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Review Article

Posterolateral corner of the knee "the mysterious corner": a review of anatomy, biomechanics and current treatment paradigms

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ABSTRACT

The posterolateral corner (PLC) of the knee remains one of the most complex and often underdiagnosed stabilizing units of the knee joint. Injuries to the PLC are frequently overlooked, contributing to chronic instability, early onset osteoarthritis and increased likelihood of total knee arthroplasty. Recent anatomical and biomechanical studies have highlighted the critical role of the PLC in maintaining knee stability, particularly in resisting varus stress, external tibial rotation and posterior translation. This review aims to consolidate current knowledge on the anatomy and biomechanics of the PLC, epidemiological trends and evolving management strategies, including anatomical reconstruction techniques and arthroscopic advancements. It emphasizes the necessity for heightened clinical suspicion, accurate diagnosis and appropriate treatment to prevent long-term disability.

Keywords: Arthroscopy, Fibular collateral ligament, Knee instability, Posterolateral corner, Popliteus tendon, Popliteofibular ligament, Reconstruction

INTRODUCTION

Knee joint stability is essential for functional ambulation and quality of life. It is governed by an intricate balance between static and dynamic stabilizers.[1] The posterolateral corner (PLC) complex, although first described decades ago, has only recently gained prominence in clinical Orthopaedics due to its complex anatomy and challenging diagnosis.[2] Neglected PLC injuries can lead to devastating consequences including chronic instability, varus thrust, progressive osteoarthritis and early need for total knee arthroplasty.[3,4]

Despite growing awareness, PLC injuries remain underdiagnosed with an average delay in diagnosis estimated to be over two years in some cohorts. The purpose of this review is to provide a comprehensive overview of the PLC's anatomy, biomechanics, injury patterns and management strategies, with a focus on evidence-based interventions.[5,6]

EPIDEMIOLOGY

Historically considered rare, PLC injuries are now recognized more frequently due to improved imaging and better clinical awareness. In MRI-based studies, PLC injury was found in up to 16% of patients with acute knee injuries, often in combination with cruciate or collateral ligament injuries.[7] Isolated PLC injuries are uncommon (approximately 2%) and are typically associated with high-energy trauma such as sports injuries or motor vehicle accidents.[7] Chronic PLC insufficiency, often resulting from unrecognized acute injuries, contributes significantly to functional impairment and joint degeneration.[8]

ANATOMY AND BIOMECHANICS

The PLC functions as a dynamic functional unit composed of static and dynamic stabilizers that resist varus stress, external rotation and posterior tibial translation.[9-11]

Static stabilizers (primary function mainly)

Fibular collateral ligament

Primary restraint against varus stress.[9]

Popliteus tendon

Provides external rotational stability at >90° flexion.[12]

Popliteofibular ligament

Assists in resisting external rotation at >90° and anterior translation.[12]

Arcuate complex and posterolateral capsule

Contribute to posterior and varus stability and resist external rotation at lower degrees of knee flexion.[10]

Dynamic stabilizers

Iliotibial band

Resistance to internal rotation is guaranteed by the BFT and superficial layer of the ITB at higher flexion.[13]

Biceps femoris tendon

Assists in resisting internal rotation and anterior translation.[13]

Lateral gastrocnemius muscle

Assists in resisting internal rotation and anterior translation.[13]

Popliteus muscle

Popliteus muscle was defined as “the fifth ligament of the knee” and is considered as both a static and dynamic stabilizer. The PT has the primary function of stabilizing the PLC, especially against external rotation, which is mostly exploited above 90◦.[13] Each component contributes variably across the range of motion. The FCL is taut in early flexion (0–30°), while the PT and PFL become more influential beyond 90°. This complementary shifting of tension ensures continuous joint stabilization throughout motion. Biomechanically, the PLC reduces the strain on the posterior cruciate ligament (PCL), particularly during posterior translation. The biceps femoris and ITB contribute to anterior stability and internal rotational control.

