Surgical Treatment of Posterior Cruciate Ligament Injury

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Successful posterior cruciate ligament (PCL) reconstruction is challenging because of the complex structures and difficult reconstruction techniques that are required. The reported results have been inconsistent. Variables that affect the results of surgery to restore PCL function include combined associated ligaments injury, difficulty to duplicate PCL anatomy, wide variation in broad femoral insertion footprint, difficulty in accurate placement of the transtibial tunnel, tunnel erosion, high internal graft stresses and graft elongation. The outcome of conservative treatment of isolated PCL injuries with mild or moderate laxity is generally acceptable. However, more severe straight posterior laxity or combined injury patterns usually lead to a worse prognosis. Surgical reconstruction for PCL can achieve satisfactory results for most patients if adequate surgical principles and techniques are followed. Recent studies on the anatomy and the biomechanics of PCL have led to a better understanding of its biomechanical properties for the reconstruction. It has been generally agreed that surgical reconstruction is indicated for symptomatic severe posterior knee instability and multiple ligament injuries for better functional recovery after PCL injuries. Accepted surgical techniques for the treatment of PCL tears include primary repair for PCL avulsion fracture, as well as open or arthroscopic reconstruction using the transtibial or tibial inlay technique. Controversy continues over the choice of graft tissue, one or two bundle reconstruction, location of tunnel placement, knee position when securing the graft, and fixation technique. From the accumulated clinical experience and surgical concepts in clinical practice, we have developed various surgical techniques to improve the outcomes of reconstruction. *(Chang Gung Med J 2007;30:480-92)*

Key words: arthroscopy, posterior cruciate ligament, tendon graft, hamstring tendon graft, quadriceps tendon graft, reconstruction

The posterior cruciate ligament (PCL) is the primary restraint to the posterior translation of the knee. The incidence of PCL injuries is lower than that of anterior cruciate ligament (ACL) injuries and occurs in approximately 3.4 to 20 percent of all knee ligament injuries.[1] Isolated partial or complete PCL tears have typically been treated nonoperatively and produced satisfactory short-term results and controversial long-term outcomes. For PCL complete tears with associated posterolateral lesions, nonoperative

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Received: Oct. 24, 2006; Accepted: May 3, 2007
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treatment has been unreliable and associated posterolateral instability. Long-term follow-up studies have shown a high incidence of progressive osteoarthritis and poor knee function.[2,3] Surgical results of PCL reconstruction are variable and often unpredictable. Recent studies on PCL anatomy and biomechanics have led to a better understanding of the biomechanical properties for PCL reconstructions.[4-7] For better functional recovery after PCL injury, surgical reconstruction is indicated for symptomatic severe posterior knee instability and multiple ligament injuries. When considering treatments for PCL injuries, the following should be included in the decision making process: pain, instability level, acute or chronic injury, MRI findings, isolated or combined injuries, and active or inactive life style.

Controversy continues over the choice of graft tissue, one or two bundle reconstruction, location of tunnel placement, knee position when securing the graft, and fixation technique. The single-bundle technique was developed to reconstruct the anterolateral PCL bundle because of its larger size and greater biomechanical properties when compared with the posteromedial bundle.[8-11] In addition, the anterolateral bundle of the PCL has the greatest tension at 90° of flexion, which is the major functional position to resist posterior tibial translation.[10,12-14] A biomechanical study to evaluate the single-bundle versus double-bundle PCL reconstruction has showed that double-bundle reconstruction can more closely restore the biomechanics of the intact knee than the single-bundle reconstruction throughout the range of knee flexion. Only the double-bundled graft restored normal knee laxity across the full range of flexion.[15-17]

A variety of grafts for PCL reconstruction have been proposed including autograft, allograft, artificial ligament, and graft with prosthetic augmentation. For double bundle fixation, there were several different graft choices including double strands anterior tibialis tendon allograft, Achilles tendon allograft, semitendinosus-gracilis autograft, double tendon strand form quadriceps tendon graft, and double-bundle Y-shaped hamstring tendon graft.[18-25] We have used hamstring tendon or quadriceps tendon autografts for PCL reconstruction and regarded them as acceptable graft choices.

