Isolated and Combined Posterior Cruciate Ligament Injuries

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Abstract

Posterior cruciate ligament (PCL) injuries represent 3% to 20% of all knee ligamentous injuries, but the diagnosis often is missed at initial evaluation. Diagnostic acumen is increased by knowledge of knee biomechanics and selective ligament-cutting studies. The examiner must differentiate the isolated PCL injury from combined ligamentous injury to determine appropriate treatment. Isolated acute PCL tears with less than 10 mm of posterior laxity at 90 degrees of flexion should be treated with an aggressive rehabilitative program. This amount of laxity is found in the majority of isolated acute PCL tears. Isolated acute PCL tears with more than 10 to 15 mm of posterior laxity and PCL tears with combined ligamentous injuries should be reconstructed. Large PCL bony avulsions should be fixed internally. Small PCL bony avulsions with more than 10 mm of posterior laxity should be reconstructed. Chronic PCL injuries initially should be treated with an aggressive rehabilitation program. If such a program is not successful in a patient with more than 10 to 15 mm of posterior laxity and no significant radiographic evidence of degenerative changes, the PCL should be reconstructed.

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Injury to the posterior cruciate ligament (PCL) is thought to account for 3% to 20% of all knee ligament injuries.[1,2] The true incidence of PCL injuries remains unknown because many isolated PCL injuries may be undetected. Parolie and Bergfeld[3] noted a 2% PCL injury rate among asymptomatic college football players invited to the National Football League predraft examination.

Accurate diagnosis of the PCL injury is the first step in determining appropriate management. The ability to differentiate an isolated from a combined ligamentous injury is aided by a knowledge of knee biomechanics obtained with the use of selective ligament-cutting techniques.[4] It is also important to understand the natural history of the PCL-injured knee, the results of nonoperative treatment with aggressive rehabilitation, and the results of surgical treatment to determine appropriate management.[5-8] In this article we will present the current approach to the diagnosis and management of isolated and combined PCL injuries.

Mechanism of Injury

Most PCL injuries occur as a result of athletic, motor vehicle, or industrial accidents. The mechanism of most athletic PCL injuries is a fall on the flexed knee with the foot in plantar flexion.[3,7] This imparts the force to the tibial tubercle, which drives the tibia posteriorly and ruptures the ligament, usually resulting in an isolated PCL injury. Similarly, in motor vehicle accidents, the knee is flexed, and the tibia is forced posteriorly on impact with the dashboard.[6] Hyperflexion of the knee without a direct blow to the tibia can also cause isolated PCL injury.

The PCL can be involved in other mechanisms of injury, but these usually involve multiple ligaments. Forced hyperextension can injure the PCL, but this usually results in combined ligamentous injury involving the anterior cruciate ligament (ACL).[1,6] Posteriorly directed force to the anteromedial tibia with the knee in hyperextension may also cause a posterolateral corner injury,[1] which results in varus and external-rotation knee instability. Significant varus or valgus stress will injure the PCL only after rupture of the appropriate collateral ligament.

Biomechanics

Posterior cruciate ligament injuries are commonly overlooked during the initial evaluation of the acutely injured knee. The physical examination findings in isolated PCL injury are subtle. Knowledge of the biomechanics obtained from selective ligament-cutting experiments allows correlation of a simulated physical examination with known ligament injury. Such selective cutting studies measure the change in knee motion after transection of a specific ligament. The experimentally produced change in laxity over a range of knee-

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flexion angles provides an important basis for clinical knee testing.

Gollehon et al[4] used selective ligament-cutting techniques to evaluate the role of the PCL and the posterolateral corner in stability of the knee. They found that isolated sectioning of the PCL increased posterior translation with posteriorly directed force at all angles of flexion, but the maximal excursion occurred at 90 degrees of flexion. With an intact PCL, sectioning of the lateral collateral ligament (LCL) and the deep ligament complex (arcuate ligament, popliteus tendon, fabellofibular ligament, and posterolateral capsule) produced small but significant increases in posterior translation at all angles of flexion and was maximal at 30 degrees. The amount of posterior translation produced by combined sectioning of the LCL and the deep ligament complex with an intact PCL was similar to that produced by isolated sectioning of the PCL at 0 and 30 degrees of knee flexion.

Isolated sectioning of the PCL did not increase varus angulation with varus moment at any angle of flexion. In contrast, sectioning of the LCL and the deep ligament complex resulted in increased varus angulation at all angles of knee flexion and was maximal at 30 degrees. Additional sectioning of the PCL further increased varus angulation at all angles of knee flexion.

Isolated sectioning of the PCL did not increase external rotation with an external rotation moment at any angle of knee flexion. With an intact PCL, sectioning of the LCL and the deep ligament complex increased external rotation at all angles of flexion and was maximal at 30 degrees. Additional sectioning of the PCL markedly increased external rotation at 60 and 90 degrees of flexion.