Mechanism of injury

PLC injuries commonly result from direct varus stress applied to an extended or flexed knee, often during athletic trauma or vehicular accidents. Less commonly, valgus forces or hyperextension injuries may also compromise the PLC. Clinical suspicion should remain high in the presence of varus instability, hyperextension or rotational instability following trauma.

CLINICAL EXAMINATION

Thorough clinical evaluation begins with detailed history-taking and assessment of lower limb alignment. Mechanisms such as varus-directed trauma or external rotation injuries raise suspicion for PLC damage. Tenderness over the posterolateral aspect is often the only early sign.[14] As most PLC injuries are associated with multi-ligament injuries, a comprehensive and layered clinical examination is essential.

Gait analysis

Initial gait examination may reveal varus thrust or hyperextension, which are indicative of chronic PLC insufficiency. Varus alignment can reflect longstanding biomechanical overload of the lateral compartment.[15]

Instability evaluation

Clinical symptoms often include a sense of "giving way," attributed to complex instability patterns. A multi-test approach enhances diagnostic accuracy.[16]

Varus stress test

Laxity at 0° indicates cruciate + FCL injury, laxity at 30° indicates isolated FCL involvement.[17]

Dial test

>10° external rotation at 30° flexion suggests PLC injury, positive at 90° implicates concurrent PCL injury.[18]

Reverse pivot shift test

Audible/palpable clunk during extension due to ITB transition. This test is less reliable alone.[19]

Posterolateral drawer test

Increased posterior and external translation. This test is reliable when compared with other side examination.[20]

External rotation recurvatum test

Indicates combined cruciate and PLC injuries.[20] This has a low sensitivity.

Evaluation of ankle dorsiflexion and peroneal nerve function is crucial due to high incidence (up to 31%) of nerve involvement.[21]

Classification

Weiss et al, categorize PLC injuries into four types based on structures and resulting instabilities.[22] Severity grading (Grade I to III) guides conservative vs surgical decision-making.

When considering cases with intact PCL, the severity of PLC instability may be graded as I, II or III if the lateral joint opening (or external rotation) is 0–5 mm (0–5 degrees), 6–10 mm (6–10 degrees) or above 10 mm (10 degrees), respectively, when compared with the contralateral knee.[2] Grade I injuries and grade II isolated injuries may be treated conservatively, estimating that high-demand patients with grade II injuries may undergo primary surgical repair. Acute and combined grade II injuries (below 3 weeks) may benefit from repair, while grade II and grade III injuries should be assessed for chronicity and the presence of associated malalignment which often indicates eventual staged osteotomy and PLC component reconstruction.[23]

DIAGNOSTIC MODALITIES

Radiographs

Essential for evaluating lower limb alignment and pre-operative osteotomy planning. Stress radiographs with >4 mm joint line asymmetry suggest PLC injury.[24]

Magnetic resonance imaging

MRI is the gold standard for soft tissue evaluation, revealing ligamentous edema, tears and associated injuries. Identification of FCL, PT and PFL is variable, oblique coronal imaging improves visualization.[25]

CT scan

Used to assess bony avulsions, tunnel placement or anatomical variations such as trochlear dysplasia. Low-dose protocols enhance preoperative planning.[26]

Arthroscopy

Diagnostic arthroscopy allows direct visualization of PLC injury through lateral gutter and drive-through signs and facilitates combined treatment approaches.[27]

Conservative management

Grade I and some grade II injuries respond well to conservative treatment. Short-term immobilization followed by progressive rehabilitation may restore function. However, higher-grade injuries often result in suboptimal outcomes without surgical repair.[28]

Conservative management (immobilization for 2–5 weeks) in grade II instability led to full recovery in 82% of cases with an average 88 Lysholm score, while the conservative approach (immobilization for 2–7 weeks) in grade III instability led to a 75% decreased activity level with a mean of a 65 Lysholm score.[29]

Rehabilitation must include neuromuscular control, progressive quadriceps training and sport-specific conditioning.[30]

SURGICAL TECHNIQUES

Surgical techniques are divided into three categories non-anatomic treatment, anatomic reconstruction and arthroscopic reconstruction. The most important surgical reconstructions are summarized in Table 1.

