Posterolateral Corner Injuries of the Knee – Not to be Missed!

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Abstract

Injuries of the posterolateral corner (PLC) usually occur in combination with other ligamentous injuries of the knee. Failure to recognize and address the PLC injury can lead to significant disability. Here, we give an overview about the clinical features and the principles involved in treating PLC injuries.

Keywords: Multiligament injury, posterior cruciate, dial test, posterolateral, collateral.

Background

The posterolateral corner (PLC) was considered as the "Dark side of the Knee" due to the complex anatomy and poor understanding of the biomechanics [1, 2, 3, 4, 5]. The injuries of the PLC should be identified and treated appropriately as it affects the knee kinematics and causes severe disability due to instability, varus malalignment, and early articular cartilage degeneration. Failure to address posterolateral instability will lead to increased strain on the reconstructed cruciate ligament grafts and lead to failure of their reconstruction [1,6].

Applied Anatomy

The three main components of the PLC are the lateral collateral ligament (LCL), the popliteus musculotendinous unit and the popliteofibular ligament (PFL). Understanding the isometric points of attachments of these components is extremely useful in the anatomic reconstruction of PLC and serves to restore the biomechanics of the knee.

- LCL: Originates from a depression located 1.4 mm proximal and 3.1 mm posterior to the lateral epicondyle. The LCL averages 7 cm in length and courses underneath the superficial layer of the iliotibial band (ITB). Distally, it attaches 8.2 mm posterior to the anterior aspect of the fibular head.
- Popliteus tendon: The femoral insertion is found at an average of 18.5 mm anteriorly from the LCL attachment.
- PFL: Originates from popliteus musculotendinous junction and inserts onto the posteromedial aspect of the fibular head [2,7,8].

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Biomechanics

The three components together acts as a primary stabilizer to varus stress and contribute to external rotatory stability at a higher degree of knee flexion [1, 2, 3, 4,8].

Etiology

PLC injuries are not uncommon. Blunt trauma to the anteromedial aspect of the tibia with a posterolateral directed force, knee hyperextension and external tibial rotation over a fixed foot are the most common injury mechanisms [4, 7]. A high index of suspicion is needed to identify PLC damage in combined injuries. Isolated PLC injury constitutes around 28%, and combined injuries with cruciate ligaments/meniscus are around 72% [9]. The common peroneal nerve is involved in about 15% of cases. Vascular injuries can occur as part of knee dislocation.

The PLC injuries can be:

- The bony avulsions: Arcuate fracture, Segond fracture, avulsion of Gerdy's tubercle, tibial plateau rim fractures or tibial spine fractures.
- Soft tissue injury: Can involve the LCL, popliteus tendon or musculotendinous junction, PFL, capsule, lateral head of gastrocnemius, or biceps femoris tendon [10, 11, 12, 13].

Clinical Features

Follow a systematic approach in clinically evaluating the patient. Examination under anesthesia is extremely useful in acute injuries to assess the various components which might be injured.

- Abrasion, laceration, or ecchymosis over the anteromedial tibia should raise the suspicion of concomitant injury of

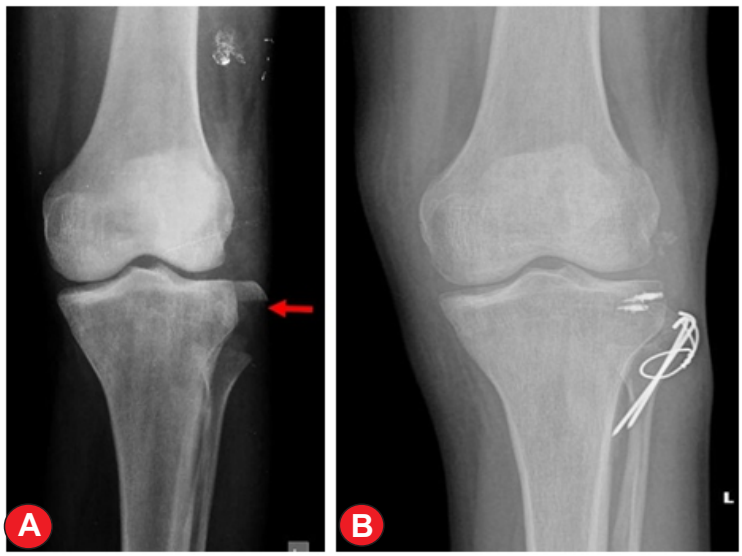

Fig. 1: (a) Radiograph is showing avulsion fracture of the fibular head (arcuate sign - Arrow). (b) Post-operative X-ray show the tension band wiring and repair with suture anchors.