Clinical Examination

Biomechanical data can be applied to clinical examination of the knee (Table 1). Changes in posterior translation, external rotation, and varus angulation are the most useful findings for detecting injury to the PCL and the posterolateral corner.[1] Isolated PCL injury will allow maximum posterior translation with posteriorly directed force at 70 to 90 degrees of flexion. Since posterior translation is greatest at 90 degrees of flexion, the posterior drawer test should be performed in this position. Achieving 90 degrees of knee flexion in an acute injury may be difficult, however. Increased posterior translation, external rotation, and varus angulation at 30 degrees of knee flexion that decreases at 90 degrees indicates isolated injury to the posterolateral corner. Thus, comparing posterior translation, external rotation, and varus angulation at 30 and 90 degrees can help differentiate PCL injury from posterolateral corner injury.[4] Increased posterior translation, varus angulation, and external rotation at 90 degrees of flexion indicate combined injury to both the PCL and the posterolateral corner.[4]

Table 1
Usefulness of Clinical Tests in Detection of Knee Injury

	Type of Injury*		
Clinical Test	PCL	Posterolateral Corner	PCL and Posterolateral Corner
Posterior drawer, 30 degrees	+	+	++
Posterior drawer, 90 degrees	++++	–	+++
Posterior sag, 90 degrees	+++	–	+++
Quadriceps active	++++	–	+++
Prone external rotation, 30 degrees	–	++++	+++
Prone external rotation, 90 degrees	++	+	+++
Varus stress, 30 degrees	–	+++	+++
Varus stress, 90 degrees	++	+	+++
Reverse pivot shift	–/+	++	++

* Symbols represent grading scale for usefulness in detecting type of injury, ranging from – (not useful) to ++++ (most useful).

The posterior drawer test at 90 degrees of flexion is most useful for documenting PCL insufficiency. This test is performed with the patient supine, with both feet on the table and the knee flexed to 90 degrees. At this angle of flexion, the anterior tibial condyles should be well anterior to the corresponding femoral condyles (approximately 10 mm). The injured knee is compared with the normal knee. If the tibia can be moved posteriorly 0 to 5 mm on the injured side, this is considered a grade I posterior drawer sign. This usually corresponds to posterior displacement of the tibial condyles to a position that is still anterior to the femoral condyles. If the tibia can be displaced 5 to 10 mm posteriorly, this is a grade II posterior drawer sign. This corresponds to posterior displacement of the tibial condyles until they are flush with the femoral condyles. If the tibia can be displaced more than 10 mm posteriorly, this represents a grade III posterior drawer sign. This corresponds to displacement of the tibial condyles posterior to the femoral condyles.

In addition to posterior displacement, the examiner should usually assess an endpoint when performing a posterior drawer test. Most acutely PCL-deficient knees have an altered endpoint with a posterior drawer test. However, the posterior endpoint may return to normal with time in the chronically PCL-deficient knee. In this situation we find the posterior drawer test endpoint less sensitive than the endpoint in a Lachman test done for an ACL injury.

Examination of the injured knee should always include a Lachman test at 30 degrees of flexion. In the PCL-deficient knee, the tibia is subluxated posteriorly, and the Lachman test may demonstrate increased anteroposterior (AP) translation with a firm anterior endpoint. The increased AP translation is due to the posterior subluxation from the PCL injury and should not be confused with the findings in an ACL-deficient knee, which has a soft endpoint.

The posterior drawer test should also be performed with the foot in internal and external rotation. Many patients with a positive posterior drawer sign in neutral rotation have decreased excursion when the drawer test is performed in internal rotation.[3,7] This finding has been attributed to PCL injury with an intact Humphry's, or Wrisberg's, ligament.[7] Such a finding also may indicate maintenance of the integrity of the posterolateral corner, which provides the secondary restraint to posterior displacement.[1]

The posterior drawer test performed with the foot in external rotation (the posterolateral drawer test) has been used to assess posterolateral corner injury. The findings with this maneuver must be compared with those in the intact uninjured knee. A positive finding can indicate injury to the PCL or posterolateral corner but is not specific.[1]

The quadriceps active test is also useful in the diagnosis of PCL injury.[9] This test involves placing the patient supine and flexing the knee 90 degrees with the foot resting on the table (Fig. 1). In the intact knee, a quadriceps contraction results in posterior translation of the tibia relative to the femur. In the PCL-deficient knee, the tibia rests in a posteriorly subluxated position, and a quadriceps contraction produces anterior translation of the tibia relative to the femur. Thus, anterior translation with quadriceps contraction with the knee at 90 degrees of flexion indicates PCL injury. We consider the quadriceps active test and the posterior drawer test to be the most useful tests for diagnosing PCL injury.

