ORTHOSPORTS
QUESTION FOR PHYSIOTHERAPISTS

QUESTION | MY PATIENT HAS A PCL INJURY BUT HE HAS BEEN TOLD HE DOES NOT NEED AN OPERATON. WHAT MAKES THE PCL SO DIFFERENT FROM THE ACL?

Last month's Question to Physiotherapists was the first part in the answer to this question. In this month's Question for Physiotherapists, Dr Doron Sher discusses part two of PCL injury which focuses on examination, investigations and treatment. Last month's article (part one) focused on the anatomy, biomechanics and function of the PCL and an injury classification system.

ANSWER|

EXAMINATION

While there are specific tests performed when looking for a PCL injury it is important to conduct a thorough examination of the knee generally. Start with the patient standing to check overall alignment and then watch them walk from the front and the back. Varus malalignment and a recurvatum thrust during gait increase suspicion of posterolateral corner injury. Look for any abrasions or bruising on the proximal tibia or in the popliteal fossa. The findings will differ considerably for an acute injury and a chronic injury. Acute injuries may be swollen with a loss of motion but generally this is not as severe as what it would be with an ACL injury.
There are many tests looking specifically for a PCL injury. At the start of each of these tests it is important to be sure that the tibia is in a neutral position and is not posteriorly displaced from where it should be. The basic function of each of these tests is to demonstrate posterior proximal tibial displacement relative to the distal femur with the knee flexed to 90 degrees. Posterior tibial displacement can occur in a straight anterior-posterior plane but a rotational component will indicate posterolateral or posteromedial instability. In patients with multi-ligament injured knees a careful neurovascular examination is important to evaluate blood flow as well as foot dorsiflexion and eversion looking for damage to the peroneal nerve.

The special tests looking for a PCL injury include:

1. The posterior drawer test,
2. The Godfrey test (posterior sag sign) and External rotation recurvatum test
3. The quadriceps active test,
4. Posterior tibial drop back or Decreased tibial step-off test,
5. Full extension varus and valgus laxity,
6. False-positive anterior drawer test

Objective testing
A knee ligament arthrometer (such as the KT-1000) can be used to track the degree of tibial displacement but is typically not as helpful as it is for ACL injuries.

Grading of injuries
Grade I : Side-to-side asymmetry exists but the tibial plateau is anterior to the femoral condyles (0-5mm of movement)
Grade II : The tibial plateau is even with the femoral condyles (5-10mm of movement)
Grade III : The tibial plateau falls behind the femoral condyles (10mm of movement).

Presentation
The typical presentation of an isolated PCL injury is

- Minimal to no pain
- Minimal haemarthrosis
- Usually full or functional range of motion (ROM)
- Contusion over the anterior tibia
- Posterior tibial sag

1. Posterior drawer test
The posterior drawer test is considered the most useful for documenting PCL injury.
The patient is placed supine with both knees flexed to 90° and the feet in neutral rotation placed flat on the examination table (the tibial plateau should be about 10 mm anterior to the femoral condyles).

The examiner pushes posteriorly on the proximal tibia (please see the grading system above).

Internal and external rotation of the foot during the posterior drawer test can assess different structures. In internal rotation, the PCL and tibial collateral ligaments are tested. In external rotation, the PCL, LCL, and posterolateral corner are tested. It is critical to assess the posterolateral corner because isolated PCL injuries generally have a very good prognosis; whereas a PCL injury combined with posterolateral corner injury has a less favorable prognosis and almost always requires surgery.

2. Posterior Sag Sign

<u>In Extension</u>
Lie the patient down and lift both heels with the legs in full extension. If a posterior sag can be seen there usually is an injury to the PCL and some secondary restraint (i.e. MCL, LCL or PLC)

<u>In Flexion</u>
Lie the patient down and flex the hip and knee to 90 º. In this position gravity pulls the tibia posteriorly and if the PCL is disrupted the tibia falls behind the femoral condyles (Always try to compare this to the opposite knee).

External rotation recurvatum test
The External rotation recurvatum test is the same as the posterior sag sign described above, except the examiner notices significant subluxation of the lateral tibial plateau as the drawer is performed.

