



Standard of Care: Posterior Cruciate Ligament Surgical Reconstruction

ICD 9 Codes: 844.2

Case Type / Diagnosis:

The primary function of the posterior cruciate ligament (PCL) complex (PCL and meniscofemoral ligaments) is to restrict posterior tibial translation. It acts as a secondary restraint to tibial varus, valgus, and external rotation.¹

There is wide variability in the reported incidence of PCL injuries, which ranges from 1% to 44% of all acute knee injuries. The incidence reported in the general population (3%) is much lower than in the traumatic setting, in which 37% of all patients with knee hemarthroses have an associated PCL injury.¹

The incidence of PCL injuries in the athletic population is sport-specific, with injuries occurring more frequently in contact sports. The mechanism of PCL injury in athletes is typically a fall on a flexed knee with the foot plantarflexed and the knee hyperflexed. Motor vehicle accidents are another common cause of PCL injuries. A “dashboard injury” occurs when the knee is in a flexed position as a posterior-directed force is applied to the tibia.¹

Clinically, the most accurate test for the integrity of the PCL is the posterior drawer test.² In terms of imaging, MRI is the preferred technique for evaluating PCL injuries, with accuracy ranging from 96-100%.¹ The PCL is very strong and injuries will often avulse the bony tibial attachment rather than cause rupture of the ligament. Plain radiographs may also detect small tibial plateau fractures that, in the setting of a PCL-injured knee, may suggest a severe combined ligament injury.²

PCL tears are graded based on the position of the medial tibial plateau relative to the medial femoral condyle at 90 degrees of knee flexion. The tibia normally lies approximately 1 cm anterior to the femoral condyles in its resting position. In grade I injuries, the tibia remains anterior to the femoral condyles, but the distance is slightly diminished (0-5 mm patholaxity). In grade II injuries, the tibia is even with the femoral condyles (5-10 mm patholaxity). With a grade III injury, the tibia no longer has a medial step-off and can be pushed beyond the medial femoral condyle (>10 mm patholaxity). Grade III injuries are often combined injuries, and involvement of the capsular ligaments should be evaluated.¹ Patients with a grade III or grade IV (posterior displacement more than 15 mm) injury are at high risk of functional disability because of recurrent pain, instability and knee degeneration.³

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Early surgical reconstruction of the knee with grade III or IV PCL injury is generally recommended.³ Surgical indications for PCL injuries also include combined ligamentous injuries involving the PCL and bony avulsion fractures.¹

The indication for surgical intervention vs. conservative management with PCL tears is somewhat controversial due to the lack of good randomized controlled trials in the management of PCL injuries of the knee.² Traditionally PCL tears have been treated conservatively with acceptable outcomes.⁴ Limited observational studies have suggested that isolated PCL tears will typically follow a benign short-term course when treated non-operatively with measures such as bracing in extension for 4-6 weeks following injury and rehabilitation including isolated quadriceps, hip, and core muscle strengthening. However, there may be implications for long-term function secondary to inadequate ligament healing and associated posterolateral injury.⁵ The prognosis for combined ligamentous injuries treated non-operatively is guarded, as long-term follow-up studies have shown a high incidence of progressive osteoarthritis and poor function.⁵

Surgical reconstruction procedures include several variables: approach (arthroscopic vs antero-medial arthrotomy), graft selection (autogenous vs allogeneous; achilles vs quadriceps vs hamstring tendon), one- or two-bundle technique, and drilling of a tibial tunnel vs tibial inlay fixation. Quelard et. al. state that as of 2010, reconstruction techniques have been simplified and double bundle ligamentoplasties by arthrotomy have been replaced by single bundle reconstructions.⁶ Associated surgical factors may include treatment of combined instabilities, and potential need to perform a high tibial valgus osteotomy.⁷

Indications for Treatment: Physical therapy is indicated for all patients following PCL reconstruction surgery.