Non-anatomic techniques

Include biceps rerouting, ITB sling and bone block advancements.[31-35] Historically used but currently less favored due to poor restoration of native biomechanics. Failure rates are higher due to limited anatomical fidelity.[36]

Anatomic reconstructions

Aim to replicate native attachments of FCL, PT and PFL. Techniques by Arciero, LaPrade and modified Hughston are widely reported.[37-40] AR provides better functional outcomes but may involve technically demanding open procedures.[41]

Table 1: Summary of advantages and disadvantages of mostly used PLC reconstruction techniques.[31,32]

Author (year)	Approach	Type	Structures reconstructed	Advantages	Disadvantages
Albright et al[42] (1994)	Open	Non-anatomic	PT, FCL	First described reconstruction- Reported outcomes- Does not require extensive expertise	Non-isometric-non-anatomic- Inferior outcomes compared to modern techniques
Kim et al[43] (2001)	Open	Partial-anatomic	PT, FCL	Isometric reconstruction	No true varus stabilization- FCL portion becomes posterior- Requires

Continued.

Author (year)	Approach	Type	Structures reconstructed	Advantages	Disadvantages
					multiple fixations- non-anatomic anterior structure- Risk of peroneal nerve injury
Larson et al[44] (2002)	Open	Partial-anatomic	PT, FCL	Simple technique- Single tunnel on fibula	PFL not reconstructed- Forces concentrated laterally- Risk to peroneal nerve during fibular tunnel drilling
Arciero et al[37] (2005)	Open	Partial-anatomic	PT, FCL	Simple- Single fibular tunnel- Graft passes through different layers	No PFL reconstruction- Lateral force concentration- Risk to peroneal nerve
LaPrade et al[38] (2010)	Open	Anatomic	PT, FCL, PFL	Anatomic reconstruction- Reconstructs all key structures- Good reported outcomes	Complex- Multiple tunnels and fixations- Risk to peroneal nerve
Jang et al[45] (2019)	Arthroscopic	Anatomic	PT, FCL, PFL	Fully anatomic- Minimally invasive- Offers true PLC stability	Technically demanding- Requires arthroscopic expertise- Time-consuming- Risk of peroneal nerve injury

Abbreviations: PT–Popliteus tendon, FCL–Fibular collateral ligament, PFL–Popliteofibular ligament.

Table 2: Comparison of surgical technique, clinical outcomes, graft material used.

Reference	Level of evidence	Technique compared	Follow-up duration	Graft used	Key findings
Yoon et al[46] (2011)	III	Semi-anatomic (Tibiofibular with vs. without PT reconstruction)	24 months	Achilles tendon allograft	Both groups showed improved varus stability, popliteus tendon reconstruction did not influence stability or outcomes.
Van Gennip et al[47] (2020)	IV	Non-anatomic (Larson) vs. Anatomic (LaPrade)	24 months	-	PROMs and varus laxity improved significantly, no significant outcome difference between groups.
Yeatts et al[48] (2021)	IV	Fibular-based (Larson) vs. Tibiofibular-based (LaPrade)	≥12 months	Allograft	Large series (n=943), no significant differences in subjective/objective outcomes between techniques.
Sharma et al[49] (2021)	II	Partial anatomic (Modified Larson) vs. Anatomic (LaPrade)	24 months	Hamstring autograft	Both techniques restored varus and rotational stability, no statistical difference between groups.
Wiess et al[50] (2023)	II	Arthroscopic Arciero vs. Arthroscopic LaPrade	12 months	-	Arciero had better flexion (134.17° vs. 126.60°, p=0.021) and shorter surgery time (p=0.003), PROMs similar, complications: button dislocation (Arciero), arthrofibrosis (LaPrade).
Khalis et al[51] (2023)	IV	Fibular-based vs. Tibiofibular-based	≥24 months	Gracilis/semitendinosus autograft, Achilles/Tibialis posterior allograft	Meta-analysis (n=183), no significant difference in PROMs or stability.

