Root Tear Repair. A Technical Note

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Abstract

Lateral meniscus posterior root tears are frequently identified during anterior cruciate ligament reconstruction. These tears are associated with increased knee instability and altered biomechanics in knees deficient in the anterior cruciate ligament, leading to potential cartilage degeneration and compromised graft function if left untreated. Repairing lateral meniscus posterior root tears during anterior cruciate ligament reconstruction improves knee stability and biomechanics, while also yielding better patient-reported outcomes. The transtibial pullout technique is a popular and reliable method for repairing lateral meniscus posterior root tears. However, it poses a substantial risk of tibial tunnel convergence, which may complicate the surgery and compromise the clinical result. We describe a simple and reproducible technique that enables anatomic anterior cruciate ligament reconstruction and lateral meniscus posterior root tear repair with no risk of tibial tunnel convergence.

Level of evidence: V

Keywords: Arthroscopy, Complications, Knee

Introduction

Lateral meniscus posterior root tears are commonly found during anterior cruciate ligament reconstruction, with an incidence of up to 14% reported in the literature.[1] The presence of a lateral meniscus posterior root tear is associated with increased instability and altered knee joint biomechanics in the anterior cruciate ligament-deficient knee.[1] Missed or untreated lateral meniscus posterior root tears can rapidly lead to cartilage degeneration and compromise anterior cruciate ligament graft function.[2] However, knee stability and biomechanics are significantly improved when lateral meniscus posterior root tears are repaired along with anterior cruciate ligament reconstruction.[1] Moreover, lateral meniscus posterior root tear repair provides superior patient-reported outcome measures and fewer osteoarthritic changes compared to meniscectomy and non-operative treatment.[2]

Therefore, repair of lateral meniscus posterior root tears is currently considered the treatment of choice, with the transtibial pullout and suture anchor techniques being the most popular.[3,4] The transtibial pullout technique is a simple, efficient, and reproducible technique, while the suture anchor technique requires an additional arthroscopic portal and is technically demanding.[4] However, with the transtibial pullout technique, there is a 26% risk of tunnel convergence between the root and the anterior cruciate ligament tibial tunnel, which may complicate the surgery and compromise the clinical result.[5]

We describe a simple and reproducible technique that enables anatomic anterior cruciate ligament reconstruction and lateral meniscus posterior root tear repair with no risk of tibial tunnel convergence.

Surgical Technique

Patient Positioning – Knee Arthroscopy:

The patient is placed in the supine position with a side support and a foot stop. Standard anteromedial and anterolateral portals are established, and a thorough examination of the knee joint is carried out. Once the anterior cruciate ligament and lateral meniscus posterior root tears are confirmed [Figure 1], the selected graft for anterior cruciate ligament reconstruction is harvested, and

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in cases of medial meniscus tear, partial medial meniscectomy or medial meniscus repair is performed.

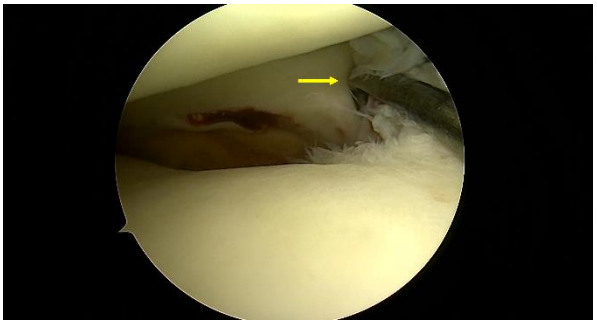

Figure 1. Right knee. Arthroscopic view through the antrolateral portal. The yellow arrow indicates the tear of the lateral meniscus posterior root

The lateral meniscus posterior root footprint is identified and debrided with a curette or a shaver blade. With the arthroscope in the anteromedial portal, a suture passer (Scorpion, Arthrex, Naples, FL, USA) [Figure 2] loaded with a suture tape is introduced through the anterolateral portal, and the lateral meniscus posterior root is sutured with an inverted mattress locking loop [Figure 3] or the surgeon's preferred suture configuration. The limbs of the suture(s) are left in the anterolateral portal, which will now serve as the viewing portal, to avoid suture tangling with the guides inserted through the anteromedial portal in the next steps.

