

## Posterior Cruciate Ligament Reconstruction and Rehabilitation

### Surgical Indications and Considerations

*Anatomical Considerations:* Many authors describe the posterior cruciate ligament (PCL) as the primary stabilizer of the knee. It is about twice as strong as the anterior cruciate ligament. It is approximately 38 mm in length and 13mm wide. It runs from the medial femoral condyle to the posterior tibia. The PCL consists of two bands, the anterolateral and posterolateral. The anterolateral band is two times as large and is 1.5 times stronger. The anterolateral band is the band that gets tight on knee flexion, while the posterolateral band is the band that tightens with knee extension. The PCL as a whole gives the knee 95% restraint to posterior tibial torsion and is a secondary control to lateral rotation, varus stresses and hyperextension.

*Pathogenesis:* Tears to the PCL by itself are uncommon. The cause of injury most often is when some force is applied to the anterior portion of the tibia while the knee is flexed, e.g., the anterior aspect of the flexed knee striking a dashboard. A fall onto a flexed knee with the foot in plantar flexion and the tibial tubercle striking the ground first, causing a posterior force to the proximal tibia, may also result in injury to the PCL. Injury may also occur with forced hyperextension while the foot is planted in dorsiflexion. A force applied to the anteromedial aspect of the knee, as during a football tackle, results in a posteriorly directed force and a varus hyperextension force, may lead to PCL and posterolateral capsular ruptures. When the PCL is ruptured there is increased posterior translation and this translation increases as knee flexion increases and has maximum translation between 70-90 degrees, when the anterior cruciate ligament is fully relaxed.

*Epidemiology:* Of all the patients seen in the emergency room for ligamentous injuries 37% are patients with severe knee injuries. Of that 37%, one third are related to sports injuries. The other two thirds are attributed to other types of injury such as falls and motor vehicle accidents. PCL injuries account for as many as 20% of all knee ligament injuries. Chronic PCL weakness can cause or predispose patients to the following pathologies: (1) medial compartmental osteoarthritis of the knee, (2) meniscal injury, and (3) patellofemoral arthritis.

*Diagnosis:* The clinical examinations commonly used to assess for PCL instability are the posterior drawer test, Godfrey or posterior sag test, and the dynamic posterior shift test.

- Positive Posterior Drawer Test with knee at 90° is 90% sensitive and 99% specific. The posterior drawer test with the knee at 90° is the most sensitive test for detecting PCL injury. Decreased range of motion may be observed, but may only lack 10-20° of flexion. Grading the injury upon examination is usually performed by using the following scale: Grade I injury, step off present but minimal (i.e., 0-5 mm); Grade II injury, 5-10 mm of posterior translation; and Grade III injury, greater than 10 mm of posterior translation.
- Positive Godfrey or posterior sag test. 58% sensitive, 97% specificity.
- Positive Dynamic Posterior Shift Test. 95% specific, but only 26% sensitive.

Imaging such as MRI has high sensitivity and specificity in the diagnosis of PCL injury. MRI is found to be 99% sensitive and specific in the diagnosis of complete PCL tears. Arthroscopy can

be performed for further diagnoses of tears in the PCL.

*Operative vs. Non-operative Management:* The decision to perform surgery or not is primarily based on the severity of the injury. It is common for non-operative rehabilitation to take place if the Grade is less than II. The key is to control the swelling, instability, and pain. If the patient, however, continues to experience pain and instability regardless of rehabilitation and bracing, a PCL reconstruction may be needed and performed. There are numerous factors that contribute to which route of treatment will be pursued. It depends on severity of the injury, whether the injury is to the PCL itself or if it is combined with other injuries to the ligaments or menisci, the activity level and goals of the patient, and the preference of the physician. Below is outlined the non-operative and the operative methods of rehabilitation.

Note: the below rehabilitation protocols are derived from guidelines provided by McNeal, Lintner, Agesen, Ertl, Bhatti, and Kischner. Please refer to their publications for further information regarding progressions, limitations, expectations, and goals.

