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Advances in Posterior Knee Arthroscopy for Cruciate Ligament Reconstruction: Portal Techniques, Fixation Strategies, and Clinical Outcomes

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Abstract

Background: Posterior knee arthroscopy using posteromedial, posterolateral, and trans-septal portals has significantly enhanced cruciate ligament reconstruction. These portals improve visualization, allow anatomic tunnel placement, and facilitate remnant-preserving techniques, particularly for posterior cruciate ligament (PCL) and anterior cruciate ligament (ACL) reconstructions.

Purpose: To review current concepts and techniques in posterior knee arthroscopy for ligamentous reconstruction, and to highlight innovations developed by the lead author in fixation methods and anatomical visualization.

Methods: A narrative review of the literature was performed, focusing on biomechanical, anatomical, and clinical data related to posterior knee portals. Emphasis was placed on three key innovations: anterior tibial suspensory fixation for PCL, trans-septal visualization of the femoral ACL footprint, and tibial tunnel placement guided by posterior foveal landmarks. Findings from the author's published studies were integrated.

Results: Posterior arthroscopy enables accurate anatomic reconstruction with improved visualization of both tibial and femoral footprints. Suspensory anterior tibial fixation avoids posterior complications and reduces killer turn stress. Trans-septal visualization improves femoral tunnel accuracy, while fovea-based tibial tunnel targeting provides radiation-free precision. Clinical outcomes show high graft survival, improved proprioception, and low complication rates.

Conclusion: Posterior knee arthroscopy plays a pivotal role in cruciate ligament reconstruction, offering superior anatomical access and technical advantages. The author's techniques further enhance safety and efficiency in surgical execution. Surgeons should be proficient in posterior portal establishment and its associated strategies to optimize outcomes

Keywords: Posterior Arthroscopy; PCL Reconstruction; ACL Footprint; Posterior Portals; Suspensory Fixation; Trans-Septal Portal

Abbreviations: PCL: Posterior Cruciate Ligament; ACL: Anterior Cruciate Ligament; PL: Posterolateral; PM: Posteromedial

Level of Evidence: Level V – Expert Opinion / Narrative Review

Introduction

Posterior knee arthroscopy-via posteromedial (PM), posterolateral (PL), and trans-septal portals—has become an essential component of modern cruciate ligament surgery, particularly for posterior cruciate ligament (PCL) and anterior cruciate ligament (ACL) reconstructions. These portals offer enhanced visualization, more accurate anatomical tunnel placement, and facilitate remnant-preserving techniques [1-3] (Figures 1 & 2). Early arthroscopic approaches were limited to anterior viewing, which restricted access to the posterior tibial insertion and required indirect, often imprecise tunnel placement.

The evolution of posterior portals, especially the trans-septal approach, has addressed these limitations [4]. When appropriately used, these portals enable safe, accurate, and reproducible access to posterior structures [5]. The posterior arthroscopic approach also enhances remnant preservation, a strategy associated with improved proprioception, graft healing, and functional outcomes [6]. This review integrates key published literature and highlights specific innovations from the senior author's contributions to the field.

Author Contributions: Key Innovations

Anterior Tibial Suspensory Fixation in PCL Reconstruction

Elazab et al. described a novel technique using suspensory fix-

ation on the anterior tibial cortex for PCL graft fixation [4]. This technique avoids the need for posterior screw fixation, thereby reducing the risks associated with the "killer turn" and posterior tibial wall blowout. It also simplifies rehabilitation due to improved graft protection (Figure 3).

Figure 1: Portal placement for posterior knee arthroscopy. Surface anatomy of a right knee demonstrating posteromedial (PM), posterolateral (PL), and trans-septal portal sites. These portals provide direct access to the posterior compartments and allow safe triangulation around the PCL and meniscal roots.