Contraindications / Precautions for Treatment:

- Patients with concomitant repair of anterior cruciate ligament (ACL), posterior lateral corner (PLC), medial collateral ligament (MCL), or lateral collateral ligament (LCL) should be progressed more conservatively. This may vary on an individual basis depending on structures involved and type of repair, and should be addressed with the patient's surgeon.
- Avoid open chain hamstring strengthening until sufficient time has been allowed for graft to bone healing (approximately 4 months). The use of the hamstring exerts excess shear on the repair which may cause the graft to slip into the bone tunnels or cause elongation of the graft.^A
- Caution against posterior translation, either by gravity or muscle action. See attached protocol for specific technique to be used with range of motion (ROM).

Evaluation:

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Medical History: Review medical history questionnaire and medical history reported in the hospital's computerized medical record. Review any relevant diagnostic imaging, tests, and operative reports listed in the hospital's electronic longitudinal medical record (LMR).

History of Present Illness: Review the length of time symptoms were present prior to surgery, specific event of onset if applicable, and history of related knee joint/ligament/tendon problems. This information may be gathered from patient interview, as well as a review of the surgeon's notes to determine underlying pathology that lead to surgery.

Social History: Review patient's home, work, recreational, and social situation. Consider environmental barriers and ergonomics. Areas of particular relevance include: distance patient must walk, presence of stairs, need to perform bending/lifting activities, and prior sports/recreational activities that the patient would like to eventually resume

Medications: Review all medications in medical record, as well as new post-operative prescriptions. Generally, the surgeon prescribes post-operative pain medication for the acute post-operative phase, and then patients are weaned to over-the-counter pain medications for use as needed.

Examination (This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.)

Pain: As described using the visual or verbal analog scale (VAS). Note location, quality of pain (i.e. sharp vs. dull), and activities that increase or decrease symptoms.

Palpation: Palpate the entire knee complex. Focus on presence and extent of muscle atrophy and swelling, areas of tenderness, and scar tissue formation along the incision or at portal sites

ROM: Goniometric measurements of A/AA/PROM knee flexion and extension. Initial knee ROM assessment is contingent on post-operative tissue quality and ROM restrictions. See attached protocol to help guide progression. Screen hip and ankle ROM for potential limitations that may affect knee motion.

Strength: Assessed by standard manual muscle testing (MMT) or Hand Held Dynamometer (HHD). Do not perform strength testing of hamstrings during the acute post-operative phase, as per precautions. Assess remainder of major LE muscle groups, with special attention to hip abduction and extension, and knee extension. Also make note of Vastus Medialis Oblique (VMO) muscle activity/endurance during quadriceps set and straight leg raise.

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Sensation: Screen dermatomes via light touch of involved extremity. If abnormal, further assessment (i.e. sharp/dull, dermatomal vs peripheral nerve pattern) may be indicated.

Posture/alignment: Note structural factors that may affect knee mechanics, such as: Q angle; hip anteversion or retroversion; knee varus, valgus or recurvatum; patella baja, alta or squinting; tibial torsion; foot pronation or supination.

Gait: Initially, the patient will be weight-bearing as tolerated (WBAT) with crutches, with brace locked in full knee extension. Assess the patient's ability to safely ambulate on level surfaces and with stair negotiation. Reinforce appropriate heel strike. Please refer to attached protocol for further details regarding gait progression.

Balance: Initially, a gross assessment of patient's safety/independence with transfers, gait, and stairs is sufficient, as balance will be limited by pain, decreased proprioception, as well as decreased weight-bearing through affected LE. Later balance assessments may include: single leg stance, tandem stance, step-up/step-down tolerance, and response to center of gravity displacement.

Visual Inspection: With particular attention to healing of the incision/portals (noting potential signs of infection), presence and extent of edema, and muscle atrophy (especially quadriceps/vastus medialis).

Edema/Atrophy: Edema or atrophy can be quantified via circumference measurements, which are typically taken at the mid patella (joint line), 15 cm above the superior border of the patella, and either at the tibial tubercle or 5 cm below the inferior border of the patella.

