ORIGINAL ARTICLE

Anatomical Reconstruction Of Posterolateral Corner In The Knee Injuries

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Abstract

Background: ***Posterolateral corner (PLC) injuries are frequently missed due to their anatomical complexity and common association with cruciate ligament tears. Undiagnosed PLC injuries contribute to failed cruciate ligament reconstructions and accelerated degenerative joint changes. While multiple reconstruction techniques exist, the optimal management remains debated.***

Methods: ***This prospective study evaluated the outcomes of the modified Larson technique in 20 patients with grade III PLC instability at Al-Azhar University Hospitals (October 2022–December 2024). Follow-up assessments included the Dial Test, Varus stress radiographs (quantifying lateral joint gapping), and functional outcomes (Lysholm score and IKDC subjective score).***

Results: ***The cohort comprised 18 males and two females, with a mean follow-up of 13.3 months (range: 12–18). Preoperative varus stress radiographs showed a mean side-to-side difference of 9.3±2.36 mm, improving to 3.3±1.59 mm postoperatively. All patients achieved stability in full extension without adductor thrust during ambulation, except two with residual grade 2 laxity and positive Dial Tests. Functional scores improved significantly: Lysholm (42.25±11.18 to 81.35±10.29; p<0.001) and IKDC (40.6±6.0 to 83.65±9.15; p<0.001).***

Conclusion: ***The modified Larson technique effectively restored varus and rotational stability in grade III PLC injuries, with significant functional improvement. Residual laxity in 10% of cases suggests further refinement may be needed for severe instability.***

Keywords: PLC reconstruction; modified Larson

1. Introduction

The rising incidence of high-energy trauma and sports-related injuries has led to increased recognition of complex knee ligament injuries. Among these, posterolateral corner (PLC) injuries - once termed the "dark side of the knee" - have emerged as critical contributors to failed cruciate ligament reconstructions and persistent instability.[1]

While PLC injuries account for about 16% of ligamentous knee trauma,[2] isolated cases remain rare (2-4% of injuries).[3,4] Their diagnostic challenge stems from both anatomical complexity and frequent association with cruciate ligament damage. Missed and untreated, PLC injuries lead to devastating sequelae, including varus thrust gait, recurrent instability, and accelerated osteoarthritis.[5]

Current reconstruction techniques range from non-anatomic procedures to anatomically oriented approaches. The LaPrade6 method addresses all three primary PLC stabilizers (LCL, popliteofibular ligament, and popliteus tendon), while the modified Larson7 technique focuses on LCL and PFL reconstruction. Despite these options, the best management remains controversial, especially for grade III injuries. This study evaluates the functional and clinical outcomes of the fibula-based modified Larson technique in grade III PLC injuries, providing evidence for its role in managing these complex cases.

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2. Patients and methods

This prospective cohort study was conducted at Al-Azhar University Hospitals, Cairo, Egypt, between October 2022 and December 2024. We evaluated the outcomes of fibula-based modified Larson reconstruction in 20 consecutive patients with grade III posterolateral corner (PLC) instability. The study protocol was approved by the Al-Azhar University Ethical Research Committee, and all participants provided written informed consent after

detailed counseling about the procedure, risks, and benefits.

The Inclusion criteria were grade III injury of PLC (isolated or combined with other ligamentous injuries),Physically active prior to injury, and Closed knee injury.

The Exclusion criteria were advanced osteoarthritis (Kellgren-Lawrence grade ≥3), Open knee injuries or prior PLC surgery, Generalized hyperlaxity (Beighton score ≥4), and Severe bony varus malalignment (>5° mechanical axis deviation).

Preoperative Evaluation: All patients underwent a comprehensive assessment:

Clinical examination:

Through history taking and analysis of the complaint, patient's activity and athletic participation, varus and valgus stress test (0° and 30° flexion), Anterior/posterior drawer tests, Posterolateral drawer test, Dial test (30° and 90° flexion), External rotation recurvatum test and neurovascular Evaluation as CPN is commonly affected.