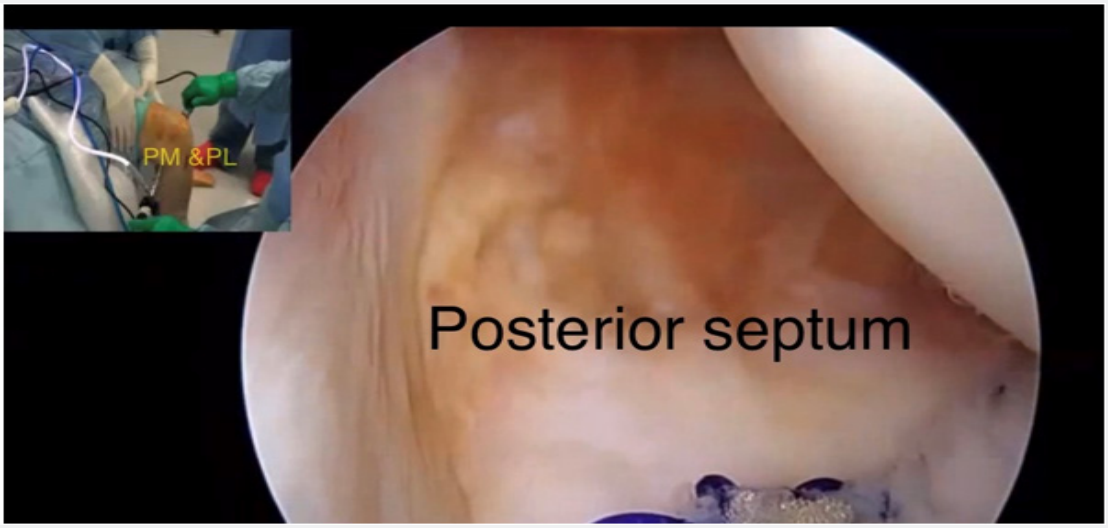

Figure 2: Establishment of the posterior trans-septal portal. Arthroscopic view from the posteromedial portal showing the creation of the trans-septal tunnel using a blunt trocar passed through the septum toward the posterolateral compartment, enabling 360° visualization of the posterior tibial plateau.

Trans-Septal Portal for Femoral ACL Tunnel Visualization

In another study, the authors employed a trans-septal portal to directly visualize the femoral ACL footprint during tunnel drilling[5]. This method improved anatomical tunnel creation and was particularly beneficial in revision or distorted anatomy cases (Figure 4).

Tibial Tunnel Placement Using Posterior Fovea Landmark

A comparative study by Kim, Elazab, and Kang evaluated tibial tunnel placement using the posterior fovea as a bony landmark instead of fluoroscopy [6]. The landmark-based technique showed superior accuracy, reproducibility, and eliminated radiation exposure (Figure 5).

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Figure 3: Suspensory fixation of the PCL graft from the anterior tibial cortex. Intraoperative arthroscopic image demonstrating the PCL graft looped and fixed anteriorly using a Tight Rope button device. This technique avoids posterior screw fixation and reduces killer turn stress on the graft.

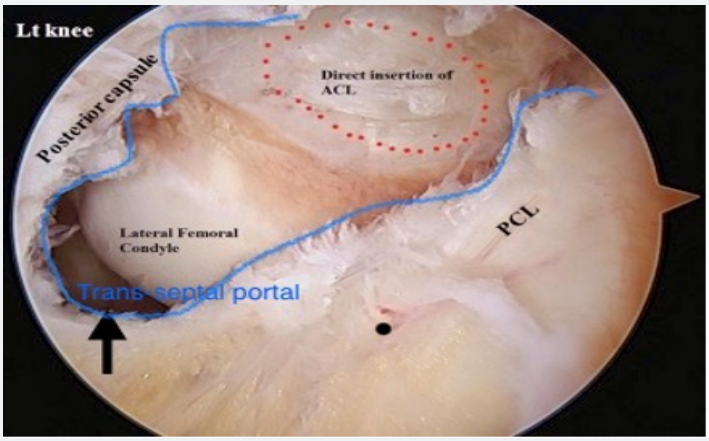

Figure 4: Visualization of the femoral ACL footprint via posterior trans-septal portal. The arthroscope placed through the posterolateral portal clearly shows the anatomical ACL femoral insertion. This view allows precise femoral tunnel placement, especially useful in revision cases or distorted anatomy.