Joint Mobility: Assess patellar mobility (inferior, superior, medial, and lateral). Limit any tibial-femoral glides in order to protect the against posterior sagging during rehabilitation.¹⁴ It is important to caution against posterior tibial translation.¹⁴

Functional Outcomes: Use of a knee-specific functional capacity questionnaire is recommended to track post-operative progress.

Possible tools:

- Lysholm Knee Score.⁸
- Tegner Activity Level Scale.⁸
- Lower Extremity Functional Scale.⁹
- International Knee Documentation Committee test (IKDC)¹⁰

Note: these tools may not initially be useful/relevant in the acute post-operative phase due to activity restrictions inherent in the post-operative

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precautions. However, as precautions decrease and the patient becomes more functional, these tools quantify progress with regards to functional outcomes.

Differential Diagnosis: None

Assessment:

Problem List

- Altered integumentary integrity (edema, incision/portal healing)
- Decreased knee ROM
- Decreased patellar mobility
- Decreased muscle performance of quadriceps, hamstrings and hip musculature (abductors, adductors, extensors, etc.)
- Pain
- Altered gait
- Decreased balance/proprioception
- Knowledge deficit regarding bracing needs (i.e. donning/doffing, wearing schedule, and weaning brace when appropriate)
- Knowledge deficit regarding post-operative precautions (i.e. ROM restrictions, avoidance of hamstring work, and weight-bearing precautions)

Prognosis: Several studies have examined outcomes following PCL reconstruction. The literature suggests that successful PCL reconstruction depends on multiple variables, including patient selection, surgical technique, graft selection, and postoperative rehabilitation.⁸ However, there is a lack of randomized and quasi-randomized controlled studies in this area. It is difficult to compare existing studies, as they differ in terms of type of injury (i.e. chronicity of injury, isolated PCL vs. multiple ligament involvement), surgical approaches, and rehabilitation regimens (which are often unclear or unspecified).

Chih-Hwa et al prospectively examined outcomes at a 4-year follow-up after PCL reconstruction using quadruple hamstring tendon autograft with an arthroscopic double fixation technique. Data was analyzed on 52 patients with symptomatic severe posterior knee instability associated with multiple ligament injuries. The average time from injury to surgery was 10.6 months (range 3 weeks to 42 months). They found that 30 patients (58%) could return to moderate or strenuous activity. Forty-two patients (81%) were rated as normal or nearly normal on IKDC scores (International Knee Documentation Committee). Forty-six patients (88%) achieved a minimum of 80% recovery of extensor strength and forty-four patients (85%) achieved a minimum of 80% recovery of flexor strength. Statistically significant differences were found in thigh girth, extensor strength, and flexor strength before and after reconstruction. These findings suggest that arthroscopic reconstruction for PCL with four-strand hamstring tendon graft may produce satisfactory results in terms of return to sports/recreation and strength recovery.³

Jenner et al evaluated clinical outcomes in patients following arthroscopic single bundle PCL reconstruction. This small study consisted of 18 subjects with chronic PCL

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instability, who did not respond to conservative treatment. In contrast to the Chih-Hwa study, the mean time from injury to operative management was 3 years. Eight patients received a bone-patellar-tendon-bone (BPTB) autograft, two patients a BPTB allograft and eight patients an Achilles tendon allograft. Patient outcomes were evaluated at a mean follow-up time of 3.3 years. Before reconstruction, all patients were grade D (severely abnormal) using the IKDC evaluation form. Post-reconstruction, 5 patients scored a grade A (normal), 8 patients scored a grade B (nearly normal), 4 patients scored a grade C (abnormal) and one patient scored a grade D (severely abnormal). The Tegner rating system was used to report daily life and sports activities; most patients showed a significant improvement in scores post-operatively. There was not a statistically significant difference between different graft types with respect to clinical outcomes. Of note, the elapsed time between injury and operation correlated to degenerative femoral pathology, suggesting chronicity of injury negatively impacts prognosis. Limitations of the study include small sample size and lack of randomization. However, there is modest evidence here to suggest that, regardless of type of graft type used, reconstruction may be beneficial for patients with symptomatic chronic PCL instability who do not respond to conservative management.¹²