The posterior sag test is similar to the posterior drawer test.[6] The test is performed at 90 degrees of hip and knee flexion and uses gravity to apply a posteriorly directed force to the tibia. The posterior sag of the tibia on the injured side is compared with that on the noninjured side. Posterior displacement of the tibia indicates PCL injury.

Passive external rotation of the tibia relative to the femur with the knee at 30 and 90 degrees of flexion should also be examined.[1] This is best evaluated with the patient in the prone position, but the supine position can also be used. The examination is done by comparing the axis of

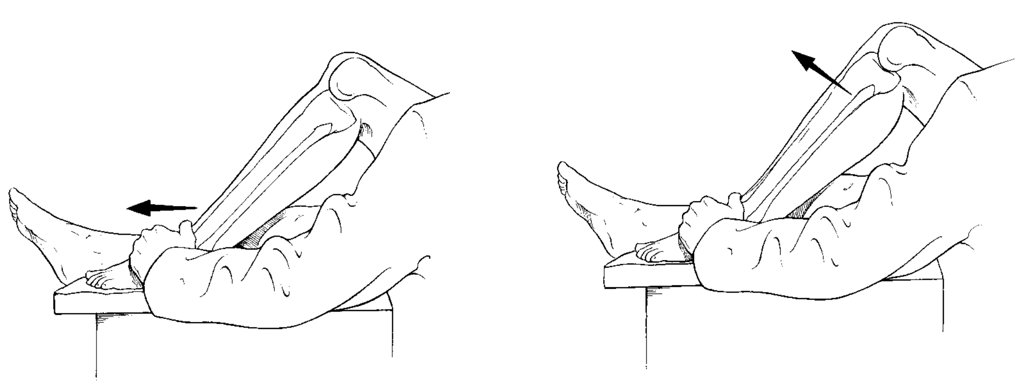

Fig. 1 The quadriceps active test is performed with the affected hip and knee at 90 degrees of flexion and the foot resting on the table. One of the examiner's hands restrains the foot of the affected leg while the patient attempts to slide the foot down the table with a quadriceps contraction. In the PCL-deficient knee, the tibia is posteriorly subluxated (**left**). A quadriceps contraction causes anterior tibial subluxation, which is visible when the examiner is observing the tibial movement from the affected side (**right**).

the medial border of the foot relative to the femur.[1] With the patient placed prone, the foot is forcefully externally rotated, and the degree of external rotation of the foot is compared with that on the noninjured side (Fig. 2). External rotation of the injured knee 10 degrees or more than can be achieved in the noninjured knee is considered significant. In addition, the tibial condyles are palpated to determine their position relative to the femur. This component of the examination ensures that the increased external rotation is from posterolateral, not anteromedial, instability. Increased external rotation at 30 degrees that decreases at 90 degrees indicates isolated injury to the posterolateral corner.[4] Increased external rotation at both 30 and 90 degrees indicates injury to both the PCL and the posterolateral corner.

Varus and valgus stress tests are performed at full extension and 30 degrees of flexion. Increased varus opening at 30 degrees of flexion indicates LCL and possibly posterolateral corner injury. Slightly increased varus opening at full extension is consistent with combined injury to the LCL and posterolateral corner. Significant varus opening at full extension indicates additional injury to the PCL and possibly the ACL.[1] Significant valgus opening at 30 degrees of flexion indicates medial collateral ligament (MCL) injury, which is commonly seen with PCL injury.

The external rotation recurvatum test and the reversed pivot shift test are also used to identify PCL and associated injuries.[9,10] The external rotation recurvatum test involves grasping the great toe with the knee in extension while the patient is supine.[1] A positive sign occurs when the knee falls in varus, hyperextension, and external rotation. This test was originally thought to indicate isolated posterolateral injury. However, when excessive varus and hyperextension are present, injury to the ACL and possibly the PCL is also present. The reverse pivot shift test has been used to diagnose posterolateral instability.[10] This test is significant only if a positive result is found to a greater degree in the injured knee than in the noninjured knee.[1] Normal intact knees may have a positive reverse pivot shift; this correlates directly with generalized ligament laxity.