Imaging:

Standard radiographs (AP, lateral, varus stress views)

MRI for soft-tissue Evaluation

CT scan (if bony avulsion or malalignment was suspected)

Surgical procedures

Under spinal anesthesia, the knee was examined, and a tourniquet was applied. The patient position was supine with the affected leg hanging for arthroscopic assessment before flexing to 60°–70° for reconstruction. Prophylactic antibiotics were administered.

Graft Selection & Sequence

Ipsilateral semitendinosus was harvested with a length of 20–24 cm for LCL & PFL reconstruction, and ipsilateral peroneus longus or contralateral hamstrings for cruciate ligament injuries and reconstruction order: PCL first (if injured), then ACL, then PLC & MCL.

Surgical Steps

Incisions & Exposure: Curved lateral incision from the lateral femoral epicondyle to Gerdy's tubercle was made (Fig.1a) then dissection of subcutaneous tissues and two fascial incisions were done, first posterior to the tendon of biceps femoris muscle for mobilization of common peroneal nerve (CPN) (Fig.1b) and the other was made through iliotibial tract at femoral epicondyle for exposur of LCL and popliteal tendon footprints.

Tunnel Creation Fibular tunnel was made using (6-7 mm) reamer at LCL attachment (Fig 2a) from anterolateral to posteromedial and femoral tunnels (25–30 mm deep, 18 mm apart) using (8 mm) reamer at epicondyle for LCL and at popliteal sulcus for popliteus complex. (Fig 2b)

Graft Passage: (Fig 3a) Graft was passed through the fibular tunnel and posterior through the popliteal hiatus into the popliteofemoral tunnel and anterior limb into the LCL tunnel.

Fixation & Closure: (Fig 3b) Tensioning at 30° knee flexion, internal rotation, slight valgus. Two 8-mm bioabsorbable screws secured femoral tunnels. First fascial incision left open for CPN neurolysis; skin sutured (2-0 Prolene) with a compressive wrap.

Figure 1. a-Skin incision b-subcutaneous dissection and exploration of common peroneal N

Figure 2. a-fibular tunneling b-femoral tunneling

Figure 3. a-Passage of graft in two femoral tunnels b-Fixation of graft by interference screws

Postoperative Rehabilitation

Postoperative care included regular wound dressing with stitch removal after two weeks. A hinged knee brace was used temporarily, with isometric quadriceps exercises and ROM initiated by day two. Non-weight-bearing mobilization using crutches lasted for six weeks, and progress to full weight-bearing was achieved by three months. Strength training began at six weeks, jogging at four months, and return to sports was permitted after nine months, once full strength, stability, and ROM were restored.

Statistical Analysis

Data were analyzed using SPSS v26. Continuous variables (e.g., SSD, scores) were compared pre- vs. postoperatively with paired t-tests. Significance was set at $p < 0.05$.

3. Results

During analysis of the results, twenty knees of twenty patients with PLC injuries combined with other ligamentous injuries were managed by PLC reconstruction using modified Larson's technique with concomitant reconstruction of other accompanied ligamentous injuries. The average age of the patients was 32.1 years (17–55 years). Only two patients were female and eighteen were male. The average follow-up period was 13.3 months (12–18 months). There was a high rate of associated injuries at the time of diagnosis. Four (20%) patients had a meniscal injury, two (10%) had articular cartilage injuries, four (20%) had a peroneal nerve injury and two (10%) had a popliteal artery injury. No patient had isolated PLC injury, while five patients had combined ACL injuries, six patients had combined PCL injuries, seven patients had both ACL and PCL injury and two patients had ACL, PCL and medial collateral injuries additionally. The characteristics of the studied patients and demographic data were tabulated as follow(table 1) and outcomes was tabulated in (Table 2)

Table 1. Demographic data and characteristics of the studied patients

		NO. = 20
AGE	Mean ± SD	32.1 ± 10.21
	Range	17 – 55
SEX	Female	2 (10.0%)
	Male	18 (90.0%)
OCCUPATION	Student	5 (25.0%)
	Housewife	2 (10.0%)
	Skilled worker	2 (10.0%)
	Employee	4 (20.0%)
	Driver	4 (20.0%)
	Carpenter	1 (5.0%)
	Farmer	1 (5.0%)
	Manual worker	1 (5.0%)
MECHANISM OF INJURY	MCA	4 (20.0%)
	MBA	6 (30.0%)
	RTA	7 (35.0%)
	Sports injury	3 (15.0%)
SIDE	—	13 (65.0%)
	—	7 (35.0%)
TIME OF PRESENTATION	Chronic	12 (60.0%)
	Acute	8 (40.0%)