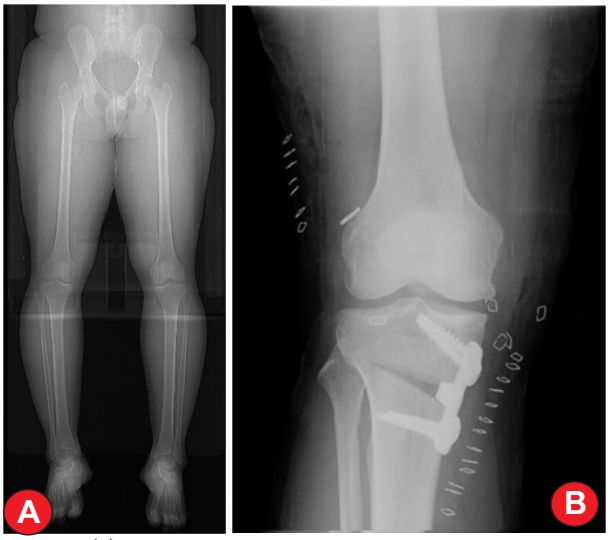

Fig. 2: (a) Pre-operative long leg scanogram showing the varus malalignment of the right lower limb. (b) Post high tibial osteotomy is showing restoration of the limb alignment.

the PCL and PLC.

• Pain over the lateral joint line, ecchymosis, swelling, gross deformity, and inability to walk are the main complaints.

• Motor or sensory symptoms in peroneal nerve distribution and vascular injury may be present.

• Gait: In patients with chronic posterolateral instability the knee may buckle into hyperextension. Therefore, the patients may ambulate with the knee in a flexed position or hold the ankle in equinus to prevent the knee from reaching full extension. A lateral or varus knee thrust, hyperextension and a varus malalignment may be visible during stance phase [2].

• Various special clinical tests are described to diagnose PLC injuries:

- Varus stress test
- Posterolateral drawer test
- Dial test
- External rotation recurvatum test (Hughston and Norwood)
- Posterior external rotation test
- Reverse pivot shift test (Jacob)
- Posterior drawers test and
- Standing apprehension test (Ferrari)

Grading of PLC injuries : Hughston scale classification system [14] for LCL (based on the varus stress opening of lateral femorotibial compartment compared to the opposite side).

• Grade I: 0-5 mm opening
• Grade II: 5-10 mm of opening
• Grade III: >10 mm of opening.

Radiological Investigations

Plain radiographs

Anteroposterior (AP), lateral and axial radiographs should be acquired to rule out the presence of fractures. A standing long-leg AP view should be obtained in chronic cases because the limb alignment should be assessed and corrected.

Magnetic Resonance Imaging

It is the most ideal investigation modality. Allows identification of concurrent lesions such as meniscal tears, cartilage lesions and occult fractures [4, 15].

Treatment

It depends mostly on

• Injury grade
• Duration of injury and
• Associated injuries[1,2].

- Grade I: Are generally managed nonoperatively with knee brace for 2-4 weeks.
- Grade II: Maybe managed operatively or nonoperatively. The indications for surgery include symptomatic instability and functional limitations, supplemented by objective positive clinical tests.
- Grade III: Always warrant surgical treatment.

Duration: Acute (<3 weeks) or chronic (>3 weeks)

A. Acute

• Acute bony avulsion injuries: Repair with suture anchors/screws with washer/tension band wiring (Fig. 1).

• Acute soft tissues injuries - primary repair and augmentation or reconstruction.

Primary repair becomes difficult after the first few weeks due to the development of scar tissue planes, tissue necrosis, and tissue retraction [1, 4, 8, 16]. Primary enmass repair (proximal or distal) takes advantage of body's ability to heal itself if the lateral capsule and biceps tendon are still connected to each other in the mass of torn tissue [17]. Augmentation can be used when there is attenuated tissue, or the primary

