A comparative study between laprade and Larson’s technique for posterolateral corner [PLC] Injury of knee

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Abstract
In the last few decades, injuries to the knee joint are common because of knee pivoting sports. The mechanism of injury to the PLC is due to direct varus stress, hyperextension, or twisting of the knee. These injuries are commonly associated with cruciate ligament tears, but PLC injury are usually overlooked or misdiagnosed. If Left untreated, it can cause chronic pain and residual instability. PLC reconstruction is normally advocated for grade 2 or 3 lesions, as it is superior to conservative treatment. This study is to compare larson’s and laparde technique. In Larson’s technique there is reconstruction of the fibular collateral ligament and popliteo fibular ligament. In LaPrade technique popliteus graft is reinforced to the PLC. This is a prospective study conducted in 40 patients between April 2016 to January 2018 in Deccan Medical College and Hospitals, to compare the clinical outcome of Laprade and Larson’s techniques in terms of best post-operative stability and function of an isolated PLC injury. Inclusion criteria: age ranging from 18 to 40 years, Posterio lateral corner injury. No previous surgery or damage in the affected knee or the contralateral knee. Exclusion criteria: Patients with medial collateral ligament injury, cruciate ligament injury, generalized ligamentous laxity and arthritis knee. Methods and analysis of results: it is randomized study between Larson’s technique and Laprade’s technique. Postoperative evaluation: is by Lysholm score, IKDC scores and Postoperative complications. In conclusion it revealed that both methods are significant, and equally good at postoperative outcomes.

Keywords: Larson’s technique, laprader technique, posteriolateral corner injury of knee, lysholm score, IKDC Scores

Introduction
In the last few decades, injuries to the knee joint were common because of popular knee pivoting sports like soccer, and basketball. The Posteriolateral Corner (PLC) is an area of the knee that does not receive adequate research despite its contribution to stability of the knee. The PLC of the knee consists of important stabilizing structures that play a crucial role in Varus and rotational stability through all ranges of motion [1-3]. The 3 major static stabilizers of the PLC are the fibular collateral ligament (FCL), popliteus tendon (PLT), and popliteofibular ligament (PFL) [1]. These injuries rarely an isolated injury and are commonly associated with cruciate ligament tears [4-6]. PLC injury are usually overlooked or misdiagnose and if Left untreated, it can cause chronic pain and residual instability. PLC reconstruction is normally advocated for grade 2 or 3 PLC lesions, considering its superior outcomes compared with conservative treatment [7-13]. Animal and clinical studies have reported that grade III PLC injuries heal poorly without surgical intervention, resulting in Varus and rotational instability of the knee [14, 15]. Chronic posteriolateral instability has also been shown to increase forces on the ACL and PCL, which can potentially lead to graft failure in the setting of multiligament injury [16, 17]. Multiple PLC reconstruction techniques exist but none have proven to perform best. There has been great interest in two specific PLC techniques, Larsons and LaPrade. but the two techniques have never been compared against each other. Advantages of the Larson technique include: a relatively straight-forward procedure for reconstruction of the fibular collateral ligament (FCL) and popliteofibular ligament (PFL) that requires less time as compared to other techniques.
The LaPrade technique benefits from the inclusion of popliteus tendon (PLT) graft which produces added reinforcement to the PLC.

**Anatomy**
The knee joint is a synovial hinge and tri axial joint consisting of three articulations, patella-femoral, medial and lateral tibio-femoral joint. It is characterized by presence of menisci because of which it is called as complex joint. The PLC is often called the "dark side" of the knee due to its complexity. The PLC consists of static and dynamic stabilizers. The static stabilizers include the posterolateral capsule, LCL, PFL and fabellofibular ligament. These three soft tissue structures stabilize the PLC at varying degrees of flexion and extension by resisting Varus gapping in combination with external rotation at the knee joint. The dynamic stabilizers are the biceps femoris, iliotibial band (ITB), and popliteus complex. The Cruciate Ligaments (ACL&PCL) act as secondary stabilizers that resist rotation. The combination of all the primary and secondary structures help to stabilize the posterolateral corner of the knee.

**Mechanism of Injury**
Injuries to the PLC of the knee are commonly caused by sports injuries, falls, and vehicle accidents. A direct hit on the tibia when knees is stretched may cause an isolated PLC injury. The PLC is primarily responsible for resisting Varus angulation and external rotation in addition to posterior displacement of the tibia. It is extremely important that the functionality of the PLC and tibiofibular joint be checked along with other clinical tests when diagnosing a knee injury. Injury occurs when the distal tibia is grounded or fixed and large amounts of angular force is exerted about the knee joint causing external rotation. This puts increased tensile stress on both the FCL and the PLT. These mechanisms of injury are commonly caused by athletic traumas, motor vehicle accidents, and falls.