### Non-operative Rehabilitation: Day 1 to Week 2

Goals: Control the initial inflammation

Regain ROM with muscle function as quickly as possible

Intervention:

- Rest, ice, compression, and elevation (RICE) several times a day, in addition to other modalities such as electrical stimulation, ice baths.
- Assisted weight bearing. Patients with grade I and grade II injuries can bear as much weight as they can tolerate immediately. Some may need crutches initially. Crutches and a long leg brace are recommended only with severe grade III injuries with no other associated ligamentous laxity or intra-articular damage.
- Electrical stimulation (ES) may be used to stimulate the quadriceps muscle, if the patient is having difficulty performing quadriceps contractions.
- Exercises for quadriceps and hip strengthening. All open kinetic chain (OKC) hamstring exercises should be avoided since they promote posterior tibial translation at the knee.

### Non-operative Rehabilitation: Weeks 2-12

Intervention:

- Bracing - Only patients with grade III injuries should still be wearing a brace (0-60°) until at least the third week of therapy. Then, the patient may be fitted for a functional knee brace.
- Assistive Devices - Crutches can be discontinued and weight bearing as tolerated can be progressed
- Exercises – At 2-3 weeks, exercises should be progressed with light resistance as tolerated. The stationary bike may be used for improving ROM. Aquatic exercises can be used for improving ROM and strengthening. At weeks 3-6, the exercises may be increased to include closed kinetic chain exercises (CKC) including: leg press, mini squats, stair stepper, step-ups. Resistance may be increased on the bicycle as tolerated. At 8-12 weeks, strengthening exercises should be progressed and a light jogging program

may be initiated.

Non-operative Rehabilitation: 3 – 9 months

- Exercises – Strengthening and proprioception exercises are progressed as tolerated. Plyometrics and sport-specific training should also be initiated and accelerated as tolerated. A running program is developed, and agility drills are integrated. An isokinetic test and a KT-2000 test should be performed at 3-month, 6-month, 9-month, and 12-month follow-up visits. The athlete may return to sporting activities when isokinetic and functional tests are satisfactory according to the PT and the MD. The patient should not return to competitive sports until full quadriceps strength has been reestablished.

### POSTOPERATIVE REHABILITATION

There are a number of different techniques used to reconstruct the PCL, so the treatment protocol is determined by the physician, the PT, and the type of graft used in surgery. The types of grafts used are the patellar tendon, quadriceps tendon, hamstring tendons, and the medial head of gastrocnemius.

**Phase I:** Day 1 to Week 2

Goals: Protect the new graft – no active knee flexion.

Gain full knee extension so patient can ambulate with normal gait.

Improve quadriceps control

Intervention:

- Bracing – The patient will be in a post-op brace that is locked at 0 degrees. The brace is to be worn at all times. The brace will be progressed slowly to 30° depending on how stiff the patient may be getting. The patient needs to be educated that activities such as walking down a ramp/hill/incline, sudden deceleration, and squatting activate the hamstrings and should be avoided and that any weight-bearing exercises should be performed in brace. The patient can usually weight bear as tolerated on the affected limb with the use of crutches and a long leg brace.
- Neuromuscular re-education – Improve muscular quadriceps control – consider using biofeedback or electrical stimulation on the quadriceps – including on vastus medialis oblique.
- Mobility Exercises: Passive only 0-30°  
Seated heel slides using towel  
Hamstring stretch  
Gastrocnemius/soleus stretch
- Strengthening exercise – Quad sets - if possible “1 million/day,” straight leg raises, short arc quads
- Manual Therapy – Manual patella mobs – especially superior/inferior. Patellar mobility is also very important, and the patient should be instructed in self-mobilization exercises

for the patella, scars, and soft tissues around the knee to prevent fibrosis.