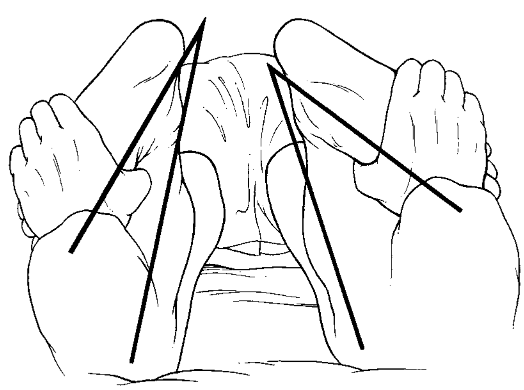

Fig. 2 The prone external rotation test with the patient's knees flexed 30 degrees. The feet are externally rotated by the examiner. External rotation of the affected foot relative to the thigh is compared with that on the normal side. The test result is considered significant if external rotation on the affected side is 10 degrees or more greater than that achieved on the normal side. This test is also performed with the patient's knees flexed 90 degrees.

Diagnostic Studies

Instrumented knee testing and magnetic resonance (MR) imaging can be used to confirm the diagnosis of PCL injury. The most useful application of instrumented knee testing is the quadriceps active test performed with a knee-ligament arthrometer as described by Daniel et al.[9] Magnetic resonance imaging has proved to be sensitive and specific in the diagnosis of acute PCL injury[11] and can be used to identify meniscal and chondral pathologic changes. Magnetic resonance imaging can also be used to detect acute partial PCL tears, which generally present as painful knees without significant posterior instability on physical examination.

Radiographs are useful in documenting PCL avulsion fractures and degenerative changes associated with PCL injury. We routinely obtain standing AP radiographs in full extension and posteroanterior (PA) radiographs in 45 degrees of flexion to assess the presence of compartment wear. Merchant views are used to evaluate the patellofemoral compartment. Standing weight-bearing radiographs in full extension from the hip to the ankle are obtained in cases of combined PCL and posterolateral instability to rule out varus alignment that would require proximal tibial valgus osteotomy prior to consideration of ligament reconstruction.[1]

Natural History and Clinical Results

Knowledge of the natural history and the results of nonoperative and surgical treatment is important when deciding on proper treatment of the PCL-injured knee. Parolie and Bergfeld[3] reported long-term results of nonoperative treatment of isolated PCL injuries. At an average followup of 6.2 years, 80% of the patients were satisfied with their results, and 84% had returned to their previous sport. Rehabilitation of the quadriceps on the injured side to 100% of the strength on the noninjured side correlated with a successful result of the rehabilitative treatment. Fowler and Messieh[5] reviewed the results of treatment of seven complete isolated PCL tears and five partial tears. All patients returned to their previous activity and experienced no limitations in their injured knee. Torg et al[8] reviewed the data on 14 patients with straight posterior instability and 29 with combined multidirectional instability. The patients with straight posterior instability had better functional results than the patients with multidirectional instability. Patients with better functional results were more likely to have greater quadriceps strength in the affected extremity.

Whether the PCL-deficient knee is at risk for the development of degenerative changes is not clear at this time because there are no pertinent prospective studies. In such a study, all patients would be followed up to determine whether chronic articular injury occurs subsequent to or independent of acute chondral injury. Despite the lack of prospective studies, it appears that progressive degenerative changes may occur in some PCL-deficient knees.[7,8]

In theory, compartment degeneration could result from acute chondral injury associated with PCL injury or from increased joint-contact forces created by the absence of the PCL. Skyhar et al[12] used a cadaver model to show that isolated sectioning of the PCL leads to increased medial and patellofemoral compartment pressures. Torg et al[8] reported that degenerative changes noted on radiographs were more common in patients with combined instability patterns than in those with isolated PCL injuries. The degenerative changes in these patients involved both the medial and the lateral compartments. Clancy et al[7] noted no articular damage in 15 acute PCL injuries, although they reported medial compartment changes in chronically PCL-deficient knees. In their series, nine of ten patients who underwent PCL reconstruction more than 4 years after their original injury had moderate to severe articular injury to the medial compartment.

The long-term results of surgical reconstructions for PCL instability also remain unclear.[13] Open reduction and internal fixation of bony avulsions and reconstruction with the central third of the patellar tendon have provided good objective and functional results.[7,13] Primary repair of interstitial tears and PCL reconstructions with the semitendinosus and gracilis, the iliotibial band, and the medial gastrocnemius inconsistently produce good functional results and often fail to provide objective stability.[13]

Acute PCL Instability

Nonoperative Treatment

Routine reconstruction is usually not required for the treatment of isolated acute PCL injuries. The degree of posterior translation is important in assessing an isolated PCL injury. If it is less than 10 mm, as in the majority of isolated injuries, a nonoperative aggressive rehabilitative program should be utilized. If the posterior translation is greater than 10 to 15 mm, reconstruction is advised, since it is likely that additional secondary restraints have been compromised, although this may not be apparent on physical examination. Associated ligament injuries identified by physical examination or at surgery should be repaired or reconstructed. Greater laxity in the acutely PCL-deficient knee may increase the risk of development of degenerative joint disease.