**Classification**
PLC injuries can be classified according to the damage to the PLC or the degree of posteriolateral instability. The following two classifications are most commonly used. Bleday et al. and Fanelli and Larson classified the PLC injuries into.

**Type A:** Injuries involve the PFL and popliteus tendon. Clinically, only an increase in tibial external rotation is observed.

**Type B:** Injuries affect the PFL, popliteus tendon, and LCL. Mild Varus opening is observed in the Varus stress test at 30° of knee flexion along with an increase in tibial external rotation.

**Type C:** Injuries involve the PFL, popliteus tendon, LCL, lateral capsular avulsion, and cruciate ligament disruption. Marked Varus instability is seen in type C injuries at 30° of knee flexion.

**The Hughston classification** is based on the assessment of Varus instability or rotational instability under Varus stress force with the knee in full extension.

- **Grade I** represent minimal tearing of a ligament with no abnormal motion.
- **Grade II** injury shows partial tearing with slight or moderate abnormal motion.
- **Grade III** injury refers to complete tearing with marked abnormal movements.

**Clinical Evaluation**
Pain on the postero-lateral aspect of the knee is a typical symptom in the isolated acute PLC injuries. Patients with chronic injuries complain of broad pain such as medial, lateral joint line pain, and posterolateral pain. Some may have common peroneal nerve injuries and present with paraesthesia or numbness as well. They often show functional instability when the knee is in extension, like knee giving way during activities like walking down and up the stairs.

**Symptoms and signs**
Symptoms of the PLC l injury are pain, ecchymosis, oedema, and hardening, in standing position, they may present with a Varus alignment of the knees compared to their corresponding limb. Patient walks with slight knee flexion to prevent hyperextension and reduce pain associated with the lateral compartment. This altered gait pattern is a clear indicator of structural damage in the PLC.

**Specialized Clinical Tests**
1. Postero-lateral Drawer Test
2. External Rotation Recurvatum
3. Reverse Pivot-Shift
4. Standing Apprehension Test
5. Dial Test
6. Varus Stress

**Investigations**
**Plain radiography**
Plain radiography with anteroposterior (AP), lateral and axial views is taken to rule out fractures. The primary use of X-ray is to determine Varus misalignment/gapping in the lateral compartment.
Stress radiography are very helpful in the diagnosis of PLC injuries. LaPrade et al. \([56]\) assessed Varus stress radiographs with the knee at 20° of flexion to provide objective measures of lateral compartment gapping. They reported that an increased opening of more than 4 mm may indicate a grade III PLC injury. In addition, the kneeling PCL stress radiograph also facilitates objective quantification of isolated or combined PLC injuries \([57]\).

| Variable                      | Degree of injury         |
|-------------------------------|--------------------------|
| Varus stress radiograph (mm)  |                          |
| <2.7                         | Normal knee or minor sprains |
| 2.7-4                        | Complete LCL tear         |
| >4                           | Complete posterolateral injury |
| PCL stress radiograph (mm)    |                          |
| <4                           | Variation in normal knee or minor sprains |
| 4-12                         | Isolated PCL injuries    |
| >12                          | Combined injuries of PCL & PLC |

**Table 1: Instability Evaluation Using Stress Radiography**

Magnetic resonance imaging (MRI)

MRI test can be beneficial when an injury of the posterolateral structures is difficult to diagnose clinically. Especially, the T2-weighted coronal oblique view is more useful in the evaluation of the posterolateral structures than the traditional coronal or sagittal view. MRI is also helpful to evaluate acute or subacute PLC injuries. Therefore, MRI should be taken within 12 weeks. It has been reported that only about 26% of the patients can be diagnosed when an MRI is taken after 12 weeks \([58]\). In addition, MRI's can identify alternative soft tissue structures that may have been injured in combination with the PLC.

**Table 2: Classification of Posterolateral Instability Assessed by Varus or Rotational Instability**

| Classification | Varus/ Rotational instability | PCL injury |
|----------------|--------------------------------|------------|
| Grade I        | 0-5mm or 0-5                  | Intact PCL |
| Grade II       | 5-10mm or 6-10                | Intact PCL |
| Grade III      | >10mm or >10 (soft endpoint)  | PCL rupture |

**Fig 1:** Radiograph imaging of an injured PLC. (A) MRI showing a strained FCL. (B) X-Ray showing lateral gapping between the lateral aspects of the distal femur and proximal tibia \([59]\)

**Management**

1. **Non-Operative Treatment**

   Grade I and grade II isolated PLC injuries can be treated with non-operative management. Appropriate rehabilitation and gait training may be helpful. The reported outcomes were good \([60]\).

