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Anatomical considerations for posterolateral corner injections of the knee

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Summary. Background. Injections into the posterolateral corner (PLC) of the knee are effective for treating or diagnosing lateral and rotational knee pathologies. However, due to the intricate anatomy and proximity of neurovascular structures, precision is essential. This study aims to identify anatomically safe zones for PLC knee injections and evaluate dye distribution with respect to critical neurovascular structures. **Methods.** Ten cadaveric knees (5 left and 5 right) without pathological lesions were dissected in the Anatomy Laboratory of the Health Sciences University Gulhane Medical Faculty. Anatomical landmarks and the injection procedures were documented through video recording. Additionally, a topographic anatomy demonstration was performed using a volunteer who had provided informed consent. **Results.** The video recording clearly illustrated critical anatomical structures of the PLC and their relationships during injection procedures. In all 10 cadaver knees, targeted injections were completed without dye leakage toward vital neurovascular bundles such as the common peroneal nerve or vascular structures. This anatomical preservation was confirmed visually and documented. Topographic equivalents were also demonstrated on a volunteer with informed consent. No dye spread was observed toward critical neurovascular structures in any of the 10 specimens. **Conclusions.** PLC injections are high-precision procedures that require detailed anatomical knowledge. Mastery of key landmarks significantly improves the safety and effectiveness of the procedure.

Key words. Posterolateral corner, knee, landmarks, injection, instability, video-based.

Considerazioni anatomiche per le iniezioni nell'angolo posterolaterale del ginocchio

Riassunto. Background. Le iniezioni nell'angolo posterolaterale (PLC) del ginocchio sono efficaci per il trattamento o la diagnosi delle patologie laterali e rotazionali del ginocchio. Tuttavia, a causa dell'anatomia complessa e della vicinanza di strutture neurovascolari, la precisione è essenziale. Questo studio mira a identificare zone anatomicamente sicure per le iniezioni del PLC del ginocchio e a valutare la distribuzione del colorante rispetto alle strutture neurovascolari critiche. **Metodi**. Dieci ginocchia di cadavere (5 sinistre e 5 destre) prive di lesioni patologiche sono state sezionate presso il Laboratorio di Anatomia della Facoltà di Medicina dell'Università di Scienze della Salute di Gulhane. I punti di repere anatomici e le procedure di iniezione sono stati documentati tramite registrazione video. Inoltre, è stata eseguita una dimostrazione di anatomia topografica utilizzando un volontario che ha fornito il consenso informato. **Risultati**. La registrazione video ha illustrato chiaramente le strutture anatomiche critiche del PLC e i loro rapporti durante le procedure di iniezione. In tutte le 10 ginocchia di cadavere, le iniezioni mirate sono state completate senza perdite di colorante verso fasci neurovascolari vitali, come il nervo peroneo comune o le strutture vascolari. Questa preservazione anatomica è stata confermata visivamente e documentata. Gli equivalenti topografici sono stati dimostrati anche su un volontario previo consenso informato. In nessuno dei 10 campioni è stata osservata una diffusione del colorante verso strutture neurovascolari critiche. **Conclusioni**. Le iniezioni nel PLC sono procedure ad alta precisione che richiedono una conoscenza anatomica dettagliata. La padronanza dei principali punti di repere migliora significativamente la sicurezza e l'efficacia della procedura.

Parole chiave. Angolo posterolaterale, ginocchio, punti di repere, iniezione, instabilità, basato su video.