Injuries to the posterolateral structures of the knee are challenging to the treatment. When acute grade 3 posterolateral injuries are combined with PCL injuries, all structures should be addressed at the time of surgery. Because of the consistent presence of the lateral collateral ligament (LCL), popliteus tendon, and popliteofibular ligament, these should be the focus of repair of the posterolateral structures of the knee. The popliteus tendon was observed to be the primary restraint to external rotation and the LCL the primary restraint to varus opening. Injury of the LCL and popliteus tendon created increases in external rotation and varus rotation at all angles of knee flexion. Severe acute injuries generally require operative repair. Combined injuries should be treated with repair or reconstruction of both the lateral ligaments complex and the injured PCL. Many reconstructive procedures have been described for chronic posterolateral instability, however, no consensus exists. A variety of grafts have been described for the reconstruction of the posterolateral structures, including split Achilles tendon allograft, patellar tendon bone-tendon-bone autograft or allografts, quadriceps tendon graft, or hamstring tendon graft.[26-35]

Diagnosis and surgical principle of PCL reconstruction

The surgical indications for PCL reconstruction include symptomatic severe posterior knee instability or association with multiple ligament injuries. For patients with Grade 3 or 4 PCL injuries without significant posterolateral lesions, PCL reconstruction was performed. For patients with combined PCL and significant posterolateral instability, simultaneous PCL and posteriolateral (PL) reconstruction should be performed. PCL rupture can be identified using the posterior drawer test, positive posterior sag sign and MRI. Posterolateral instability can be diagnosed using external tibial rotation at 30 and 90 degrees, external rotation thigh foot angle test, posterolateral external rotation test, reverse pivot-shift test, external rotation recurvatum test, and posterolateral drawer test. Each patient should be fully informed of the details of the condition and the surgical procedures. Arthroscopic surgery was not performed for acute injuries until the knee achieved near full range of motion (ROM) with minimal pain and effusion. For patients with concomitant posterolateral instability, a semitendinosus tendon autograft from the contralateral limb or tendon allograft was employed to reconstruct the popliteofibular ligament and fibular collateral ligament.[36,37]

Rehabilitation guidelines

The initial goals in postoperative management of PCL reconstruction are to decrease pain, decrease inflammation and swelling, re-establish quadriceps control, and restore a normal gait. Postoperatively, the knee is immobilized in full extension during the first week. Full weight-bearing is allowed as tolerated by the patient. Quadriceps isometric exercises, straight-leg raising and passive ROM should be initiated as early as possible. During the first 4 weeks following surgery, protected ROM from 0° to 60° is maintained, and a series of closed kinetic-chain exercises are started. At 6 weeks, the brace is unlocked to establish a normal gait and allow for passive ROM. At 8 weeks, the active ROM should progress to complete flexion and extension, and aggressive hamstring-strengthening exercises should be initiated. Quadriceps and hamstring muscle strength are trained according to an at home rehabilitation program. Patients usually return to normal daily activity within 3 months of the surgery, and return to light sports activity by 6 months after the surgery. Resumption of full pre-injury sports activities can be undertaken between 9 and 12 months following the reconstruction. For the patients with combined PCL and PL reconstruction, the full extension brace is applied for 3 weeks for non-weight bearing immediately after operation. Progressive range of motion occurs during weeks 4 through 6. Progressive weight bearing starts at the end of 6 weeks after the surgery. Progressive closed-chain kinetic strength training and continued motion exercises are performed. The brace may be discarded at 10 weeks after the surgery. Return to sports and heavy labor activity is recommended at 9 months after the surgery when sufficient muscle strength and range of motion has recovered.

For PCL injury with insufficient posterior and posterolateral function, we have developed various surgical techniques to improve the outcomes of the reconstruction. The results of the following studies reveal our research in the basic and clinical aspects of PCL injuries.

Comparison of three grafts in PCL reconstruction in an animal study[38]

In this study, we evaluated the initial fixation strength of three grafts using in PCL reconstruction in a porcine model. Twenty fresh porcine knees were harvested and randomly assigned to four groups: bone-patellar tendon-bone graft, quadruple tendons graft, Achilles tendon graft, and normal PCL. After reconstruction, the knee was tested on a material testing system (MTS) testing machine by translating the tibia posteriorly until failure at 30 degrees of flexion, neutral rotation, and anatomical vertical alignment. Biomechanical parameters, including maximal failure load, stiffness, and failure modes, were analyzed and compared. In the maximal failure load, the four-strand tendon group was significantly greater than the other two grafts. However, it had the greatest translation. There were no significant differences between the three grafts in stiffness. All three of these commonly used grafts had weaker initial fixation strength and stiffness than the normal PCL. Graft failure occurred mainly at the tendon-bone junction and tendon-suture sites. The Patellar tendon group had significantly lower translation during the continuing loading test.