Radiographs are used to document the presence of PCL avulsion fractures and osteochondral injury (Fig. 3). The PCL is not reconstructed when small tibial PCL avulsion fractures are present and posterior translation of the tibia at 90 degrees of flexion is less than 10 mm. If the avulsed fragment is small and posterior translation at 90 degrees of flexion is greater than 10 to 15 mm, the PCL should be reconstructed. If the avulsed fragment is large (i.e., can be internally fixed with a 4.0-mm cancellous screw),

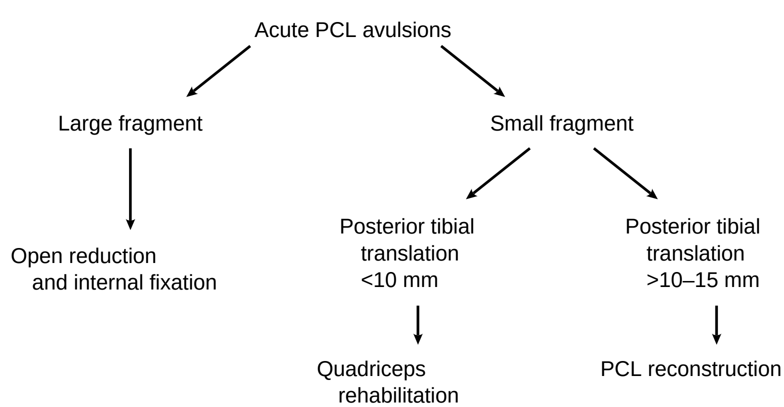

Fig. 3 Treatment algorithm for PCL avulsion fractures.

fixation is warranted. For large tibial avulsions this is performed by a posterior approach as described by Burks and Schaffer.[14]

Magnetic resonance imaging is used to document the location of the PCL tear and the presence of associated meniscal or chondral injury in acute tears that are amenable to nonoperative treatment. The finding of increased signal intensity on the T2 images suggests osseous and possibly chondral injury. If significant chondral injury is suspected, one should perform arthroscopy to evaluate the status of the articular cartilage. Meniscal injury is relatively infrequent in acute isolated PCL ruptures. If a vertical longitudinal tear in the vascularized portion of the medial meniscus is present, we recommend repair, since isolated sectioning of the PCL has been shown to increase medial compartment pressures in a cadaver model.[12] Once the osteochondral and meniscal injuries have been treated, we proceed with a rehabilitation program that emphasizes quadriceps strengthening.

Rehabilitation follows the principles of open- and closed-kinetic-chain exercises.[15] Open-kinetic-chain exercises are performed with the foot free; knee motion is independent of hip and ankle motion. In closed-kinetic-chain exercises, the foot is fixed so that knee motion occurs in concert with hip and ankle motion. Open-kinetic-chain extension exercises (i.e., seated knee extensions with weights) are avoided in PCL rehabilitation, since they can stress the patellofemoral joint. The quadriceps muscles are rehabilitated with functional closed-chain exercises, such as squats and leg presses. This nonoperative rehabilitative treatment requires constant maintenance of quadriceps strength to achieve functional success. When the patient's injured knee has regained 90% of the quadriceps and hamstring strength on the normal side, the patient can return to athletic activity. In the authors' experience, athletes with isolated acute PCL injuries without associated chondral or meniscal injuries can return to their sport in 3 to 4 weeks, but that return must be based on the individual patient's progress; on occasion, return to sport can take significantly longer.

Operative Treatment

If an acute PCL injury is present and the posterior displacement is greater than 10 to 15 mm at 90 degrees of flexion, reconstruction or augmentation of the PCL should be performed (Fig. 4). If a grade III MCL, ACL, or posterolateral injury is present in association with a PCL