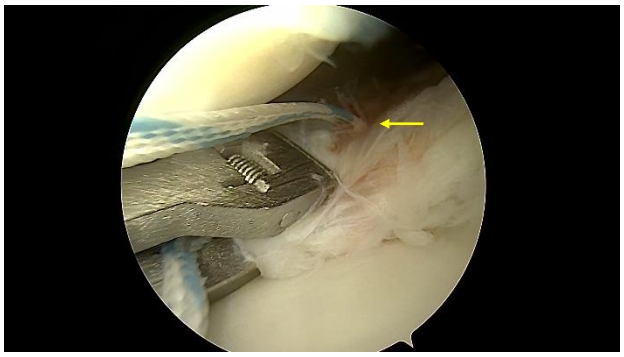

Figure 2. Right knee. Arthroscopic view through the anteromedial portal. A suture passer (Scorpion, Arthrex, Naples, FL, USA) loaded with a suture tape is introduced through the anterolateral portal to suture (yellow arrow) the lateral meniscus posterior root tear

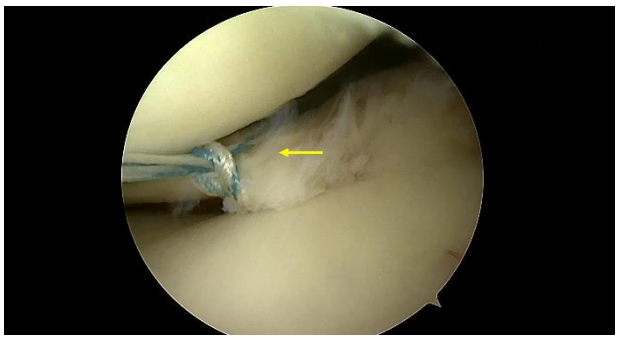

Figure 3. Right knee. Arthroscopic view through the anteromedial portal. An inverted mattress locking loop (indicated by the yellow arrow) has been created.

Femoral Tunnel Preparation:

The anterior cruciate ligament remnants are debrided, and the femoral footprint is identified. The femoral tunnel is drilled using the inside-out technique, and a shuttle suture is passed through the tunnel and secured to facilitate the passage of the graft.

Tibial Tunnel and Lateral Meniscus Posterior Root Tunnel Preparation:

The tibial tunnels are then created. A root tear tibial guide (Smith & Nephew Meniscal Root System, Memphis, TN, USA) is set at a 65° angle and introduced into the joint through the anteromedial portal. The tip of the guide is positioned at the tibial footprint of the lateral meniscus posterior root, and the drill sleeve is positioned onto the anteromedial aspect of the tibia in proximity to the anterior border of the medial collateral ligament. The guide pin (Smith & Nephew 2.4 mm drill pin, Memphis, TN, USA) is advanced into the joint, and correct placement is confirmed arthroscopically. The tibial tunnel is not drilled at this point.

The anterior cruciate ligament tibial guide is then set at a 55° angle and introduced through the anteromedial portal into the joint. The tip of the guide (Tibial ACL Marking Hook, Arthrex, Naples, FL, USA) is positioned at the center of the anterior cruciate ligament tibial footprint, and the drill sleeve is placed in proximity to the medial border of the tibial tuberosity, leaving a sufficient bone bridge between the pins. The guide pin (FlipCutter, Arthrex, Naples, FL, USA) is advanced into the joint, and optimal placement is confirmed arthroscopically.

An arthroscopic ruler is then used to measure the distance between the two pins in the joint. The surgeon can now reliably calculate the distance of the two tibial tunnel apertures in the joint [Figure 4]. The distance of the two pins can also be measured in the anteromedial cortex of the tibia to define the bone bridge of the two tibial tunnel apertures onto the anteromedial cortex [Figure 5].