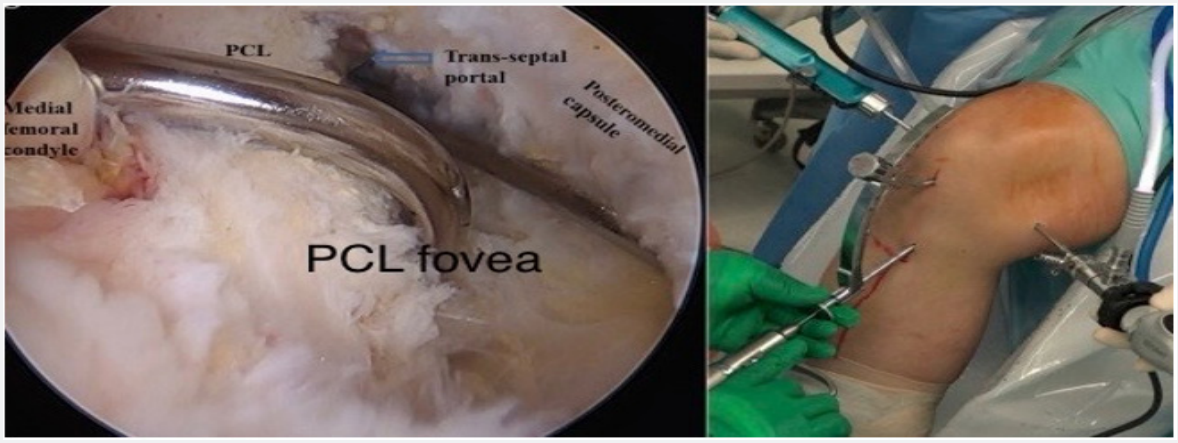

Figure 5: Tibial tunnel placement using the posterior fovea landmark. An arthroscopic view showing a guide pin positioned at the posterior tibial footprint using the posterior intercondylar fovea as a consistent landmark. This method improves tunnel accuracy without the need for intraoperative fluoroscopy.

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Biomechanical and Anatomical Considerations

Posterior portals provide surgeons with direct access to the posterior tibial plateau, enabling more accurate anatomical graft placement [7-9]. Anatomical tunnel creation reduces graft tension and minimizes angular stress. Suspensory fixation on the anterior cortex also benefits from stronger cortical bone and avoids disruption of the posterior tibial wall [4]. The use of PM and PL portals in conjunction with a trans-septal connection allows for 360° access to posterior structures, crucial for precise tunnel positioning and remnant sparing techniques [10].

Clinical Outcomes

Posterior arthroscopy techniques have shown favorable clinical outcomes in both ACL and PCL reconstructions. Studies report significant improvements in Lysholm and IKDC scores, reduced posterior laxity, and high return-to-sport rates when posterior portals and remnant preservation strategies are employed [7-12]. The reported complication rate from properly executed trans-septal portal techniques is low, with no neurovascular injuries in large series [13-14]. Use of posterior visualization improves graft positioning, reduces the killer-turn angle, and enhances healing biology.

Discussion

Posterior knee arthroscopy has revolutionized the treatment of posterior compartment pathology, especially for cruciate ligament reconstruction. The introduction of the trans-septal portal provided unparalleled access, allowing for true anatomical reconstruction of both ACL and PCL tunnels [10-14]. When the knee is flexed beyond 90°, the neurovascular bundle safely migrates posteriorly, creating a secure corridor for portal creation [15-20]. Posterior arthroscopy also supports: Anatomic tibial tunnel creation, which minimizes graft abrasion and improves tunnel-to-footprint alignment [6-7].

Suspensory tibial fixation on the anterior cortex, which avoids the posterior killer turn, enhances cortical grip, and reduces surgical time [4]. Trans-septal visualization of the femoral ACL footprint, particularly valuable in revision surgery [5]. These innovations lead to better biomechanical outcomes and improved graft integration [9-12]. Despite these advancements, challenges remain. There is a learning curve associated with posterior portal use, and complications can occur if anatomical landmarks are not respected [9-11]. Therefore, cadaveric simulation and structured training should be incorporated into orthopedic education.

Conclusion

Posterior arthroscopy using PM, PL, and trans-septal portals represents a major advancement in anatomical ligament reconstruction. It allows for precise tunnel placement, supports remnant preserving strategies, and facilitates improved graft healing and biomechanical strength. The contributions of Dr. Elazab and colleagues-particularly in anterior tibial suspensory fixation, landmark-guided tunnel drilling, and posterior femoral visualization—have expanded the utility and safety of posterior knee arthroscopy in clinical practice.

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