Table 2. Comparison between preoperative and postoperative evaluation between the studied patients

		PRE-OPERATIVE	POSTOPERATIVE	TEST VALUE	P-VALUE	SIG.
SSD STRESS OPENING VARUS RADIO.	Mean ± SD	9.30 ± 2.36	3.30 ± 1.95	18.974•	< 0.001	HS
	Range	6 – 15	1 – 8			
LYSHOLM SCORE	Mean ± SD	42.25 ± 11.18	81.35 ± 10.29	-19.577•	< 0.001	HS
	Range	20 – 60	60 – 95			
IKDC SORE	Mean ± SD	40.6 ± 6.95	86.65 ± 9.15	-30.919•	< 0.001	HS
	Range	30 – 55	70 – 97			
DIAL TEST	Negative	0 (0.00%)	18 (90.0%)	32.727*	< 0.001	HS
	Positive	20 (100.0%)	2 (10.0%)			
ROM	Normal	7 (35.0%)	17 (85.0%)	10.417*	0.001	HS
	Loss of flexion	13 (65.0%)	3 (15.0%)			
LOSS OF FLEXION DEGREE	Mean ± SD	47.31 ± 9.90	19.33 ± 4.04	7.660•	0.017	S
	Range	35 – 70	15 – 23			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant

*: Chi-square test; •: Paired t-test; ≠: Wilcoxon Ranks test

Table 3. Incidence of postoperative complications

COMPLICATION	NO.
PERSISTENT INSTABILITY	2 (10.0%)
WOUND INFECTION	1 (5.0%)
LIMITATION OF ROM	3 (15.0%)

The table 2 shows improvement in all clinical evaluations and scores with p-value < 0.001 that is statistically significant between pre and post-operative values. Table 3 shows the postoperative complications.

Case Presentation

A 25 years old male student sustained a motor car accident and presented with a two-month history of painful limitation of movement and instability in his left knee (Fig 4 -7). Preoperative evaluation confirmed ACL and PLC injuries, with intact PCL, MCL, and neurovascular structures. SSD stress varus radiograph improved from 8° preoperatively to 2° postoperatively. Functional outcomes showed significant improvement, with the Lysholm score increasing from 45% to 83% and the IKDC score from 40% to 89%. The postoperative dial test was negative, indicating successful stabilization (Fig 8-9)

Figure 4. Preoperative x-ray AP and lateral

views of the LT knee show avulsion fracture of the fibular head

Figure 5. Preoperative x-rays stress varus AP views of RT and LT knee Show widening of the lateral joint space of the LT side

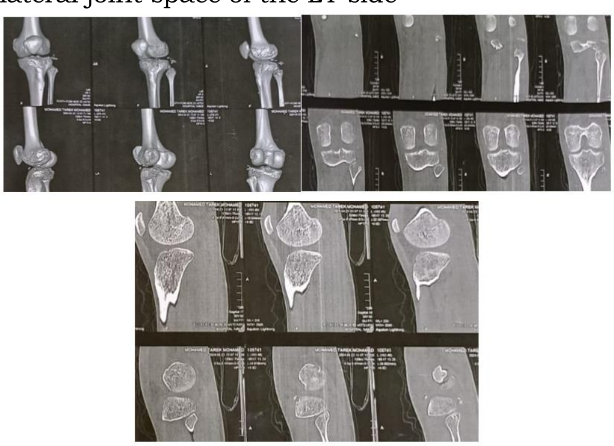

Figure 6. CT scan the RT knee (coronal, sagittal and 3D views) show avulsion fracture of head fibula