Once an adequate distance is confirmed at both sides, the anterior cruciate ligament tibial socket is drilled reversely with the FlipCutter (Arthrex, Naples, FL, USA). The arthroscope is then brought to the aperture of the socket, and the entire socket is visualized [Figure 6] during root tunnel preparation. A 4.5 mm cannulated drill (Smith & Nephew 2.4 mm drill pin, Memphis, TN, USA) is used to create the root tunnel. The limbs of the repair suture tape are then shuttled through the root tunnel and pulled to confirm optimal lateral meniscus posterior root reduction [Figure 7]. Direct visualization of the socket enables safe confirmation of tunnel convergence avoidance. In the case of a full-length tibial tunnel, the arthroscope is inserted into the tibial tunnel through the aperture at the anteromedial cortex of the tibia [Figure 8].

Lateral Meniscus Posterior Root Fixation and Anterior Cruciate Ligament Reconstruction Completion:

The anterior cruciate ligament graft is passed and fixed [Figure 9] at full knee extension with adjustable loop buttons (ACL TightRope, Arthrex, Naples, FL, USA). The knee is then brought into the figure-four position, and the suture limbs of the lateral meniscus posterior root are tied over a button (Dog Bone Button, Arthrex, Naples, FL, USA). The anterior

cruciate ligament graft and root repair are checked [Figure 10]. The distance between the buttons can be measured [Figure 11]. Alternatively, the sutures can be tied over the anterior cruciate ligament tibial button or with any other method. The tunnels can be objectively evaluated with imaging studies [Figures 12 and 13].

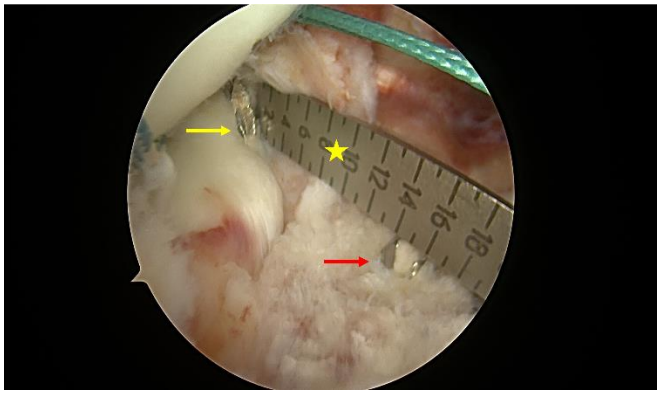

Figure 4. Right knee. Arthroscopic view through the antrolateral portal. An arthroscopic ruler (yellow asterisk) is introduced through the anteromedial to measure the distance between the tip of the root pin (yellow arrow) and the tip of the anterior cruciate ligament pin (red arrow)

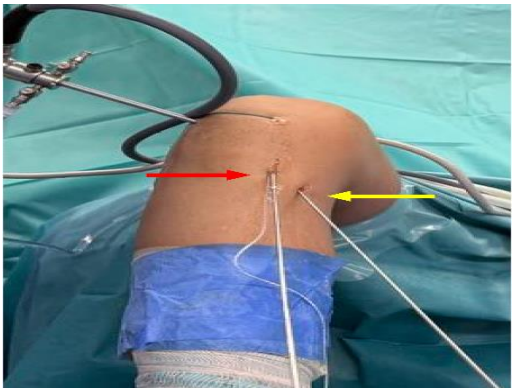

Figure 5. Right knee. Outside anteromedial view. The red arrow indicates the anterior cruciate ligament pin, and the yellow arrow indicates the root pin. The distance between the pins can be measured to determine the bone bridge between the tunnels

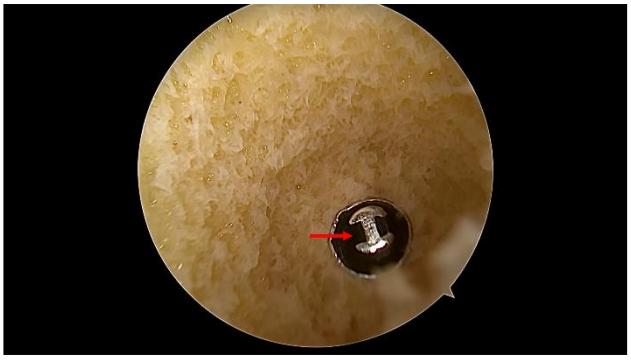

Figure 6. Right knee. Arthroscopic view through the antrolateral portal. The tibial socket is visualized. The red arrow indicates the pin that will deliver the shuttle suture for graft passage