Wang et al used a larger population to examine potential differences in outcomes between autogenous and allogeneous tendon grafts in ligament reconstructions of the knee. Their study prospectively compared functional and clinical outcomes of 32 autogenous and 23 allogeneous PCL reconstructions with an average follow-up time of 34 months. Both types of reconstructions showed comparable favorable results in terms of functional assessment, ligamentous laxity, functional score, kinematics, and radiographic examination.¹¹

Goudie et. al. studied the functional outcome of surgical reconstruction of the PCL with focus on documenting the recovery of muscle function. In this study 20 patients underwent single bundle reconstruction. Patients were assessed by activity level, subjective assessment of the success of the procedure, the presence of any symptom, range of motion, degree of laxity and functional assessment via the Tegner score. The results suggest that functional outcome following PCL reconstruction is good in a majority of cases. Following surgery, knee function improved significantly with most cases achieving a normal or nearly normal rating at final follow up. They found that muscle function improved postoperatively and demonstrated a trend of gradual recovery over the 2 year follow up.¹³

To summarize, in spite of a lack of randomized controlled trials regarding PCL reconstruction and functional outcomes, there is some evidence in the literature to suggest that several types of PCL reconstruction procedures may functionally benefit patients with either subacute or chronic PCL instabilities. The literature suggests that there is a good chance that patients following PCL reconstruction will have good recovery of knee strength and be able to return not only to “normal activity” but also to higher level sports/recreational activities.

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Goals (Measurable parameters and specific timelines to be included on eval form)
Goals of intervention are individualized to each patient's medical status and needs, but may include:

1. Decrease pain
2. Increase ROM
3. Increase strength
4. Normalize patellar mobility
5. Normalize gait pattern
6. Improve balance/proprioception
7. Improve function
8. Improve knowledge regarding post-op precautions and appropriate activity progression

Treatment Planning / Interventions

Established Pathway ☐ Yes, see attached. ☒ No

Established Protocol ☒ Yes, see attached. ☐ No

Interventions most commonly used for this case type/diagnosis.

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

See Brigham and Women's Rehabilitation Services PCL Reconstruction Protocol for details of Rehab progression.

Frequency & Duration: Inpatient Stay: PCL reconstructions are often performed as day surgery procedures; however, in some cases, the patient may require an overnight stay to allow for additional time to achieve adequate pain control prior to returning home. In either case, the patient may be seen for physical therapy intervention focused on mobility and gait training with crutches, education regarding edema and pain control, and basic home exercises to be initiated prior to starting outpatient PT.

Outpatient Care: 2-3x/week for 3-4 months as indicated by patient's status and progression. May need continued care for 4-6 months post-operatively, but at a decreased frequency of 1-2x/wk.

Patient / family education

1. Instruction in home exercise program.
2. Instruction in pain control and ways to minimize inflammation.
3. Instruction in activity level modification /joint protection.
4. Instruction regarding post-operative precautions, including bracing needs, weight-bearing status and appropriate activity progression.

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Recommendations and referrals to other providers.

None, except back to Attending Surgeon if issues arise

Re-evaluation

Standard Time Frame- 30 days or less if appropriate

Other Possible Triggers- A significant change in signs and symptoms, new orthotics may trigger a gait assessment, change in medication for iontophoresis etc.

Discharge Planning

Commonly expected outcomes at discharge: Patient will have achieved approximately 85% of normal quadriceps and hamstring strength. In general, athletes are able to return to full activity 9-12 months following surgery, depending on the demands of the specific sport and progression of physical therapy.¹⁴

Transfer of Care: N/A

Patient's discharge instructions: Continue with individualized home program indefinitely to ensure maintenance of ROM, strength, and function

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