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Introduction

Over the past two decades, the understanding of PLC injuries has significantly advanced. This region, often referred to as "the dark side of the knee", consists of numerous structures[1,2]. These structures contribute to both the dynamic and static stabilization of the knee. Three primary static stabilizers of the knee include the lateral (fibular) collateral ligament (LCL), the popliteus tendon (PLT), and the popliteofibular ligament (PFL). Secondary stabilizers are fabellofibular ligament (FFL), iliotibial band (ITB), lateral gastrocnemius tendon (LGT), lateral capsular thickening with meniscofemoral and meniscotibial ligaments, and the short and long heads of biceps femoris tendon (BFT)[2-6]. Although the anterolateral ligament (ALL) differs anatomically from other structures, it may be considered functionally related[2]. Disruption of any of these structures may result in injuries to the primary static stabilizers of the knee, known as PLC injuries. According to Fanelli's classification, PLC injuries are divided into three types: Type A: Injury to the PLT and the PFL only; Type B: Type A injuries plus LCL injury; Type C: Injury involving all three major stabilizers (LCL, PFL, and PLT). According to the Hughston classification: Grade 1: 0-5 mm varus opening; Grade 2: 5-10 mm varus opening; Grade 3: greater than 10 mm varus opening[7,8].

PLC injuries account for approximately 16% of all knee ligament injuries[9,10]. PLC injuries are frequently associated with cruciate ligament injuries[9,11]. Only 28% of PLC injuries occur in isolation[9]. Neurological [e.g., common peroneal nerve (CPN)] and vascular injuries frequently accompany PLC injuries, particularly in cases of knee dislocation. Meniscal and cartilage injuries are also commonly observed[12-14]. Due to these complex injury patterns, challenges in diagnosis and treatment are common[14]. If early diagnosis is delayed, particularly in athletes, the treatment process is prolonged, and both rehabilitation and return-to-sport timelines are adversely affected[4,10]. Initial treatment of Stage I and II PLC injuries typically involves conservative management, focusing on edema control, maintenance of range of motion, and muscle strengthening, similar to protocols for other sports injuries. Stage III injuries typically require surgical intervention, followed by a structured rehabilitation program[15,16]. Athletes generally may not return to sports before 8 months post-surgery, with recovery often extending to 9-12 months[17].

Patients with combined acute or chronic PLC and cruciate ligament injuries generally require surgical treatment to prevent recurrent instability and cruciate ligament failure[15,16]. Untreated Stage I and II PLC injuries may progress to greater instability and more severe injury compared to cases treated promptly[16]. Preventing instability by preserving the function of both primary and secondary stabilizers is critical. Early treatment and careful rehabilitation of these structures following injury are essential. While conservative measures such as edema control, range of motion exercises, and muscle strengthening are well established, injection therapies present unique anatomical challenges due to variations and the proximity of critical neurovascular structures. For this reason, the application of injections such as hypertonic dextrose, platelet rich plasma, ozone, collagen or any regenerative therapies with the prolotherapy technique, which is frequently used by sports physicians, remains challenging. Numerous studies have investigated diagnosis process and surgical procedures due to the difficulty of diagnosis and treatment of PLC[5,16,18-20].

Although several techniques for PLC injections have been described, their clinical applicability is often limited by anatomical complexity and a lack of standardization. Traditional landmark-based methods may yield inconsistent results, while ultrasound-guided approaches require significant operator experience. Moreover, there remains a scarcity of visual or video-assisted protocols to facilitate effective learning. This study aims to identify anatomically safe zones for PLC knee injections and evaluate dye distribution with respect to critical neurovascular structures.

Patients and methods

This was a cadaveric study approved by the Institutional Review Board and conducted in accordance with the principles of the Declaration of Helsinki. As the study was performed on cadaveric specimens, informed consent for participation was not required.

A total of 10 knees (5 left, 5 right) obtained from cadavers without apparent lesions or deformities were dissected at the Anatomy Laboratory of Gulhane Medical Faculty, University of Health Sciences.

The dissection protocol: cadavers were placed in the prone position. A vertical incision was made along the popliteal fossa, with two horizontal incisions above the femoral and below the tibial condyles. Subcutaneous tissue was reflected to expose the fascia laterally.

The biceps femoris tendon was first dissected to identify the LCL beneath it, extending to the fibular head. The lateral head of the gastrocnemius and the plantaris muscles were visualized at their origins.