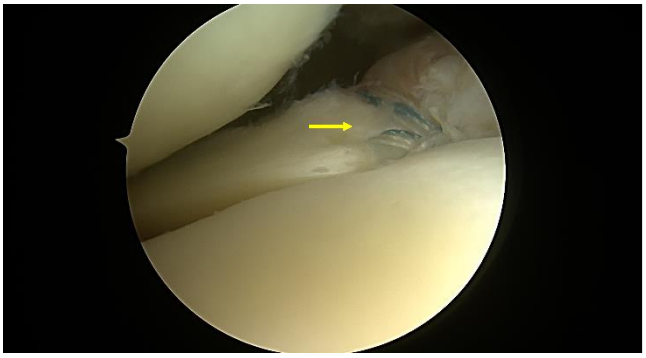

Figure 7. Right knee. Arthroscopic view through the antrolateral portal. The yellow arrow indicates anatomic reduction of the lateral meniscus posterior root tear

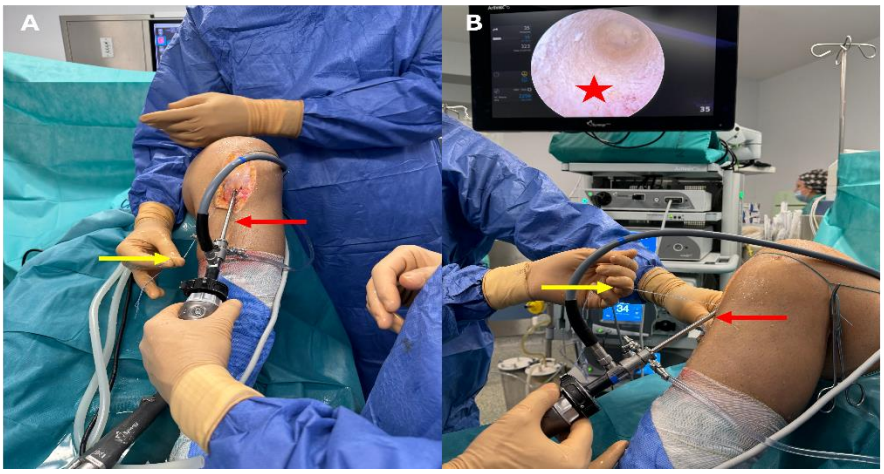

Figure 8. Left knee at 90° of flexion. A. Outside anterior view. B. Outside lateral view. The red arrow indicates the arthroscope that is introduced into the anterior cruciate ligament tibial tunnel. The yellow arrow indicates the repair root suture exiting the root tibial tunnel. The red asterisk indicates the arthroscopic view of the anterior cruciate ligament tibial tunnel

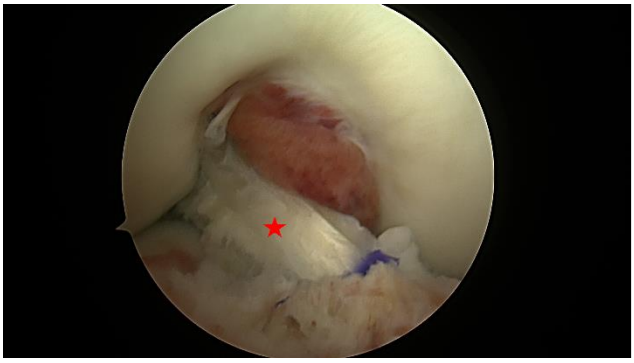

Figure 9. Right knee. Arthroscopic view through the antrolateral portal. The anterior cruciate ligament graft (red asterisk) has been passed and fixed