Continued.

Reference	Level of evidence	Technique compared	Follow-up duration	Graft used	Key findings
Fahlbusch et al[52] (2024)	II	Open Arciero vs. Arthroscopic Arciero	14.9±7.2 months	Autologous gracilis (Open Arciero)	No clinical differences, arthroscopic technique had significantly shorter operative time (p=0.0109).
Colatruglio et al[53] (2024)	IV	Tibial-based vs. Fibular-based PLCR	39.6 months	-	No significant differences in PROMs between techniques across four included studies.
Jackson et al[36] (2024)	IV	Anatomic vs. non-anatomic techniques	24 months	Hamstrings, tibialis posterior allograft, biceps tendon autograft	Systematic review (n=230), failure rates 4.3–24.2% (anatomic) vs. 0–36% (non-anatomic), most common complication: arthrofibrosis (0–12.1%).

Table 3. Comparison of different studies and their outcomes.

Comparison group	Outcome summary
Larson vs LaPrade (2 studies)	No significant difference
Modified Larson vs LaPrade	No significant difference
Open Arciero vs Arthroscopic Arciero	Arthroscopic Arciero superior (shorter surgical time)
Arthroscopic Arciero vs Arthroscopic LaPrade	Arthroscopic Arciero superior (shorter time, improved flexion)

Arthroscopic reconstructions

Emerging as a viable, minimally invasive approach. Techniques by Ahn et al, and Kolb demonstrate full reconstruction of PLC structures with promising outcomes. Advantages include reduced surgical time, better visualization and faster recovery, though surgical expertise is critical. Biomechanical analyses suggest no significant difference between fibular-based and tibio-fibular-based reconstructions. Meta-analyses show similar outcomes between open and arthroscopic approaches when performed anatomically.

POSTOPERATIVE REHABILITATION

Tailored rehab protocols are essential. Early phases up to 6 weeks focus on protection and progressive weight bearing. Intermediate phases involve ROM gains and core stabilization.[54-56] Between 7 and 12 weeks, full WB is encouraged and walking aids may be discharged once there is active QM activation and strength, ROM should be further assessed and balance training can be initiated. In this phase, closed-chain exercises and core/endurance are reinforced.[30,57]

Final stages 13-20 weeks emphasize dynamic strength and return to sport. Delayed or immediate full weight bearing may lead to increased complications, progressive loading protocols show the most promise.[57-59] Morris et al, addressed the postoperative management PLC reconstruction with combined ligamentous injuries by comparing immediate WB, progressive WB (partial to full WB by 6 weeks postoperative) and delayed WB (starting 4 weeks postoperative).[60] The time to return to sports did not differ significantly between groups (9 months), however, it tended towards an earlier return in the progressive WB group (6 months). The ongoing research on the PLC would provide a lot of benefit from motion analysis techniques that will help clinicians to understand things better and establishing patient-centred care for better clinical and surgical choice, as well as treatment outcomes.

CONCLUSION

The PLC is a pivotal yet underappreciated stabilizer of the knee joint. A detailed understanding of its anatomy, biomechanics and injury patterns is crucial for effective management. PLC injuries demand early recognition and anatomically focused treatment strategies to restore function and avoid long-term disability. While surgical techniques continue to evolve, anatomical reconstruction remains the gold standard. Arthroscopic advancements offer new horizons, but long-term comparative trials are needed. An individualized, biomechanics-informed approach including patient-centered rehab is key to optimal recovery. Nonetheless, heightened awareness and early intervention remain the cornerstones of successful treatment.

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