The posterolateral drawer test in 90° of flexion: Sit the patient with their thighs supported by the examining table and legs dangling down. In this position, the knees are at 90° of flexion. The examiner performs a posterior drawer test. If the posterolateral structures are injured, the lateral tibial plateau rotates posteriorly around the axis of the PCL as the posterior force is applied.

A close-up view of a posterior tibial sag with an incompetent posterior cruciate ligament.

3. Quadriceps active drawer test
Lie the patient down and flex the knee to 90 degrees which allows the tibia to sublux posteriorly. Ask them to activate their extensor mechanism (Quads contraction) which pulls the tibia anteriorly into its normal reduced position. Remember to hold their ankle still while they do this to anchor their tibia. You will see the tibia move forward in patients who have a deficient PCL (More than 2 mm of forward movement is considered a positive test.

4. Posterior tibial drop back test or decreased step off test
The tibial drop back or sag test provides a static view of the amount of posterior translation caused by gravity in a knee with a PCL tear. This test can be performed on most patients as it usually does not cause pain. The knee is flexed to 90° and is viewed from its lateral aspect. In the normal knee, the anterior tibia is one centimeter anterior to the femoral condyles. In the PCL deficient knee, there is a posterior sag of the tibia and there is loss of the normal anterior tibial plateau outline.

5. Full extension varus and valgus laxity
This usually indicates a more complex injury such as that involving the posterolateral corner

6. False-positive Lachmann test
The Lachmann is almost certainly the best test to use when looking for an ACL injury. If a knee has a torn PCL the tibia will sag backwards creating a posterior starting point for the Lachmann test. This allows the tibia to be anteriorly translated a long way which may seem like increased anterior laxity. The anterior endpoint of the Lachmann test is still firm with PCL disruption and is called a false-positive Lachmann test.

IMAGING STUDIES

- Start with plain xrays: Standing AP views of both knees, a tunnel view, a 30-degree flexion lateral view, and a 30-degree AP axial view of both patellae.
- Stress xrays can help with the grading of the tear but are not essential.
- MRI scanning is the best test in acute PCL injuries but is less good for chronic PCL deficiency. Recent studies have shown that the PCL looks normal on MRI as early as 6 months after injury. Unfortunately the MRI change does not correlate with improvement in clinical examination.
- While bone scanning is not useful for diagnosis it has been used to study the development of arthrosis in the medial and patellofemoral compartments.

<u>Non Operative treatment</u>

- After completing their rehabilitation program about 70% of pts return to their previous level of sport with minor intermittent problems.
- Xray signs of arthritis show up in about 1/3 of patients.
- 2/3 end up with medial compartment and patella degeneration after 5 years.
- Operative intervention is eventually required in 42% of patients (not always a PCL reconstruction though).

Surgical Indications and Timing of PCL Reconstructions

This article will focus on isolated PCL reconstruction with only brief reference to multiligament injured patients.

The approach to tibial fixation during PCL reconstruction is a subject of controversy. Historically, the most common method for tibial fixation during PCL reconstruction was the transtibial technique, in which the graft passes proximally and posteriorly through the tibia and makes a 90° turn around the superior edge of the posterior opening of the tibial tunnel before entering the knee joint. This 90° bend, or "killer curve," in the graft has been shown to create increased internal tendon pressures and to possibly lead to graft elongation and failure.
Aperture fixation, where the graft is fixed at the posterior opening of the tunnel, creating the shortest possible graft, is preferable based on cadaveric testing. These biomechanicial studies have shown that fixing the graft closest to the exit point of the bone is superior to fixing it to the tibia or femur some distance away from the joint. *The same theory has been applied to ACL reconstruction but has not been shown to affect clinical outcomes there*. Aperture fixation with the transtibial technique requires an interference screw to be placed all the way up the tunnel, which can be both technically challenging and potentially dangerous to the vessels at the back of the knee.

The results of operative reconstruction are variable and may be no better than nonoperative treatment. With improved techniques and understanding of the PCL anatomy, improved surgical results may be possible. Single bundle PCL reconstruction reduces the posterior tibial translation significantly, but it cannot restore the kinematics of the uninjured knee.