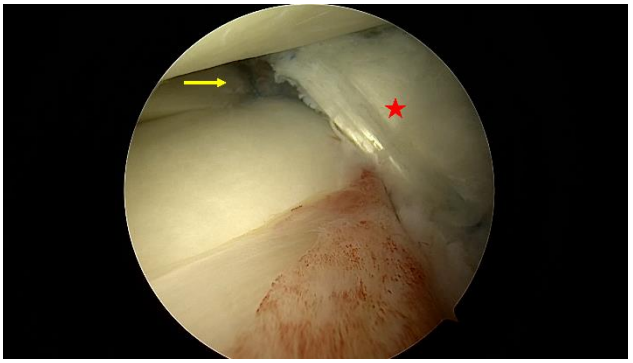

Figure 10. Right knee. Arthroscopic view through the antrolateral portal. Final check of the anterior cruciate ligament graft (red asterisk) and the lateral meniscus posterior root tear repair (yellow arrow)

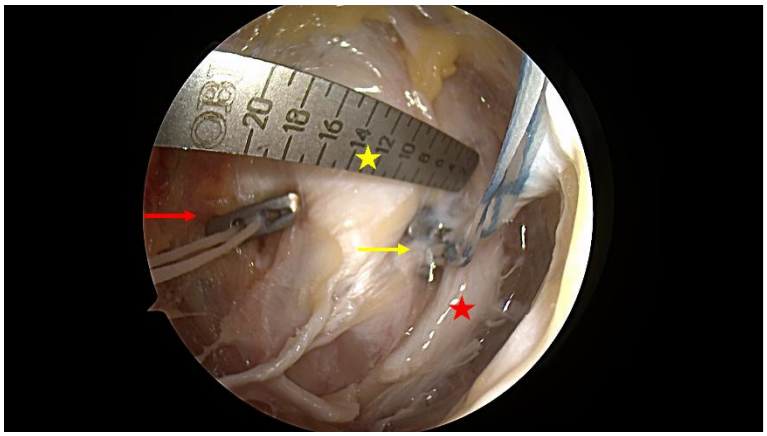

Figure 11. Right knee. Outside view of the anteromedial tibial cortex. The ruler (yellow asterisk) measures the distance (Bone Bridge) between the anterior cruciate ligament button (red arrow) and the root button (yellow arrow). The red asterisk indicates the medial collateral ligament

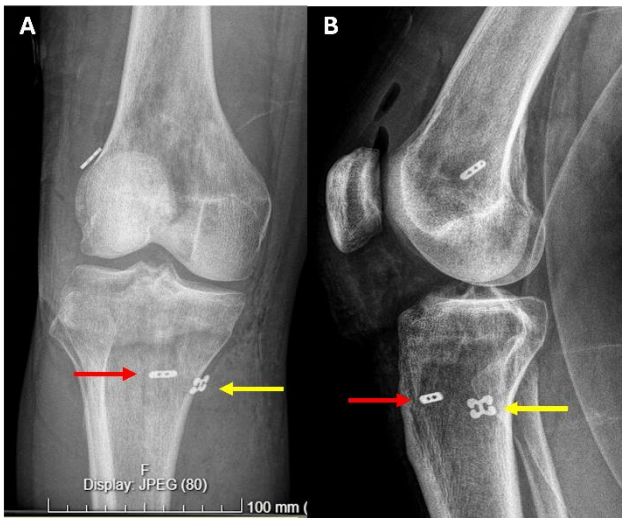

Figure 12.Radiographs on the first postoperative day. A. Anteroposterior view. B. Lateral view. The red arrow indicates the anterior cruciate ligament button, and the yellow arrow indicates the root button