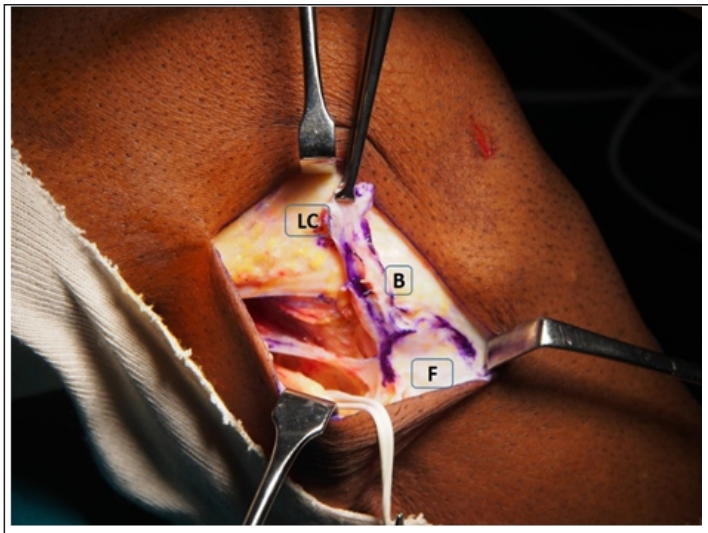

Fig. 3: Biceps tenodesis technique. The insertion of the tendon of biceps femoris (B) on the fibula (F) is left intact, and the proximal resected end is reinserted into the lateral femoral condyle (LC).

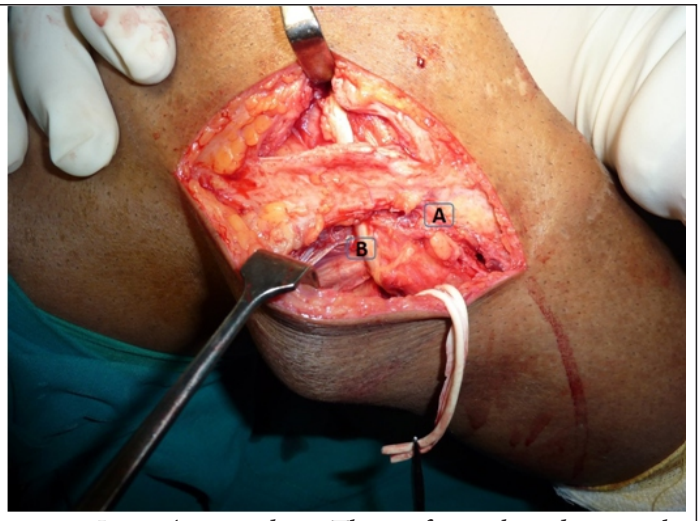

Fig. 4: Larson's procedure. The graft is taken deep to the iliotibial band into the tunnel in the fibula head and back to the lateral femoral epicondyle. "A" is the anterior limb which acts as the LCL part, and "B" is the posterior limb of the graft representing the popliteofibular ligament.

repair is tenuous. Slips of the ITB or biceps can be used to augment the PFL or popliteus, respectively.

B. Chronic injuries

Tears more than 3 weeks old, mid-substance tears and tears with poor quality tissue at the time of surgery are better reconstructed [18]. Various graft options include native hamstrings, bone-patellar tendon-bone, tendon-achilles, ITB, Central aspect of the biceps femoris tendon, or allografts.

High Tibial Osteotomy

Any varus deformity about the knee will place undue stress on the posterolateral aspect of the knee and increase the potential for failure of repair or reconstruction. If a varus deformity exists, it should be addressed before or concurrently with that of the PLC [16]. Proximal tibial medial opening wedge osteotomy can be an effective first method of treatment for patients with chronic combined PLC knee injuries and genu varus alignment (Fig. 2).

PLC Reconstructions

A. Non-anatomic reconstructions

May be considered in low demand patients or those with Grade II PLC injury.

1. Biceps tenodesis (Fig. 3).
2. Larsons sling procedures - Larson's PLC reconstruction aims to restore the functions of the PFL and the LCL. However, it is non-anatomical because the femoral insertion is at the lateral epicondyle and not at the anatomical insertion sites of these structures. A single graft is passed through a tunnel in the fibular head. (Fig. 4) The anterior aspect of the graft represents the LCL while the posterior part mimics the PFL [19]. Modifications of Larson's technique has been described like crossing the graft in a figure of eight (Fanelli) [20] or making two insertion points on the femoral side to recreate footprint of popliteus tendon and LCL (Arciero [21].

B. Anatomic reconstruction

It is preferred because it restores near-native knee biomechanics, results in less varus laxity and external tibial rotation and improves patient outcome. LaPrade technique: Uses two grafts one of which reproduces the LCL and PFL and the other the popliteus tendon. Tunnels are made in the tibia, fibula, and femur [2, 16, 22, 23, 24]. A lateral curved incision over the lateral femoral condyle to the area between Gerdy's tubercle and the fibula head is made, and dissection is carried down to the IT band and facial layer of biceps femoris. The common peroneal nerve is identified and protected. Two small incisions are made, one over the biceps bursa to expose the distal fibers of LCL and its fibular attachment. The second incision is made over the IT band to expose the femoral attachments of the LCL and popliteus tendon. Blunt dissection between the soleus and the lateral head of gastrocnemius muscle is carried out to expose the posterolateral aspect of the upper tibia. Oblique tunnel (6-7mm) is made in the head of the fibula in a distal anterolateral to the proximal posteromedial direction about 28-30 mm distal to the tip of the fibular styloid process. The tibial tunnel is reamed from the flat spot distal and medial to Gerdy's tubercle, exiting on the back of the tibia about 1 cm medial and 1 cm proximal to the fibular tunnel exit point. Once the femoral LCL attachment is identified, a guide pin is advanced across the femur in the anteromedial direction (to avoid potential