Deeper dissection revealed the PFL and arcuate ligament. The popliteus muscle and its tendon were identified anterior to the LCL. The joint capsule was opened posteriorly to observe structural relationships.

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Special care was taken to preserve and visualize the CPN. During injections, anatomical structures were repositioned to their native anatomical positions.

The injection protocol: to evaluate injectate distribution, a mixture of 1 part methylene blue and 9 parts 5% dextrose was prepared. A 27G needle was used to inject the following sites: LCL origin and insertion, biceps femoris insertion, gastrocnemius origin, PLT, ALL and ITB insertions.

No dye spread was observed toward critical neurovascular structures in any of the 10 specimens.

Video Recording: The procedure was recorded using DJI Osmo Pocket 3 (4K, 60 fps). Post-production editing was completed with iMovie software. Although some positional shifts occurred in cadaveric tissue, the selected specimen used for the video clearly displayed vascular and neural structures and was chosen specifically for this visibility.

Results

The video recording (video 1*) clearly illustrated critical anatomical structures of the PLC and their relationships during injection procedures.

In all 10 cadaver knees, targeted injections were completed without dye leakage toward vital neurovascular bundles such as the CPN or vascular structures.

This anatomical preservation was confirmed visually and documented. Topographic equivalents were also demonstrated on a volunteer (figure 1) with informed consent.

Discussion

The PLC of the knee is a complex anatomical region composed of static and dynamic stabilizers that resist varus stress and external rotational forces of the tibia. A thorough understanding of this area is essential to minimize complications during clinical procedures. The key structures, their locations, functions, and clinical relevance within the PLC are summarized in table 1.

Injection procedures can be performed in two distinct methods: the landmark-based approach and the ultrasound-guided approach. The patient is positioned in a supine or lateral decubitus position with slight knee flexion, as indicated by the landmark-based approach. The fibular head, lateral joint line, and lateral femoral epicondyle are palpable anatomical structures. The needle pathway is characterized by a lateral-to-medial trajectory, directing anteriorly and superiorly towards the fibular head. The target areas for these injections are determined by the specific clinical indication and may include the LCL or adjacent soft tissues.

Ultrasound visualization of target structures (particularly the LCL, popliteus, and PFL), real-time needle guidance be employed, with the aim of avoiding the CPN and vascular structures is strongly recommended.

The injected volume may be adjusted according to the target structure and patient characteristics. The typical range for this adjustment is from 1 to 3 milliliters (mL).

Complications to be avoided

Care should be taken to avoid deep posterior needle placement near the fibular neck, as this may result in a CPN injury. To prevent ineffective injections, it is first necessary to confirm anatomical landmarks or, alternatively, employ ultrasound. It is imperative to avoid vascular injection. Prior to injection, it is essential to perform aspiration.

Advantages of the video-guided application

The anatomical complexity of the PLC, with its dense concentration of neurovascular and ligamentous structures, presents significant challenges during injections. Traditional landmark-based injection techniques, while widely practiced, often