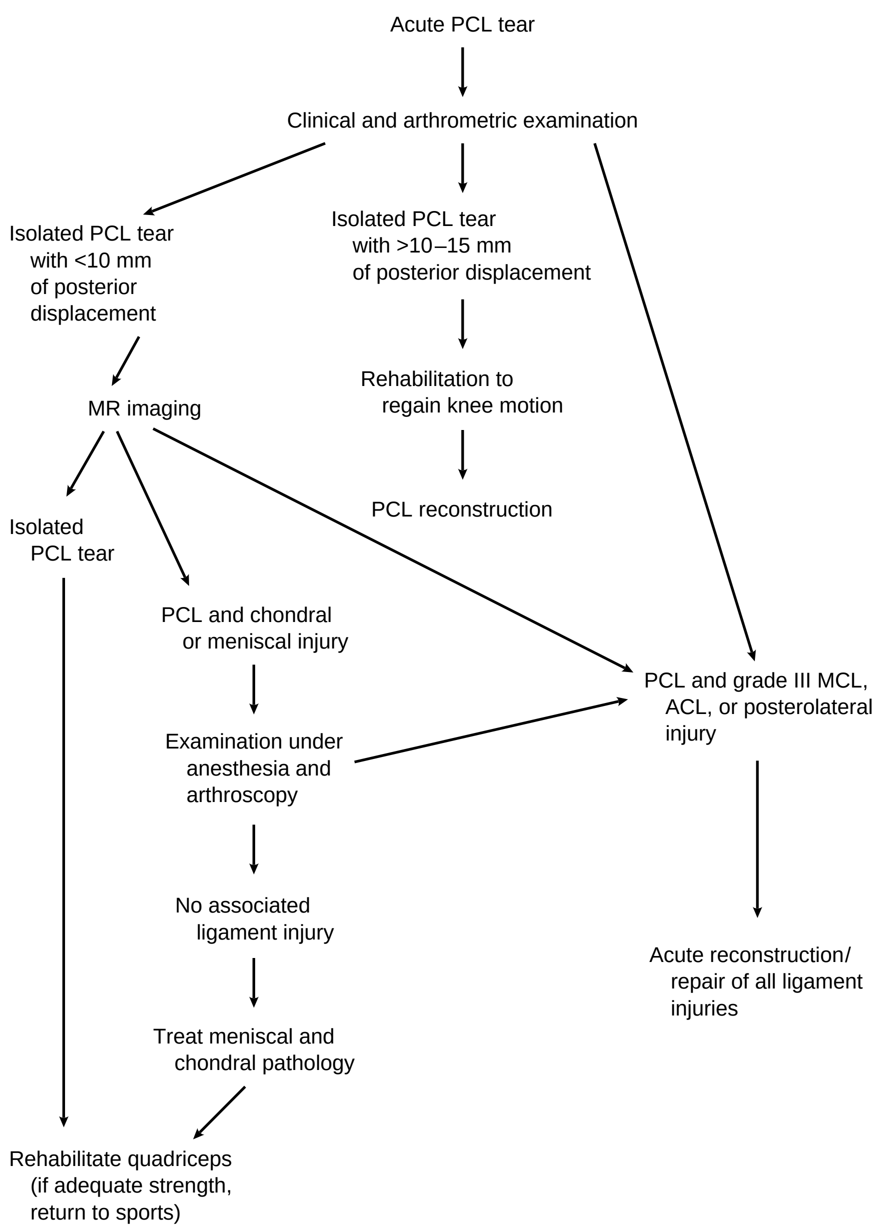

Fig. 4 Treatment algorithm for acute PCL injuries other than avulsion fractures.

injury, reconstruction of all ligamentous injuries should be undertaken. If the knee is grossly unstable, placing the neurovascular structures at risk, early reconstruction with a patellar tendon autograft is performed. In such a case, one must be concerned that a knee dislocation might have occurred and spontaneously reduced. Prior to surgery, an angiogram or MR study with vascular imaging capability should be performed to rule out associated arterial injury.

With associated posterolateral, ACL, or grade III MCL injury, it appears best to operate early (within 1 week) to maximize healing potential, since late surgery for posterolateral injury has relatively poor results. Delaying ACL reconstruction after acute ACL injury to regain full knee motion and to allow for capsular healing has been found to be of benefit in decreasing the incidence of postoperative arthrofibrosis. It may be prudent for operative candidates with acute isolated PCL tears to undergo a rehabilitative course to regain knee motion prior to surgery.

Acute surgical treatment of complete PCL tears can include primary repair, augmentation, or reconstruction, depending on the location of the injury. If the tear is on the bone-ligament interface, we use the principles noted above. Primary repair of intrasubstance PCL tears should not be done without augmentation of the repaired PCL with a semitendinosus and/or gracilis autograft. Alternatively, the defect can be reconstructed with a patellar tendon autograft, a semitendinosus or gracilis autograft, or a patellar or Achilles allograft. The optimal method for PCL reconstruction is not clear at this time, but the use of patellar tendon autografts appears to result in a higher rate of objective success.[7,13] Reconstruction with a patellar tendon autograft is our preferred method, provided there is sufficient length of the patellar tendon (40 mm or more).

Reconstructions of the PCL can be performed with open or arthroscopically assisted techniques. If the arthroscopically assisted technique is chosen, we recommend fluoroscopic control and a posteromedial portal to assist in tibial tunnel preparation.[16] This procedure is technically demanding, particularly because the patellar tendon graft is passed at a sharp angle from the tibia to the femur. This may create fraying of the patellar tendon graft and subsequent laxity. If the tibia is of poor bone quality, the patellar tendon graft may erode through the proximal tibia, creating graft laxity. Most important, the arthroscopically assisted technique requires a patellar tendon length of 40 mm or more to maintain the bone blocks within their tunnels.