Tibial Inlay Technique

This method uses arthroscopic placement of the femoral tunnel or tunnels and the open creation of a bone trough in the posterior tibia. The theoretical benefit of this procedure is that the graft is secured to the anatomic tibial attachment site of the PCL, thus avoiding the killer curve associated with the transtibial tunnel. Some studies have shown that this method potentially decreases internal graft forces. While both the transtibial drilling and this method tend to allow some stretching of the graft, the inlay technique showed less stretching.
The AL bundle is approximately twice the width of the PM bundle, is stiffer and has a higher ultimate load to tensile failure. Historically surgeons have focused on reconstructing just the AL bundle but there is also a renewed interest in using 2 bundles to provide a consistent restraint to posterior tibial translation throughout knee flexion (this was first done on 1984). Double bundle techniques have been shown to more closely reproduce the normal biomechanics of the knee in the laboratory. The AL bundle footprint of the native PCL was used for the femoral tunnel in the single-bundle reconstruction, and the double-bundle reconstruction used the AL bundle and PM bundle footprints of the native PCL as the sites of the femoral tunnels. These studies did not show significant differences between the two techniques, therefore the literature remains conflicted on this idea.

Femoral Tunnel Positioning

We know that femoral tunnel position influences bundle tension and the ability of the graft bundle to restore normal posterior tibial translation. With single-bundle reconstructions, it is the proximal-distal attachment in the femur that determines where the graft will be most functional based on length tension behavior. A distally placed single-bundle graft will be tense when the knee is in extension, and a proximal graft will be tense when the knee is in extension.
AL tunnel reconstruction reproduces normal PCL forces but is associated with increased laxity from 0° to 45° of flexion. Central tunnel reconstruction best reproduces normal knee laxity but has high graft forces between 0° and 45° of flexion. The PM position over constrains the knee and generates higher graft forces in the same flexion range. *It is recommended that for a single-bundle reconstruction, the graft should be placed either in the AL or central aspect of the native PCL footprint, and the PM region should be avoided.*

This is somewhat different for double bundle reconstruction. Anterior femoral tunnel position provides significantly less posterior tibial translation than does the posterior tunnel position. An anterior femoral tunnel position of a double-bundle reconstruction restores normal knee kinematics more closely than does posterior tunnel positioning.
The angle at which the graft enters the femoral tunnel may be a factor in graft failure. This is analogous to the killer curve phenomenon associated with the transtibial tunnel. The inside-out technique is theoretically at a biomechanical disadvantage compared with the outside-in technique because it is associated with an increase in graft angulation at the femoral aperture. This has not been shown to be true in clinical studies.

Drilling two tunnels in the medial femoral condyle removes additional bone, may interfere with condylar blood supply, and, ultimately, may cause an increased risk of fracture and subchondral collapse*. It may be wise to recommended a period of protected weight bearing in the early postoperative period to reduce the risk of fracture in patients undergoing double-bundle reconstruction.*

It is important to repair any PLC injuries when the PCL reconstruction is performed

Graft Forces
Excessive graft forces during the graft remodeling phase may result in either excessive knee constraint (leading to OA) or decreased posterior stability. There does not appear to be a difference in graft forces between the inlay-reconstructed and transtibial reconstructed PCL grafts but passive knee flexion >95°does create slightly higher forces for the transtibial technique. Traditional single-bundle reconstruction techniques have emphasized replacement of the larger AL bundle tensioned with the knee at between 70° and 90° of flexion; however, residual knee laxity has been observed in full extension and during early flexion. *If a double bundle reconstruction is used it seems that differential tensioning of the AL bundle at 90° and the PM bundle at 0° results in forces similar to those of the native PCL*.

Chronic Injury

The indications for surgical treatment of chronic PCL injuries are:
- Development of progressive functional instability
- Development of secondary symptoms such as anterior knee pain.