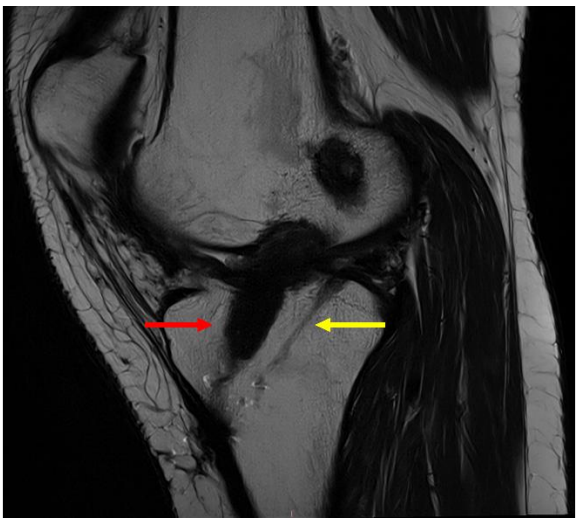

Figure 13. Postoperative MRI (magnetic resonance imaging) at 6 months. PD (proton density), TSE (turbo spin echo), sagittal view. The red arrow indicates the anterior cruciate ligament tunnel, and the yellow arrow indicates the root tunnel

Postoperative Rehabilitation

Postoperatively, early knee full extension and quadriceps activation are advised with the aid of physiotherapy. Knee flexion is restricted to 90° with a brace, and the patients are allowed to walk with crutches and touch-weight-bearing for six weeks. Full weight-bearing and knee range of motion is permitted thereafter, gradually and as tolerated. No squatting and pivoting activities are allowed for four months. Return to unrestricted activities is allowed after completing the physiotherapy program, typically at nine months postoperatively.

Discussion

Several techniques have been described to avoid tunnel convergence in concomitant anterior cruciate ligament reconstruction and transtibial pullout lateral meniscus posterior root tear repair. Zhou et al.[6] proposed lateral meniscus posterior root repair through the anterior cruciate ligament tibial tunnel. The shared tibial tunnel for anterior cruciate ligament reconstruction and root repair poses no risk of tunnel convergence at the expense of a non-anatomic lateral meniscus posterior root reapproximation. Likewise, the utilization of the posterolateral bundle tibial tunnel in the double bundle anterior cruciate ligament reconstruction technique results in a non-anatomic lateral meniscus posterior root repair.[7]

Johannsen et al.[8] reported a distance of 6.2 to 11.0 mm between the lateral meniscus posterior root attachment center and the posterior border of the anterior cruciate ligament tibial footprint. As a result, the shared tunnel technique, besides being non-anatomic, also raises concerns about healing.

Matassi et al.[9] described a root tunnel that is oriented laterally to the tibial tubercle. This technique requires an additional skin incision and may be technically difficult to obtain optimal guide placement in this trajectory. Nlandu et al.[10] proposed a two mm in diameter root tunnel to minimize the chances of tunnel convergence. However, surgeons need to change their drilling technique, and it is still not 100% safe.

The main strength of our technique is that it is applicable to both tibial sockets and full-length tunnels, as well as all drilling techniques. Our technique is based on the position of the drill guides onto the anteromedial tibial cortex. Once the root guide is positioned next to the medial collateral ligament and the anterior cruciate ligament guide is positioned next to the tibial tubercle, an adequate bone bridge is obtained between the two tunnels. This is confirmed with direct measurement of the distance of the pins, at both the joint surface and the tibial anteromedial cortex. Moreover, direct visualization of the anterior cruciate ligament tunnel during drilling of the root tunnel eliminates any possibility of tunnel convergence.

The primary limitation of our technique is that it requires an arthroscopic ruler, which is not always readily available. In this case, a calibrated probe can be used as an alternative. It may also result in a slightly increased surgical duration. However, it is a reproducible technique that can reliably and consistently confirm the avoidance of tunnel overlap, which may compromise graft integrity or impair fixation of the anterior cruciate ligament graft and lateral meniscus posterior root repair.

Conclusion

Our technique has no learning curve, as it does not require any additional surgical steps. In our hands, and in thirty-six consecutive patients over the last eight years, we have had zero cases of tunnel convergence following anterior cruciate ligament reconstruction and transtibial pull-out lateral meniscus posterior root repair. Additionally, no adverse events or technique-related complications were encountered. Of course, the sufficiency and safety of our technique need to be confirmed by other centers as well.

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N/A

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