Arthroscopic PCL reconstruction with quadriceps tendon autograft[39,40]

In this study, we described an arthroscopic PCL reconstruction technique using the quadriceps tendon-patellar bone autograft with a minimum of 3 years of follow-up. A total of 83% of the patients achieved good or excellent results using the Lysholm knee rating. A total of 55% of the patients returned to moderate or strenuous activity. A total of 86% of the patients had ligament laxity of less than 5 mm. A total of 83% of the patients were rated as normal or nearly normal using the International Knee Documentation Committee (IKDC) guidelines. A statistically significant difference existed in thigh girth difference, extensor strength, and flexor strength before and after reconstruction. Quadriceps tendon autograft has the advantages of being self-available, relatively easier arthroscopic technique, and having a suitable size, making it an acceptable graft choice for PCL reconstruction. Our study revealed satisfactory clinical subjective and objective results at a minimum of 3 years of follow-up (Fig. 1).

One-incision endoscopic technique for PCL reconstruction with quadriceps tendon autograft[41]

A 2-incision technique with outside-in fixation

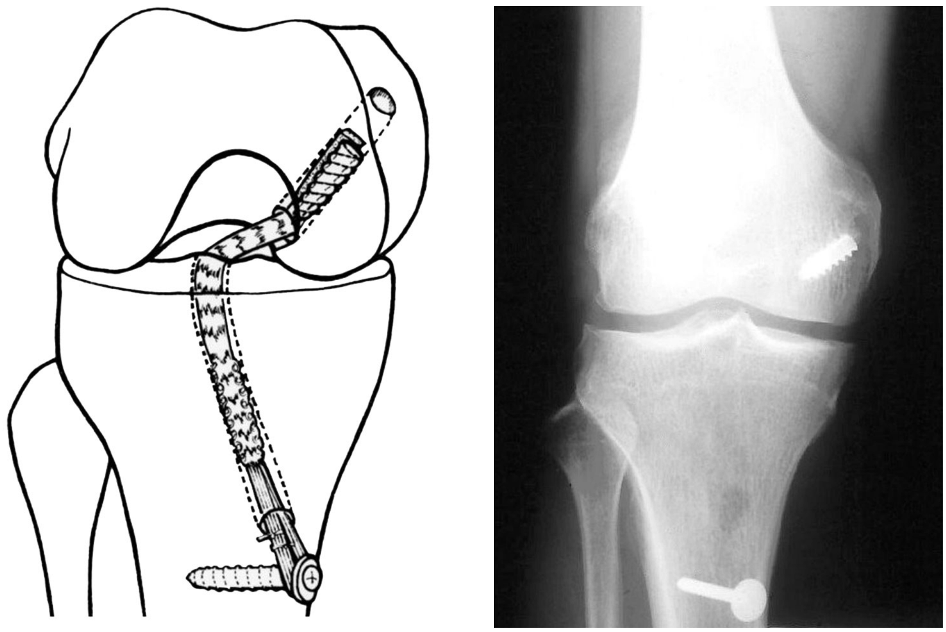

Fig. 1 Arthroscopic PCL reconstruction with quadriceps tendon autograft.

at the femoral condyle is generally used. In this study, we described a 1-incision endoscopic technique for PCL reconstruction with quadriceps tendon-patellar bone autograft. Three arthroscopic portals, including anteromedial, anterolateral, and posteromedial, were used. All procedures were performed in an endoscopic manner with only one incision at the proximal tibia. At the femoral side, the bone plug was fixed by an interference screw. At the tibial side, the tendon portion was fixed by a suture to a screw on the anterior cortex and an interference bioscrew in the posterior tibial tunnel opening. The 1-incision technique provides a simple reconstruction method for PCL insufficiency without a second incision at the medial femoral condyle.

Arthroscopic double-bundled reconstruction with quadriceps tendon autograft[42]

In this study, we presented an arthroscopic technique for double-bundled reconstruction for PCL with quadriceps tendon-patellar bone autograft. Anterolateral and posteromedial tunnels were created to simulate and reproduce the double-bundle structure of the PCL. The bone plug was situated at the tibial tunnel and fixed by a titanium interference screw. Each of the bundles of tendon graft was rigidly fixed at the femoral tunnel with a bioabsorbable screw (Fig. 2).