Surgical timing is dependent upon vascular status, reduction stability, skin condition, systemic injuries, open versus closed knee injury, meniscus and articular surface injuries, other orthopedic injuries, and the collateral capsular ligaments involved. Certain ACL/PCL/MCL injuries can be treated with a brace for the medial collateral ligament followed by arthroscopic combined ACL/PCL reconstruction 4 to 6 weeks after healing of the MCL. Other cases may require repair or reconstruction of the medial structures and must be assessed on an individual basis. Combined ACL/PCL/posterolateral injuries are addressed as early as safely possible. ACL/PCL/posterolateral repair-reconstruction performed between 2 and 4 weeks postinjury allows sealing of capsular tissues to permit an arthroscopic approach and still permits primary repair of injured posterolateral structures. Open PCL-based, multiple ligament knee injuries/ dislocations may require staged procedures. The collateral capsular structures are repaired after thorough irrigation and debridement, and the combined ACL/ PCL reconstruction is performed at a later date after wound healing has occurred. Care must be taken in all cases of delayed reconstruction to confirm that the tibiofemoral joint is reduced by serial xrays.

The surgical timing guidelines outlined above should be considered in the context of the individual patient. Many patients with multiple ligament injuries of the knee are severely injured multiple trauma patients with multisystem injuries. Modifiers to the ideal timing protocols outlined above include the vascular status of the involved extremity, reduction stability, skin condition, open or closed injury, and other orthopaedic and systemic injuries. These additional

considerations may cause the knee ligament surgery to be performed earlier or later than desired.

Final functional results were significantly better in patients with no cartilage damage at the time of surgery and in those who underwent surgery within 1 year post injury.

REHABILIATION OF PCL INJURIES

There is good evidence to support nonoperative treatment of isolated grade I and II PCL injuries. The goal of a comprehensive rehabilitation program should be to strengthen the muscles around the knee while minimizing forces across the patellofemoral joint. *Open chain hamstring exercises should probably be avoided for the first 2 weeks to avoid stretching of the pcl scar*. In theory, quadriceps strengthening may often compensate enough for loss of PCL to allow a desired level of function despite excessive posterior tibial translation. Long-term studies have shown that in spite of this rehabilitation program, progressive degeneration of the knee, especially in the patellofemoral and medial compartments, may be inevitable.

Postop Rehabilitation

In contrast with ACL rehabilitation, PCL postoperative rehabilitation is slower and more deliberate. General principles include appropriate immobilization, avoidance of overstressing of healing tissues, and staged progression of individualized rehabilitation based on basic science and clinical research.

One example of these principles is listed here:
The knee is kept locked in a long leg brace in full extension for 3 to 6 weeks, non-weight bearing on crutches. The brace is unlocked at weeks 4 – 6 to allow a slow increase in range of motion. Start weight-bearing with ¼ of body weight and increase this until week 10. Crutches are discontinued at the end of postop week 10 with the patient being fully weight-bearing and having enough quadriceps control for unassisted walking. Open chain exercises (45 to 0) begin in week 11 and progress to closed chain quadriceps exercises (0 to 45). Open chain resisted knee flexion should probably be avoided for 6 months. Return to sports and heavy labor occurs at 6 to 9 months, when sufficient strength, range of motion, and proprioceptive skills have returned.

CONCLUSION

In recent years there have been new studies looking at the biomechanical function and complex anatomy of the PCL. This has led to an improved understanding of knee ligament structure and biomechanics in general and has allowed technical advancements in many areas. This includes allograft tissue, surgical instrumentation, graft tensioning and fixation methods, improved surgical techniques and more scientific rehabilitation methods have enhanced the results in PCL reconstruction and PCL-based, multiple ligament knee surgical outcomes. Generally speaking most PCL injuries can be managed non-operatively.

SUMMARY:

The typical presentation of an isolated PCL injury is

- Minimal to no pain
- Minimal haemarthrosis
- Usually full or functional range of motion (ROM)
- Contusion over the anterior tibia
- Posterior tibial sag

Special Tests:

- The posterior drawer test,
- The Godfrey test (posterior sag sign) and External rotation recurvatum test
- The quadriceps active test,
- Posterior tibial drop back or Decreased tibial step-off test,
- Full extension varus and valgus laxity,
- False-positive anterior drawer test

Xrays and MRI scans are the imaging modalities of choice

Non operative treatment is usually successful

Dr Doron Sher

www.orthosports.com.au