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Mini Review

Posterior Cruciate Ligament Injuries of the Knee

Srinivas B S Kambhampati*

Department of Trauma and Orthopaedic Surgeon, Sri Dhaatri Orthopaedic, Maternity and Gynaecology Center, India

***Corresponding Author:** Srinivas B S Kambhampati, Department of Trauma and Orthopaedic Surgeon, Sri Dhaatri Orthopaedic, Maternity and Gynaecology Center, India.

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Abstract

Posterior Cruciate Ligament (PCL) one of the major ligaments of the knee. Injuries to PCL are less frequent than ACL injuries. Management of these injuries has been evolving from purely conservative management in early reports to current philosophy of selective surgical management. Surgical techniques for management of PCL injuries are also evolving. We look at a brief review of the ligament with management of its injuries.

Keywords: *PCL, Posterior Cruciate Ligament, PCL Injuries, PCL Review*

Introduction

Posterior Cruciate Ligament (PCL) injuries are not frequent. They may occur in isolation or in combination with other injuries and may be easily missed without a high index of suspicion. Improvements in understanding of biomechanics of PCL and its insufficiency, diagnostic tests have improved picking up of these injuries. Management of injuries to the PCL has been evolving from conservative management to selective surgical management.

Anatomy

PCL attaches to the lateral surface of the medial condyle of the femur and the PCL facet posteriorly on the tibia. It has 2 bundles named according to the femoral attachment first followed by the tibial attachment. AL (AnteroLateral) bundle which is attached anterior in femur and lateral in tibia and forms 85% of the width of the PCL and the PM (PosteroMedial) bundle.

The PCL is Y shaped, The cross sectional area is one and half times that of ACL and the insertional area is 3 times larger than the midsubstance area which makes the anatomical reconstruction difficult. Shape of femoral attachment varies from rounded to elliptical (common) shape.

PCL along with the Meniscofemoral ligaments(MFL) forms the posterior cruciate complex. MFLs contribute to the footprint of the PCL and consist of the Anterior (Humphrey's) and Posterior (Wrisberg) ligaments. They originate from the lateral meniscus and attach along with the bulk of PCL to the femoral condyle. 93% of population have at least one of them. MFLs help to stabilise the knee and also in the healing of a ruptured PCL [1].

Biomechanics

The PM bundle tightens in extension and loosens in flexion while the AL bundle tightens in flexion and loosens in extension. The bundles of the PCL are recently thought to serve a codominant function rather than a reciprocal function.

Forces upto 50% body weight occur on the PCL during level walking. Higher PCL forces are seen while stair climbing - ascending or descending stairs. In a flexed knee, PCL resists 85 - 100% of posteriorly directed loads. Posterior subluxation of tibia occurs in PCL deficient knees during activities of daily living in high knee flexion positions. PCL also offers rotational stability.

There is loss of medial meniscus function due to posteriorly subluxed position which causes significantly increased contact pressures in Medial Tibiofemoral and PatelloFemoral Joint compartments [2].

Injuries

Incidence of PCL ruptures was found to be variable in the literature between 3.4 to 40% of all knee ligament injuries. It is commonly caused by a direct blow to the front of the tibia in a flexed knee - in sports or in motor vehicular accidents. Other mechanisms are hyperflexion and extension IR or hyperextension injuries.

PCL injuries can be broadly classified as isolated or combined. Isolated injuries may be partial or complete and complete injuries can be bone avulsions/ligament peel off or ligament substance injuries. Combined injuries are more common than isolated injuries.

Combined injuries may occur with other ligaments as in dislocations or may be associated with osteoarthritis or musculoskeletal abnormalities. Strobel., *et al.* [3] did an arthroscopic study involving PCL deficient knees and found significant OA changes in the medial compartment and the patellofemoral compartment.

Among all patients with hemarthrosis, PCL injuries were found in 40% of patients [4] and PLC injuries were found in 9.1% [5]. PCL injury is very frequently missed in acute injuries as the classical diagnostic signs are slightly difficult to assess. Dominant signs in acute injury are bruising, effusion and a flexed knee.

Distal pulses and vascular assessment is critical in acute injuries. Ankle Brachial Index should be done and one should have a very low threshold to do vascular studies to look for vascular injury or intimal flap tears.

Associated intra articular findings

Among associated injuries, chondral defects were seen in 49 - 52% and meniscal tears in 28 - 36% and in chronic cases as we have already seen, OA changes [3,6,7].

Clinical diagnosis and tests

History includes injury to the knee. Pain, swelling, discomfort and instability may be complained.

Following is a list of clinical tests for diagnosing PCL injuries.

Posterior Drawer test, Quadriceps active test at 20 - 30 degree flexion and modified test, Testing posterolateral corner by external rotation recurvatum test, And reverse pivot shift test

Other signs are: Varus thrust - especially with PLC injury, Varus opening if associated with LCL injury, ER and hyperextension at the knee, Dial test.

PCL laxity has been graded by Clancy [8] into three grades. At 90° knee flexion:

1. Grade 1 the anterior tibial crest remains anterior to the femoral condyle but sags behind compared to normal side.
2. Grade 2, anterior tibial crest is at same level as femoral condyle and in
3. Grade 3, anterior tibial crest is behind the femoral condyle.