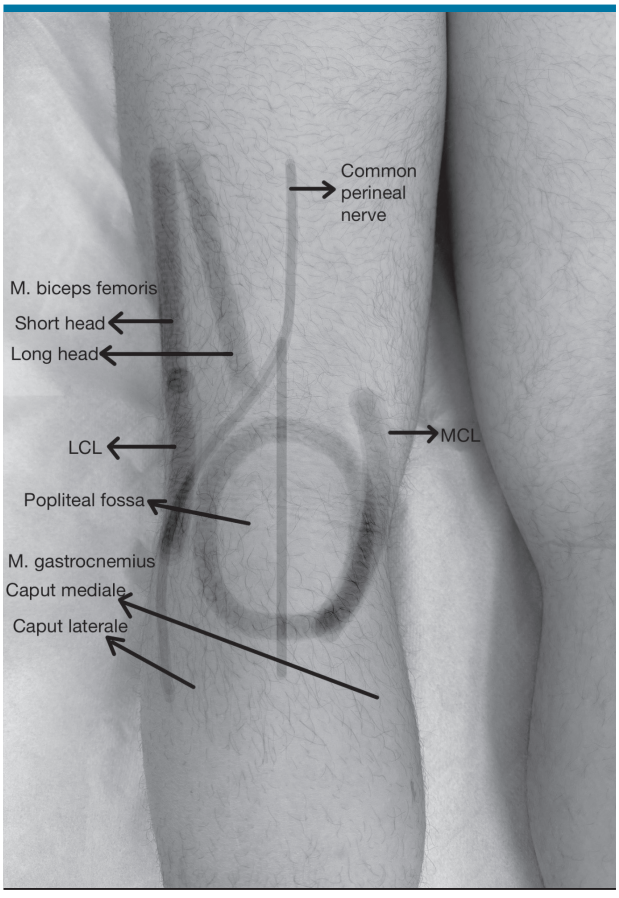

Figure 1. Topographic anatomy of posterior side of the knee.
LCL: Lateral Collateral ligament; MCL: Medial Collateral ligament.

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Table 1. The structures, locations, functions and the importance of the PLC.

Structures	Location	Function	Clinical/Injection Relevance
Fibular Head	Lateral aspect of the proximal fibula; easily palpable.	Serves as a primary bony landmark. The common peroneal nerve wraps around it just posteriorly.	Always approach anterior or superior to this structure to avoid nerve injury.
Lateral Collateral Ligament (LCL)	Origin: lateral femoral epicondyle. Insertion: Near the fibular head (approximately 8 mm posterior to its anterior border).	Primary restraint to varus stress.	The LCL is often targeted in injections for lateral instability or chronic strain.
Popliteus Tendon	Arises from the posterior tibia, curves around the lateral femoral condyle, and passes between the lateral meniscus and the capsule.	Dynamic stabilizer, especially during internal tibial rotation.	Injection Relevance: can be involved in deep PLC pain or tendinopathy.
Popliteofibular Ligament (PFL)	Origin: musculotendinous junction of the popliteus muscle. Insertion: Fibular styloid process.	Primary static restraint against external tibial rotation.	Often injured in conjunction with LCL and popliteus injuries.
Iliotibial Band (ITB)	Superficial structure on the lateral aspect.	Depends on the position of the knee active extensor or flexor.	Not a major concern during PLC injection but can be a guide for orientation.
Common Peroneal Nerve (CPN)	Wraps posteriorly around the neck of the fibula.		Clinical Danger: vulnerable to direct trauma or iatrogenic injury during poorly placed injections. Recommendation: always palpate and identify the course of the nerve before approaching the fibular head.

result in inconsistent accuracy and a steep learning curve. In this context, video-guided instruction offers a reproducible and highly visual method to standardize procedural steps across practitioners. The visual nature of video allows for better spatial understanding of needle trajectory and anatomical relationships, thereby reducing technical variability and enhancing procedural confidence, particularly among less experienced clinicians. These findings align with previous studies demonstrating that video-based learning tools improve both short-term procedural accuracy and long-term skill retention[21,22].

One of the major advantages observed in this study was the reduction in procedural errors and complications associated with blind or palpation-based approaches. By enabling real-time demonstration of proper needle positioning, angle, and depth, video-assisted protocols may significantly enhance the safety profile of PLC injections. This is especially relevant given the anatomical complexity of the region, where inadvertent injury to the CPN or surrounding vascular structures may result in serious complications. Our results support prior literature suggesting that video-assisted techniques in musculoskeletal interventions are associated with improved patient outcomes and reduced complication rates[22].