PCL reconstruction with hamstring tendon graft and double fixation technique[43,44]

In this study, we prospectively assessed the outcomes of PCL reconstruction using quadruple hamstring tendon autograft with a double-fixation technique at a minimum of 4 years of follow-up. The mean Lysholm scores were 54 (40-65) and 91 (65-100) points ($p < 0.01$) before and after surgery, respectively. A total of 58% of the patients returned to moderate or strenuous activity. The average posterior displacement measured with KT-1000 was 11.69+/-2.01 mm preoperatively and 3.45+/-2.04 mm postoperatively. A total of 81% of the patients demonstrated less than grade 1 ligament laxity. A total of 81% of the patients were rated as normal or nearly normal based on IKDC scores. A total of 88% of the patients achieved a minimum of 80% recovery of extensor strength and 85% achieved a minimum of 80% recovery of flexor strength. The semitendinosus and gracilis tendon graft was adequate in graft size, easy to perform technique and more reproducible outcomes (Fig. 3).

Comparison of clinical outcomes in two grafts for PCL reconstruction[45]

In this study, we compared, at a minimal 2-year follow-up, the outcomes of PCL reconstruction between using the quadriceps tendon autograft and the quadruple hamstring tendon autograft. Using the Lysholm knee rating, 86% of patients showed good or excellent results in the quadriceps tendon group and 89% of patients showed good or excellent results in the hamstring tendon group. In the postoperative

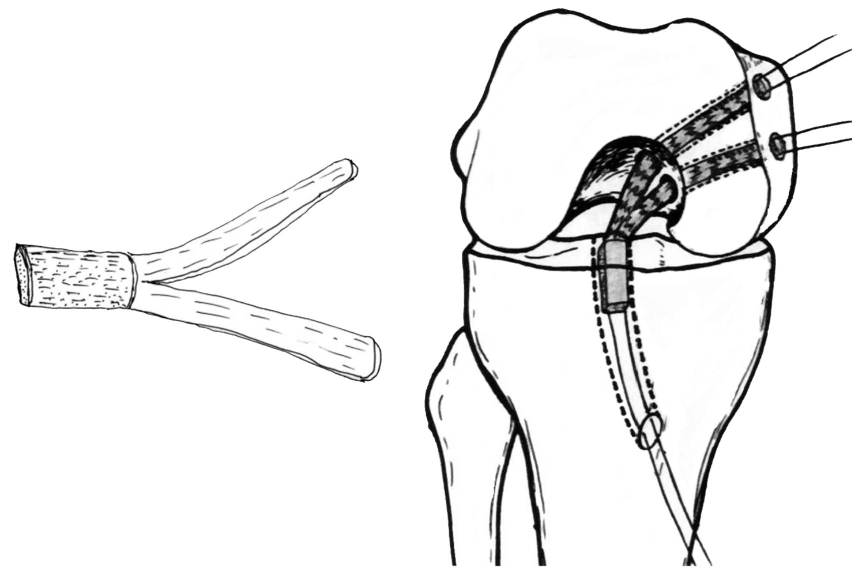

Fig. 2 Arthroscopic double-bundled reconstruction with quadriceps tendon autograft.