Although this procedure can be done in most cases, in some patients the autograft patellar tendon will be too short to allow the bone blocks to remain in their tunnels, and adequate graft fixation will not be achieved. A posterior approach can be used to ensure adequate tendon length and to avoid an acute angle for graft passage.[14] The femoral PCL tunnel is prepared with arthroscopic assistance.[16] A posterior arthrotomy is then used to prepare the proximal tibia for graft placement.[14] The tibial bone block is fixed to the posterior aspect of the tibia using standard 4.0-mm cancellous screws. This allows greater length for passage of the femoral bone block into its tunnel and a straighter graft orientation.

In addition to patellar tendon and semitendinosus or gracilis autografts, allografts can be used for PCL reconstruction. Patellar or Achilles tendon allografts should be longer than 40 mm to ensure adequate length for fixation.

If posterolateral or MCL reconstruction is performed with PCL reconstruction, additional incisions are used. The posterolateral corner can be reconstructed with a biceps tenodesis or patellar tendon allograft. The MCL is repaired primarily. If an ACL reconstruction is needed, this can also be performed arthroscopically. The ACL and PCL femoral and tibial tunnels are prepared first. The PCL graft is inserted next, followed by ACL graft insertion. The PCL graft is fixed with interference screws while the tibia is centered on the femur in full extension. The ACL is then fixed with interference screws with the knee in 20 degrees of flexion. If multiple ligament reconstructions are required, patellar tendon and semitendinosus/gracilis autografts can be used. Finally, multiple allografts can be used to avoid the extensive dissection necessary for multiple graft harvest.

Postoperative Rehabilitation

Postoperative rehabilitation following PCL reconstruction is designed to restore range of motion without stressing the graft. Exercises that produce posterior tibial translation are avoided. Limited weight bearing using crutches is allowed with a knee brace locked in full extension to stabilize the joint. Quadriceps exercises are started on the first postoperative day with active knee extension (without weights) from 90 to 0 degrees and straight leg raises. Passive knee-flexion exercises are used to gain knee flexion slowly over 6 weeks. Open-kinetic-chain hamstring exercises (seated leg curls) are not used, since posterior tibial translation occurs with open-chain knee flexion exercises.[15] Running begins at 5 months and sport-specific agility drills at 6 to 7 months following surgery. Full return to sports is allowed when adequate quadriceps and hamstring strength is demonstrated (90% of that on the noninjured side) and sport-specific agility and proprioreceptive skills have been mastered.

Chronic PCL Instability

Treatment of chronic PCL instability is based on the degree of instability, the radiographic evidence of degenerative changes, and the presence of symptoms that have not responded to rehabilitative treatment (Fig. 5). The surgeon must evaluate the results of previous surgical or conservative treatment. It is important to note the mechanical alignment, the patellofemoral function, and the status of the medial and lateral compartments. Standing AP radiographs in full extension and 45-degree-flexion PA radiographs are useful for documenting early degenerative knee changes. If the patient's main complaint is pain and the symptoms suggest patellofemoral or medial compartment disease, a bone scan is performed. Increased bone-scan activity may represent the sequelae of an acute chondral injury or altered weight-bearing forces due to the absence of the PCL, or it may be unrelated to the chronic PCL injury. Whether the chronically PCL-deficient knee is at risk for progressive degenerative changes is not known. However, isolated sectioning of the PCL has been shown to increase medial and patellofemoral compartment pressures in a cadaver model.[12] We consider progressively increased activity on serial bone scans to be secondary to altered knee biomechanics from the absence of the PCL.