Beyond clinical settings, video-guided techniques provide considerable value in educational environments. Medical trainees and early-career practitioners often benefit from the ability to replay procedures, analyze step-by-step instructions, and compare their own performance to established standards. This reflective learning model not only reinforces procedural knowledge but also promotes self-assessment and continuous improvement. In this study, the integration of video instruction was perceived as highly beneficial by participants, echoing previous findings that support video-based education as a preferred modality in procedural skill acquisition[22,23].

Despite critiques regarding positional distortion in cadaveric specimens, the video demonstration used in this study was selected precisely because of its exceptional clarity of vascular and nerve structures. Although minor positional changes occurred, the anatomical features remained sufficiently distinguishable for procedural training and documentation.

Implications for clinical practice

The video-guided injection technique described in this study offers substantial potential benefits for routine clinical practice. In particular, injections targeting the PLC of the knee often pose challenges due to complex anatomical configurations. A visually standardized protocol may not only enhance injec-

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tion accuracy but also reduce inter-practitioner variability, thereby improving patient safety. This method also represents a viable alternative in settings where advanced imaging modalities, such as ultrasound, are not readily available. Furthermore, it may serve as an effective educational tool, supporting the skill development of novice clinicians. The integration of this technique into clinical workflows could shorten the learning curve and promote safer, more efficient injection practices.

Limitations

The effectiveness of video-based instruction depends partially on the practitioner's prior experience and familiarity with knee anatomy. In complex regions such as the PLC, visual guidance alone may not suffice, and some practitioners may require supplementary supervision. Furthermore, the technical quality of the instructional videos (including resolution, camera angle, and lighting) may significantly influence the viewer's ability to identify relevant anatomical landmarks. Variability in user interpretation may therefore affect the reproducibility of the technique. Future research involving larger and more diverse participant groups is necessary to validate the widespread applicability of video-assisted injection techniques.

Conclusions

Posterolateral knee injections are high-precision procedures that demand a thorough understanding of the PLC anatomy. Mastery of key landmarks, such as the fibular head, LCL, and PLT, combined with careful identification of the CPN, is essential for safe and effective practice. The use of ultrasound guidance further improves injection accuracy and minimizes complications, and is recommended whenever available.

Given these findings, video-assisted injection protocols could be valuable additions to training curricula in orthopedic and sports medicine fields. Future studies should aim to quantify reductions in learning curves and assess the long-term retention of procedural skills among trainees.

Conflicts of interest. The authors declare there is no conflict of interest.

Authors' contributions. Project development, data collection, manuscript writing: AO; data collection, manuscript editing: NE; data collection: ZD.

Ethical statement. Health Sciences University Gulhane Scientific Research Ethics Committee's decision dated 03/06/2025 and numbered 2025/321. There is no need for the consent to participation. Clinical trial number: not applicable.

**Availability of data and materials.* Video 1: https://drive.google.com/file/d/1FluhF_5L8GTVtaXLsumM5UK3i-fA-Heq/view?usp=drive_link