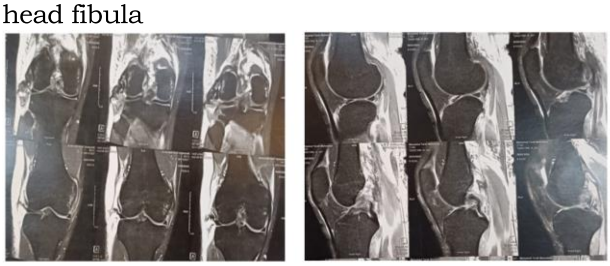

Figure 7. a-MRI coronal view showing complete tear of lateral collateral and edema at lateral side of the knee b- MRI sagittal view show complete tear of ACL and intact PCL

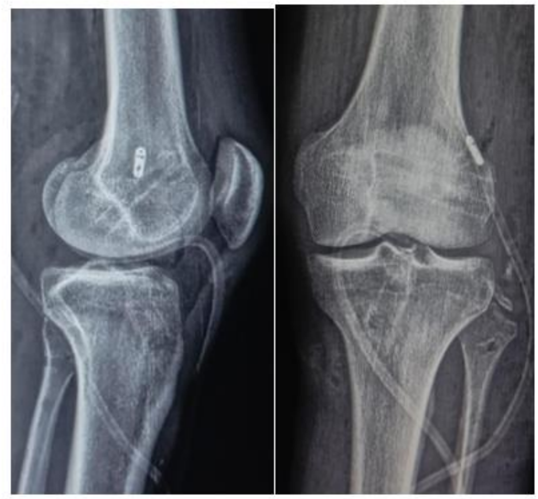

Figure 8. Postoperative x-ray AP and lateral view

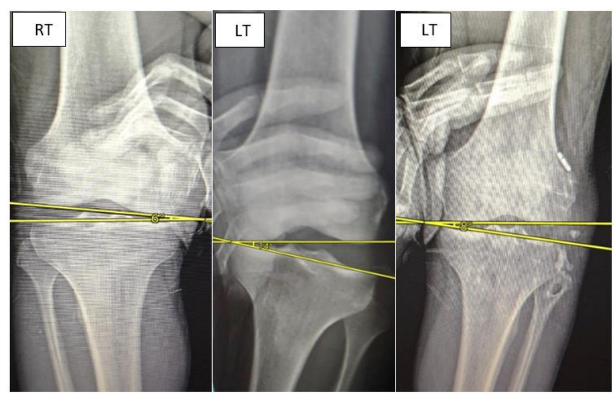

Figure 9. a-Varus stress radiograph of the RT knee b&c- Preoperative and 1 year postoperative varus stress radiograph of the LT knee

SSD varus angle preoperatively: 14 – 6 = 8o

SSD varus angle postoperatively: 8 – 6 = 2o

Figure 10. a,b): 1-year postoperative clinical photo of the LT knee shows full range of motion

4. Discussion

The posterolateral corner (PLC) is a crucial knee stabilizer, primarily restraining varus and posterolateral rotation. Injury to the PLC can lead to chronic knee instability, a varus thrust during gait, and early arthritis of medial compartment. Over time, various techniquesranging from open to arthroscopic-assisted and all-arthroscopic approaches—have been developed to address these injuries.

Early comparative studies showed that reconstruction had a failure rate of about 9%, significantly lower than the 37% seen with repair. Initial reconstruction techniques, however, had high failure rates, likely due to non-anatomic methods.[8] As our understanding of the posterolateral corner anatomy and biomechanics improved, more anatomic reconstruction methods were proposed. These include reconstruction of the fibular collateral ligament, popliteal tendon, and popliteofibular ligament, which can be performed using either a fibular sling technique or a combined tibial and fibular sling approach.