2. **Operative Treatment**

   For grade III and grade II PLC injuries accompanied by other structural injuries, surgical management is recommended. The choice of treatment depends on the time of injury.

   Acute PLC injury: In general, an acute injury is defined as an injury within 3 weeks of trauma. Acute injuries can be treated with direct repair or augmentation. If the grade of injury is severe or tissue is not vital enough, augmentation or reconstruction can be considered instead of primary repair. The hamstring tendon, biceps tendon, and ITB are candidates for allograft unlike the surgical improvements made for anterior and posterior reconstructions in the past decades, the posterolateral corner has seen little advancement in comparison. Residual laxity, instability and graft failure still exist post operatively in present day outcomes \([61-63]\). In this study we compared two widely used PLC reconstruction techniques: Larson’s and LaPrade. The reconstruction techniques and biomechanical evaluations of each technique are described below.
Larson’s Technique

Harvesting graft
The graft for PLC is Semitendinosus (ST) tendon is harvested from the contralateral side using a smooth tendon stripper. The appropriate length of ST graft for PLC is 16-19 cm, which typically reflects the distance between the femoral and fibular insertions of the PLC plus an additional 30 mm, as both ends of the graft require at least 15 mm each, corresponding to the insertion into bone tunnels. One limb of the graft comprises PFL and the other comprises LCL. A baseball glove suture using Fiber Wire TM (Arthrex, Naples, FL) is used at both ends of the graft, and one end of the popliteus tendon is connected to an Endobutton TM (Smith & Nephew, Memphis, TN), then placed within antibiotic-soaked gauzes and set aside for fixation later.

Incision
A lateral incision is given from lateral femoral epicondyle to the midpoint of Gerdy’s tubercle and the fibular head. After femoral attachments of the LCL and popliteus tendon are exposed, they are taken off the femur. An incision is made on the biceps femoris muscle in line with this fiber so that the fibular head is well exposed. Anatomical insertions of the LCL and popliteus tendon at the lateral femoral condyle are drilled with 2.4-mm guide pins aimed toward the flare of the medial femoral epicondyle, followed by over drilling (typically 4–5 mm). The peroneal nerve should be identified and retracted with the biceps muscle. To prepare the fibular tunnel, the starting point is set at the distal anterolateral portion of the fibular head, corresponding to the anatomical insertion of the LCL, and the guide pin should exit the proximal posteromedial portion of the fibular head, which corresponds to the insertion of the PFL.
and is passed through the fibular tunnel from posterior to anterior. As the LCL graft end is strained manually, the knee is taken through several cycles of full flexion and extension. While the knee is held in 90° of flexion and the tibia is in a neutral rotation, the graft is then secured in the fibular tunnel by use of a ligament tensioner. The graft end for the LCL is then delivered under the biceps and ITB, and is passed into the femoral bone tunnel from the lateral epicondyle to the medial cortex of the femur. After performing several cycles of full flexion and extension to provide pretension, graft fixation to the bone is accomplished using the 5-mm interference screw (TJ screw) with 10 N force applied to the graft at the knee in extension and neutral rotation by use of a ligament tensioner. Full flexion and extension are then verified, and improved knee stability is confirmed.