A grade 3 laxity in most cases may be associated with a PLC injury.

IKDC classified laxity based on millimeters posterior shift.

Grade 1 is < 5 mm, Grade 2 is 6 - 10 mm and Grade 3 is > 10 mm.

Imaging

One should get plain radiographs to look for other injuries, PCL avulsion fracture can occur either from tibial or femoral side. Tibial side avulsions are more common. Another finding to look for is posterior translation of the tibia under the femur.

Stress test may also be done if in doubt to display laxity posteriorly [2].

MRI is used to confirm the diagnosis and look for other intra articular injuries which are frequently found.

Management

Conservative management is chosen for isolated PCL Grade 1 and 2 injuries [9] and includes immobilisation for 4 weeks in a full knee extension brace (PCL Brace) or bivalved cylinder cast to maintain tibiofemoral reduction.

For grade 3 injuries and for multi-ligament injuries, operative option is chosen. Other indications for surgery include: associated injuries like dislocation of the knee, meniscal root tears and functional limitations in a chronic tear setting.

In chronic injuries with varus deformity and varus thrust, High tibial osteotomy may be considered - here a medial opening wedge osteotomy is done to correct deformity and also to increase the slope of tibia to reduce posterior sag especially when loading the knee.

Avulsion fractures

Tibial sided avulsions are the most frequent. General management of avulsion fractures is fixation - either arthroscopic or open fixation techniques have been described. Different techniques have been described and most of them lead to good fixation and healing. These include open screw fixation to arthroscopic button fixation. In general, bigger fragments are favourable for screw fixation whereas comminuted fragments would be best fixed using suture and/or button.

Natural history of PCL injured Knee

The natural history of PCL injuries is not very clear in the literature. This is because there are only a few prospective studies. Most early studies report good results with conservative management of these injuries. The remaining papers have either a mixed etiology or short follow up or involve symptomatic patients only or have a very small number.

In general, they report that there is greater incidence of chondral injuries and meniscal injuries in chronic deficient states and also there are effects on osteoarthritis on the medial compartment and the patellofemoral compartment as stated previously.

Studies have looked into multiple outcomes with conservative management. The most important ones are residual instability, pain and return to sport. Instability has been found in upto 46% of cases. Shelbourne., *et al.* [10] found no relation between degree of laxity and feeling of instability.

Earlier studies with short follow up found most patients returned to previous sport [11]. Whereas later studies reported lesser patients getting to the same level of sport as before injury [12]. Shelbourne [13] found only 50% went back to same level of sport and 31% to lower level of sport.

Keller., *et al*. [12] reported that 49% patients felt the knee did not recover fully despite rehab and that 90% patients had some pain with activity when managed conservatively. Dejour., *et al.* [14] also reported similar results.

The general trend in the studies is for greater percentage with pain to be associated with longer follow up.

Majority of studies found increasing OA changes radiologically with increasing interval from injury [10,12,14,15].

According to Dejour., *et al.* [14], the natural history of isolated rupture of the PCL has three phases: initial functional adaptation, subsequent functional tolerance and eventual arthritic deterioration. Hence, they recommend surgery in young patients with PCL ruptures.

Outcomes of surgery

Historically, PCL reconstruction was done using non-anatomic isometric reference points and recent literature has focused on anatomical reconstruction techniques using arthroscopic and radiographic references. The best results of PCL reconstruction are not comparable to the best results of ACL reconstruction. Options for surgical treatment are

1. Transtibial Single bundle reconstruction (TTSR)
2. Tibial Inlay Singel bundle reconstruction (TISR)
3. Transtibial Double Bundle Reconstruction (TTDR)
4. Tibial Inlay Double bundle Reconstruction (TIDR)

Arthroscopic PCL reconstruction techniques are challenging and have a long learning curve. Single bundle techniques aim to reconstruct the AL bundle of the PCL. Reconstruction using Transtibial single bundle technique improved instability by 1 grade, 75% of these patients had normal/near normal outcome. This procedure, however did not prevent osteoarthritis [16]. Reconstruction TISR and TTDR techniques achieved similar results as TTSR technique [2].

Reconstruction using any technique improved laxity of PCL compared to preoperative status but there remained residual laxity of 1 - 3 mm. The residual laxity appeared to be least for TIDR and more for combination injuries with PLC. Hence the last technique is favoured for revision PCL reconstruction surgeries [2]. Issues to debate in surgical management are type of graft used, dealing with killer curve, direction of tunnels, remnant preservation, single vs Y shaped vs Double bundle grafts, fixation methods, open vs arthroscopic inlay techniques.

Conclusion

PCL has a definite role in the AP and rotational stability of the knee. Its injury may be associated with injury to other structures inside the knee. Meticulous examination and low index of suspicion is important to diagnose instability. Laxity of PCL can lead to secondary degenerative changes within the knee. Mild injuries may be treated conservatively. Severe injuries need surgical management as their natural history is not favourable. Surgical techniques are evolving and lead to good outcomes with current techniques.

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