The fibular sling technique, originally described by Fanelli and Larson[9], uses a trans-fibular sling with one femoral tunnel to reconstruct the LCL and PFL with a single graft. Modifications, such as Arciero's[10] two-femoral socket approach, further refined this technique. In contrast, LaPrade's tibio-fibular sling technique[7] reconstructs the LCL, PFL, and popliteal tendon with two grafts and is considered more anatomic. A key advantage of the modified Larson technique is its more medial fibular tunnel trajectory, which reduces the risk of common peroneal nerve injury and better replicates the natural insertion points of the LCL and popliteus.[11] There remains some debate as to whether a combined tibial and fibular reconstruction is superior to a single fibular sling. For instance, a cadaveric study by Rauh et al.[12] found that both techniques restored varus stability and external rotation nearly to the intact knee, although the fibular-based reconstruction achieved some varus laxity at 30° flexion comparable to the intact state. Similarly, Yoon et al.[13] retrospectively assessed cases with and without popliteal tendon reconstruction and found no significant differences in range of motion, stability, or subjective knee scores. In a systematic review and meta-analysis to compare subjective and objective outcomes of fibular and combined tibial-fibular (TF) -based posterolateral corner reconstruction, they found no statistically significant differences in subjective or objective clinical outcome measurements after fibular-based versus combined TF-based PLC reconstruction.[14] These findings are consistent with our prospective data.

In our series, the preoperative mean difference in lateral joint opening seen on stress varus radiograph compared to the other side was (9.3±2.36), and at final follow-up, it was (3.3±1.59). ROM at final follow-up was normal in 85% of cases (17) except for three patients, with a mean loss of flexion degree of 19.33 (range 15 to 23). At the last follow-up, clinical assessment of the affected and contralateral healthy knees showed that no patient had laxity in full extension during varus stress or adductor thrust with walking. None of the patients had posterolateral rotatory instability with the dial test. Only two patients with grade 2 varus laxity (5-10) at full extension with positive dial test and adductor thrust during ambulation, who had extensive injuries, postoperative wound infection, and persistent instability. The average Lysholm score improved from 42.25 ± 11.18 preoperatively to 81.35± 10.29 at the last follow-up. Preoperatively, the IKDC subjective knee score was 40.6 ± 6. We observed no cases of isolated PLC injury, aligning with LaPrade's original reports.[15] Overall, our studied group demonstrated a significant reduction in lateral compartment opening on stress radiographs, along with marked improvements in Lysholm and IKDC scores and varus laxity at one-year follow-up compared to preoperative measurements.

Van der Wal et al.[16] and Van Gennip et al.[17] found no significant difference in varus stress and subjective knee function. In this study, postoperative complications occurred in four patients. One patient was complicated with postoperative wound infection and was managed promptly with debridement and antibiotics, and later on complicated by persistent instability, limitation of range of motion, and residual laxity with a positive dial test, who refused any further treatment. The other two patients were complicated with residual stiffness; one lost 20 ° and the other lost 23 ° of flexion. The last patient was complicated with a haematoma 1 week postoperative and managed by evacuation and good debridement, which was complicated by residual laxity.

In our series, three patients presented preoperatively with common peroneal nerve injuries. One patient had a complete nerve transection that was initially managed with two sural nerve cables; however, due to graft failure, a tibialis posterior tendon transfer was performed one year later. The other two patients exhibited nerve contusions intraoperatively and were managed conservatively, achieving full recovery within 4 to 6 weeks postoperatively. As with other complex surgical procedures, PLC reconstruction carries a significant learning curve, and our experience mirrored that reported in the literature, with operating times decreasing in the later cases compared to the initial ones.[18]

The limitations of our study were a short-term follow-up and a limited sample size with no control or comparison groups. We used historical controls for other techniques, with an inherent bias in comparisons owing to different sampling, inclusion criteria, and associated injuries. In addition, no gold standard for a specific stress radiographic technique or magnitude of varus force application during testing has been established to assess knee stability. Thus, there may be a bias in measuring the lateral joint line opening using stress radiographs. The effect of the posterior tibial slope on clinical outcomes was not evaluated in this cohort, which may be a cause of the residual laxity.

4. Conclusion

In summary, injuries to the lateral structures of the knee, including the posterolateral corner (PLC), are less common but can lead to chronic instability if not diagnosed or managed appropriately. Such injuries may also increase stress on concomitant cruciate ligament reconstructions, potentially resulting in premature failure. Despite advances in anatomy and biomechanics of the posterolateral corner, there remains no consensus on the optimal surgical techniques for its treatment.

Early recognition and prompt treatment of PLC injuries are crucial for achieving reliable outcomes. Identifying and addressing these injuries in a timely manner can help prevent long-term complications and enhance the overall stability and function of the knee.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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