Laprade Technique
A 1.5-cm medial incision is made 2 cm medial to the tibial anterior tubercle and around 4 finger breadths distal to the joint line. Semitendinosus and gracilis grafts are harvested and prepared with No.2 Ultrabraid (Smith & Nephew, Andover, MA) Krackow stitches are applied. A curvilinear incision is made on the lateral side of the knee along the iliobial band. The fibular nerve is identified and isolated. The space anterior to the lateral gastrocnemius and posterior to the biceps is dissected. A transfibular tunnel is made from anterior to posterior, protecting the neurovascular structures, a guide pin is introduced at these locations, and a 7- to 8-mm drill is used to perforate the desired tunnel guided by the pin. The transfibular tunnel is first created with a guide pin and subsequently drilled to 7 mm. It is oriented from anterior, lateral, and distal to posterior, medial, and proximal, aiming at reproducing the origin of the LCL at the fibular head. The tibial tunnel is measured, the semitendinosus tendon is mounted asymmetrically onto the Endo Button, the graft is passed from anterior to posterior at the 7-mm tibial tunnel and is secured anteriorly by suspensory fixation. The longest semitendinosus strand passed through the fibula will be directed toward the LCL femoral insertion along with the anterior gracilis strand and will reproduce LCL. The shortest semitendinosus strand exiting at the posterior part of the tibial tunnel will be directed toward the PT femoral insertion along with the posterior gracilis strand and will reproduce the PT. The tibia-fibula connecting part of the longest semitendinosus strand and the posterior gracilis strand will reproduce the PFL. Abone Bridge measuring approximately 5 to 10 mm will separate both tunnels. These femoral tunnels are reamed through the medial femoral cortex to facilitate graft passage. The grafts are routed through the third layer of the lateral side of the knee, deep to the iliobial tract, lateral retinaculum, and biceps. The shortest and bulkiest semitendinosus strand emerging directly from the tibia and the posterior strand of the gracilis are inserted into the PT femoral insertion tunnel and secured with an 8-mm interference screw with the knee flexed 60° and in 5° of internal rotation in relation to the foot-neutral position with 10 lb of tension. The longest semitendinosus strands emerging from the fibula and the anterior gracilis strand will be inserted into the LCL femoral insertion tunnel and secured with an 8-mm interference screw with the knee flexed 30°, neutral rotation of the leg, valgus force, and 10 lb of ten

Materials and Methods
This is a prospective study on 40 patients (20 in each group) operated between April 2016 to January 2018 conducted in the Department of Orthopaedics at Deccan College of Medical Sciences.

Inclusion criteria
1. Age ranging from 18 to 40 years.
2. Cases with only Posteriolateral corner injury.
3. No history of previous surgery of the cruciate ligament injury on affected knee.

Exclusion criteria
Patients with medial collateral ligament injury, posterior cruciate ligament injury, anterior cruciate ligament injury. Patient with osteoarthritis.

Results
For final end result, all patients were reviewed and analysed at the end of 6 months postoperatively. Results include preoperative, intraoperative findings and postoperative subjective assessment scores and examination findings, IKDC scoring scale, and range of motion, measured to the nearest 5 degrees by using a Goniometer.

Scores for each
The present study was undertaken to compare the short-term functional results of Larson posterior lateral corner reconstruction and Laprade technique of reconstruction, 32.5% of the patients were in 23-27 years age group. Mean age for Larson technique group is 27.39 and for laprade reconstruction group is 26.09. Patients were predominantly males, 85% in Larson group and 90% in laprade group. Right sided involvement in Larson group is 55% of patients and 70% in Laprade group. Pain is the most common complaint reported. In the Larson group, patients presenting with only pain were 13(65%), patients presenting with only complaint of giving away were 5(25%) and patients presenting with complaint of pain associated with giving away were 2(10%). In the Laprade group, patients presenting with only complaint of pain were 9(45%), patients with only complaint of giving away were 7(35%) and patients with complaint of pain associated with giving away were 4(20%). Most common complication among both the groups is knee pain 12.5% followed by infection 5%. There were no sensory deficits reported. Satisfactory results within each group in terms of Lysholm and IKDC scores when compared with preoperative and postoperative values. Post operatively 15 patients (75%) had full range of motion (0-140°), 1 patient (5%) had (0-130°) range of motion, and 4 patients (20%) had range of motion (0-120°).

| SCORE | Larson | Laprade |
|-------|--------|---------|
| Excellent | 0 | 4 (20%) |
| Good | 6 (30%) | 9 (45%) |
| Fair | 10 (50%) | 6 (30%) |
| Poor | 4 (20%) | 1 (5%) |
| Total | 20 (100%) | 20 (100%) |

Table 3: Lysholm score
Table 4: Complications

| Complications                  | Larsons | Laprades |
|-------------------------------|---------|----------|
| Infection                     | 2 (33.3%) | 0        |
| Knee pain                     | 3 (50%)  | 2 (100%) |
| Pain at terminal extension    | 1 (16.6%) | 0        |
| Sensory deficits              | 0       | 0        |
| **Total**                     | 6 (100%) | 2 (100%) |

Conclusion

Clear cut advantage of Laprade reconstruction technique is observed over Larson’s technique in terms of postoperative outcomes or complications. Statistical analysis between both the groups revealed that both methods are significant, but there is no clear-cut superiority of one group over the other and that both methods are equally good at postoperative outcomes. We recommend that an anatomic posterolateral knee reconstruction be performed in patients with PLC injury to best improve functional and clinical outcomes. This study further needs to be evaluated. The validity of both techniques and to perform continued assessment for long-term results. Large scale study with long term follow up is required to corroborate findings of the study and to find out long term functional results in the two groups.

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