- Physical Agents – Ice can be used following exercise and initially every hour for 20 minutes

### **Phase II:** Week 2 to Week 6

Goals: Protect the graft (note that it is at its weakest point in the healing process)

Ambulate with normal gait  
 Good quad control  
 Improve strength and ROM  
 Minimal to no swelling  
 Able to ascend/descend stairs

Intervention:

- Exercises: Heel slides – seated and/or supine  
 Continue quad sets until swelling is gone and quad tone is good  
 Straight leg raises - add ankle weights when ready  
 Active knee flexion – PRONE – 0-30/40°  
 Shuttle/Total gym – 0-60° - bilateral and unilateral; focus on weight distribution more on heel than toes to avoid overload on patella tendon  
 Closed chain terminal knee extension  
 Leg Press  
 Step-ups – forward  
 Step-overs  
 Wall squats 0-30°  
 Calf raises  
 Cycle when 110° of flexion is reached  
 Continue with HS and calf stretching  
 Balance/proprioceptive training - weight shifting - med/lat, single leg stance - even and uneven surface - focus on knee flexion, plyoball tossing  
 Aquatic resistance training may be initiated during the later part of this phase.
- Brace: Continue to wear brace – unlocked to 90° at week 4

### **Phase III:** Week 6 to Week 12

Goal: Perform everyday ADLs without difficulty  
 Full knee ROM

Intervention:

- Bracing - Post-op brace will is often discontinued at 6 weeks – patient may then be fitted for functional brace

- Exercises: Continue with above exercises, increasing intensity as tolerated.  
Active knee flexion – prone – 0-90°  
Knee extensions – 0-90°  
Step-ups – forward and lateral; add dumbbells to increase intensity; focus on slow, controlled movement during the ascent and descent  
Squats - standing (at week 8)  
Lunges – forward and reverse; add dumbbells or medicine ball  
Theraband hip flexion  
Single leg squats  
Single leg wall squats  
Cycle – increase intensity; single leg cycle maintaining 80 RPM  
Balance/proprioceptive exercise - Plyoball tossing – even and uneven surfaces, squats on balance board/foam roll,  
Cycle – increase intensity

#### **Phase IV:** Week 12 to one year

Goal: Perform everyday ADLs without difficulty  
Full knee ROM  
Increase strength, power, and endurance.  
Prepares the athlete for return to competition

#### Intervention:

- Exercises: Strengthening should continue with focus on high intensity and low repetitions (6-10) for increased strength.  
Hamstring and calf stretches should also continue  
Quad stretch should be implemented.  
Week 12:  
Light resisted hamstring work can be initiated  
Initiate lateral movements and sports cord exercises: lunges, forward, backward, or side-step with sports cord, lat step-ups with sports cord, step over hurdles.  
Jogging/Plyometrics:  
When cleared by the physician, the patient can begin light plyos and jogging at a slow to normal pace. Patient should be focusing on achieving normal stride length and frequency. Initiate jogging for 2 minutes, walking for 1 until this is comfortable for the patient and then progress the time as able. Jogging should first be performed on even surfaces such as a treadmill or track. Then it can be progressed to mild uneven surfaces such as grass and then asphalt or concrete. It is normal for the patient to have increased swelling as well as some soreness, but this should not persist beyond one day or the patient did too much.  
Jump rope and line jumps can be initiated when the patient is cleared to jog.

Jogging and plyos should be performed with brace on.  
 Advanced Plyos can include squat jumps, tuck jumps, box jumps, depth jumps, 180 jumps, cone jumps, broad jumps, scissor hops.  
 Leg circuit: squats, lunges, scissor jumps on step, squat jumps.  
 Power skipping  
 Bounding in place and for distance  
 Quick feet on step – forward and side-to-side – use sports cord  
 Progress lateral movements – shuffles with sports cord; slide board  
 Ladder drills  
 Swimming – all styles

**Focus should be on quality, NOT quantity**

Landing from jumps is critical – knees should flex to 30° and should be aligned over second toe. Controlling valgus stress and movements, will be a challenge at first, and unilateral hops should not be performed until this is achieved.

Gradually initiate sprints and cutting drills.

Progression: Straight line, figure 8, circles, 45° turns, 90° cuts and sports specific drills

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