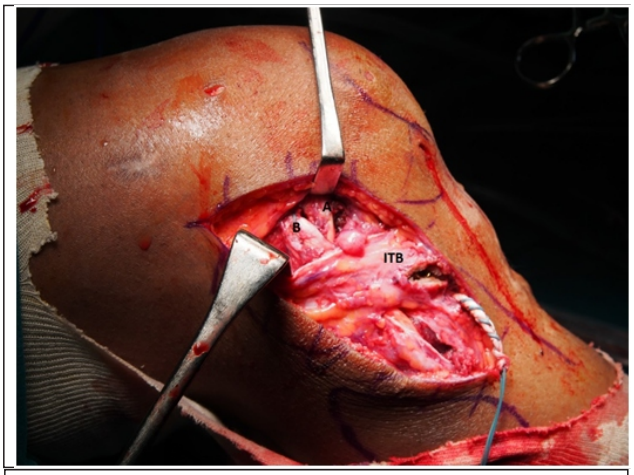

Fig. 5: LaPrade's anatomical reconstruction procedure. One of the grafts extends along the popliteal groove to the back of the knee (A) and represents the popliteus muscle-tendon unit. The other graft (B) passes above the first graft but deep to the iliotibial band (ITB) and is looped through a tunnel in the fibula head from anterior to posterior direction and acts like the lateral collateral ligament. The free portions of both the grafts are then passed from posterior to anterior through a tunnel in the tibia, and posteriorly it represents the popliteofibular ligament.

convergence with ACL tunnel if reconstructing). The popliteus attachment is 18.5 mm distal and anterior to the LCL attachment and a second guide pin is drilled at this position parallel to the first one. The two femoral tunnels are initially drilled through and through using a 4 mm drill and later with a larger drill to a depth of 25 mm. The popliteus graft is passed through the popliteus hiatus and anchored in the femoral tunnel. Then, the LCL graft is fixed in the femoral tunnel and passed over the popliteus graft but under the superficial IT band and brought out through the rent made in the biceps fascia. The LCL graft is then passed into the fibular tunnel in an anterolateral to posteromedial direction and fixed on the fibula with a 7 × 23 mm bio interference screw with the knee at 20° flexion, neutral rotation and applying a slight valgus force. The popliteus graft and remaining portion of the LCL graft are then passed from posterior to anterior through the tibial tunnel and fixed in the tibia with the knee flexed at 60° and in neutral rotation (Fig. 5).

Combined Injuries

Chronic ACL/PCL/PLC instabilities can be successfully treated as single or staged procedures [25].

- ACL + PLC injuries: Tighten the posterolateral structures before fixing the ACL graft in the tibia. If ACL is fixed first, it allows posterior translation and lateral rotation of the lateral tibial plateau.
- PCL + PLC injuries: The PCL graft can be tightened before performing the PLC reconstruction.

Rehabilitation[6, 8, 24, 26]

- 0-3 weeks: Knee immobilizer, non-weight bearing crutch walking, static quadriceps exercises in brace, straight leg raise with immobilizer.
- 3-6 weeks: To continue non-weight bearing, quadriceps strengthening, straight leg raise, and gravity assisted passive knee mobilization with hinged braces.
- 6-12 weeks: Core strengthening exercises. Start active assisted and active range of movements, continue quadriceps strengthening.
- 4-6 months: Strengthening exercises and weight resisted exercises.
- 6-9 months: Return to sports is allowed when normal strength, stability, and knee range of motion has been achieved.

Complications of operative treatment [1, 27]

Potential complications associated with the operative treatment of PLC injuries include peroneal nerve palsy, infection, hematoma, knee stiffness, failure of the reconstruction, and irritation from hardware used.

Conclusion

- A high index of suspicion is mandatory to detect PLC injuries, especially in multi-ligament injured knee.
- Thorough clinical assessment, stress X-rays and MRI are mandatory for confirmation.
- Acute injuries may be repaired, augmented or reconstructed while chronic injuries need reconstruction.
- An anatomic PLC reconstruction results in superior biomechanics and thereby better clinical outcomes.
- In combined injuries, the associated injuries must also be addressed to prevent failure of PLC reconstruction.

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