References

1. James EW, LaPrade CM, Johannsen AM, LaPrade RF. Anatomy and biomechanics of the posterolateral and posteromedial corners of the knee and their surgical ımplications. In: Posterior cruciate ligament ınjuries. Cham, Switzerland: Springer International Publishing; 2015: 33-45.
2. LaPrade RF, Floyd ER, Carlson GB, Moatshe G, Chahla J, Monson J. The posterolateral corner: explanations and outcomes. J Arthrosc Surg Sport Med 2021; 2: 108-18.
3. John JT, Divya G. Posterolateral corner ınjuries of knee. Kerala J Orthop 2021; 34: 50-5.
4. Raheem O, Philpott J, Ryan W, O'Brien M. Anatomical variations in the anatomy of the posterolateral corner of the knee. Knee Surgery, Sport Traumatol Arthrosc 2007; 15: 895-900.
5. Olewnik Ł, Gonera B, Kurtys K, et al. Classification of the popliteofibular ligament. Clin Anat 2022; 35: 375-82.
6. Standring S. Gray's Anatomy. 41th ed. London: Churchill Livingstone, 2015.
7. Lunden JB, Bzdusek PJ, Monson JK, Malcomson KW, Laprade RF. Current Concepts in the recognition and treatment of posterolateral corner ınjuries of the knee. J Orthop Sport Phys Ther 2010; 40: 502-16.
8. Negus JJ, Haddad FS. Posterior cruciate ligament, posterolateral corner and multiligament knee ınjuries. In: Rodríguez-Merchán EC, Liddle AD, eds. Joint preservation in the adult knee. Cham, Switzerland: Springer International Publishing; 2017: 91-112.
9. Dean RS, LaPrade RF. ACL and posterolateral corner ınjuries. Curr Rev Musculoskelet Med 2020; 13: 123-32.
10. Olewnik Ł, LaPrade RF, Paulsen F, et al. A proposal for a new morphological classification of the popliteus muscle tendon with potential clinical and biomechanical significance. Sci Rep 2021; 11: 14434.
11. Perry AK, Knapik DM, Gursoy S, et al. Determining the roles of the anterior cruciate ligament, posterolateral corner, and medial collateral ligament in knee hyperextension using the heel-height test. Orthop J Sport Med 2022; 10: 232596712210866.
12. Chagas-Neto FA. Common peroneal nerve alterations associated with injuries to the posterolateral corner of the knee: how can we contribute? Radiol Bras 2021; 54: 8-9.
13. Marconi GF, Simão MN, Fogagnolo F, Nogueira-Barbosa MH. Magnetic resonance imaging evaluation of common peroneal nerve injury in acute and subacute posterolateral corner lesion: a retrospective study. Radiol Bras 2021; 54: 303-10.
14. Floyd ER, Carlson GB, Monson J, LaPrade RF. Multiple Ligament Reconstructions of the Knee and Posterolateral Corner. Arthrosc Tech 2021; 10: e1269-80.
15. Anderson CJ, Kennedy NI, LaPrade RF. Reconstruction of the posterolateral corner of the knee. In: Sports injuries. Berlin Heidelberg: Springer; 2015: 1417-28.
16. Shon OJ, Park JW, Kim BJ. Current concepts of posterolateral corner ınjuries of the knee. Knee Surg Relat Res 2017; 29: 256-68.
17. Morris BL, Poppe T, Kim K, et al. Weightbearing protocols after posterolateral corner reconstruction: a systematic review. Orthop J Sport Med 2021; 9: 232596712098827.
18. LaPrade RF, Floyd ER, Carlson GB, Moatshe G, Chahla J, Monson JK. Multiple ligament anatomic-based reconstructions of the knee: state- of-the-art. J Arthrosc Surg Sport Med 2021; 3: 18-33.

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19. Franciozi CE, Kubota MS, Abdalla RJ, Cohen M, Luzo MVM, LaPrade RF. Posterolateral corner repair and reconstruction: overview of current techniques. Ann Jt 2018; 3: 89-98.
20. Moran J, Kahan JB, Schneble CA, et al. Repair of acute grade 3 combined posterolateral corner avulsion ınjuries using an enhanced fixation technique. Orthop J Sport Med 2022; 10: 232596712211318.
21. Sbayeh A, Choo MAQ, Quane KA, et al. Relevance of anatomy to medical education and clinical practice: perspectives of medical students, clinicians, and educators. Perspect Med Educ 2016; 5: 338-46.
22. Jang CW, Bang M, Park JH, Cho HE. Value of online videos as a shoulder ınjection training tool for physicians and usability of current video evaluation tools. Int J Environ Res Public Health 2022; 19: 15177.
23. Hilty DM, Groshong LW, Coleman M, et al. Best practices for technology in clinical social work and mental health professions to promote well-being and prevent fatigue. Clin Soc Work J 2023; 51: 211-45.

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