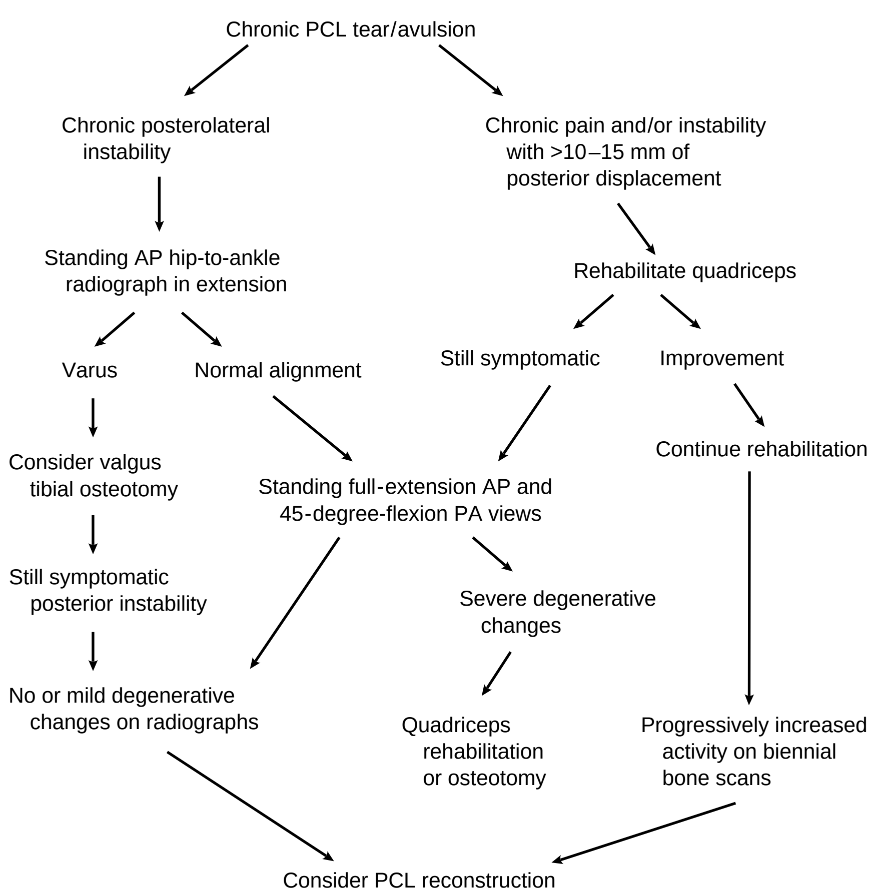

Fig. 5 Treatment algorithm for chronic PCL injuries.

We recommend nonoperative treatment with quadriceps rehabilitation for the majority of patients with chronic PCL instability. In these cases, the degree of posterior laxity alone is not a criterion for reconstruction; one must also consider the presence of symptoms, the results of diagnostic studies, and the results of nonoperative rehabilitation. If posterior displacement is greater than 10 to 15 mm and nonoperative treatment with aggressive rehabilitation has failed, we consider reconstruction. Reconstruction is not performed if there is radiographic evidence of marked degenerative changes. If associated posterolateral instability is present, a standing AP radiograph from the hip to the ankle is used to assess mechanical knee alignment. In knees with posterolateral instability and varus knee deformity, a valgus tibial osteotomy is recommended. If the patient remains symptomatic following osteotomy, PCL reconstruction is considered. Patients selected for a nonoperative aggressive rehabilitative program are followed up closely. In the absence of radiographic evidence of progressive degenerative changes, bone scans are performed every 2 years to see whether bone-scan activity is increasing.

Although there are no prospective studies that document that PCL reconstruction can prevent the development of degenerative knee changes or return bone-scan activity to normal, we recommend PCL reconstruction if early radiographic evidence of mild degenerative change or progressively increased bone-scan activity is noted. We have found that reconstruction can improve stability and decrease pain in such cases. The technique for chronic reconstruction is the same as that outlined for arthroscopically assisted acute reconstruction.[16] If patellofemoral degenerative changes are present, one can use a contralateral patellar tendon autograft, a semitendinosus or gracilis autograft, or a patellar or Achilles tendon allograft for reconstruction to avoid any effect of graft harvest on the patellofemoral joint. Rehabilitation is similar to that after acute reconstruction.

Summary

Although PCL tears are estimated to account for 3% to 20% of all knee ligament injuries, these injuries are commonly missed at initial evaluation.[1,2] The natural history of the PCL-injured knee and the results of nonoperative and surgical treatment provide some guidelines for management of these injuries.[5-8,16] In acute isolated PCL tears with less than 10 mm of posterior laxity at 90 degrees of flexion, current knowledge suggests nonoperative treatment that stresses aggressive quadriceps rehabilitation. In acute PCL tears with more than 10 to 15 mm of posterior laxity at 90 degrees of flexion or combined ligamentous injury, the PCL should be reconstructed with a patellar tendon autograft, a semitendinosus or gracilis autograft, or, in selected cases, a patellar or Achilles tendon allograft. We recommend a patellar tendon autograft for the majority of PCL reconstructions. In combined-ligament injuries, all ligamentous injuries should be reconstructed. Small acute PCL avulsion fractures with more than 10 mm of posterior laxity are treated with PCL reconstruction. All large PCL avulsion fractures are treated with internal fixation. All chronic PCL injuries are initially treated with a nonoperative aggressive rehabilitation program. Reconstruction should be performed in chronic PCL injuries when laxity is more than 10 to 15 mm at 90 degrees of knee flexion, minimal radiographic degenerative changes are present, and a nonoperative aggressive rehabilitation program has failed. Proper diagnosis, the knowledge of the natural history, and the results of surgical and nonoperative treatment provide the rationale for current management of the PCL-injured knee.

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