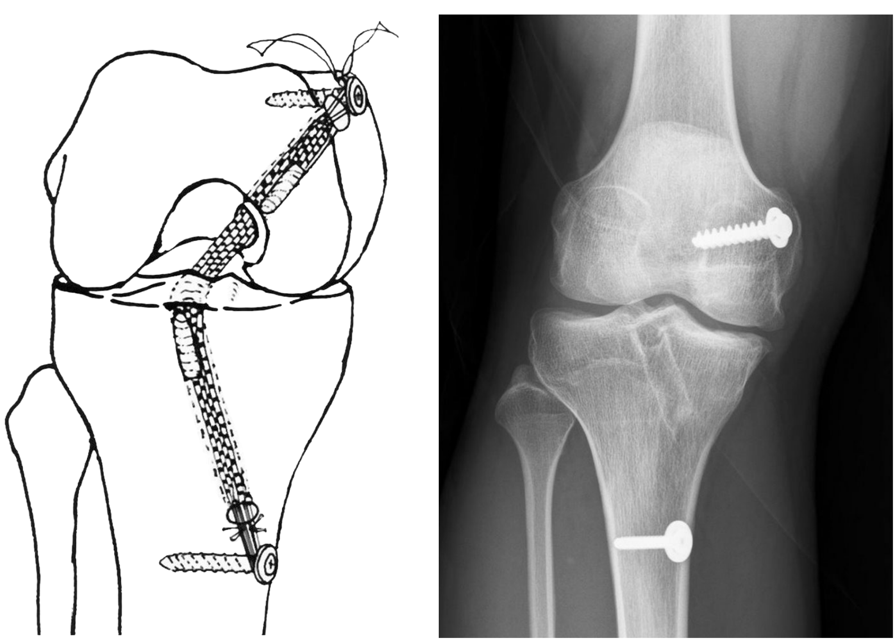

Fig. 3 Arthroscopic PCL reconstruction with hamstring tendon graft and double fixation technique.

ligament laxity, 59% percent of the quadriceps tendon group and 56% of the hamstring tendon group revealed 3- to 5-mm ligament laxity. The IKDC rating showed no significant differences between the two groups in terms of activity level, ligament laxity, or final ratings. Comparable satisfactory results between the two surgical groups were shown at a minimum of 2 years of follow-up.

Arthroscopic double-bundled PCL reconstruction with quadriceps tendon and hamstring tendon grafts[46]

In this study, we present a novel arthroscopic technique for double-bundle reconstruction of the PCL. A quadriceps tendon-patellar bone autograft was used to reconstruct the major anterolateral bundle. An additional double-stranded semitendinosus tendon was used to reconstruct the posteromedial bundle. At 70 degrees of flexion and full extension with anterior drawer force, the quadriceps tendon graft and semitendinosus tendon graft were fixed inside the anterior aspect of the single tibial tunnel, respectively. Anatomic reconstruction was achieved using both of these two autografts (Fig. 4).

Tibial inlay technique with quadriceps tendon autograft for PCL reconstruction[47]

In this study, we describe an arthroscopic-assisted inlay technique for PCL reconstruction using quadriceps tendon-patellar bone autografts. Bone plugs were fixated at the original PCL insertion sites at the tibia and the free tendon portion was fixated with Bioscrew and screwed at the femoral condyle. The tibial inlay method has the benefit of preventing the acute turns associated with transtibial reconstruction and permitting accurate anatomic placement of the graft. This technique is a reasonable alternative for PCL reconstruction.

Double-bundle PCL reconstruction using a tibia inlay technique with quadriceps tendon autograft[48]

In this study, we presented an inlay technique for arthroscopic PCL reconstruction using a double-bundled quadriceps tendon-patellar bone autograft. The tendon portion of the quadriceps tendon graft was split into a larger part for reconstruction of anterolateral bundle and small part for posteromedial bundle. The bone plug was fixated at original PCL insertion site at posterior tibia and two free tendon parts were fixated with Bioscrews and screwed within two tunnels at the femoral condyle. The double-bundled graft appeared to restore normal knee function across the full range of flexion (Fig. 5).

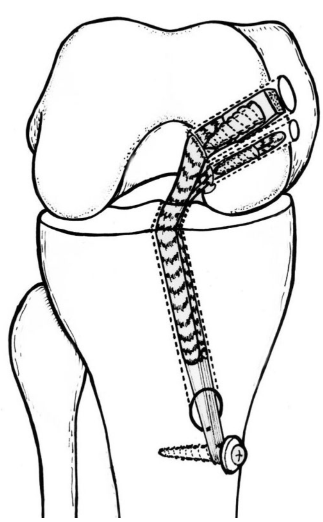

Fig. 4 Arthroscopic double-bundled PCL reconstruction with quadriceps tendon and hamstring tendon grafts.

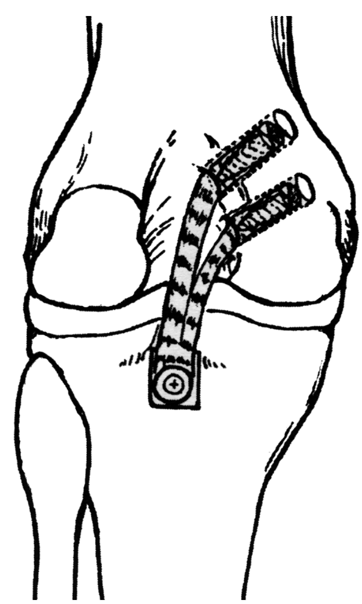

Fig. 5 Double-bundle PCL reconstruction using tibial inlay technique with quadriceps tendon autograft.

Fixation of a small tibial avulsion fracture of the PCL using a double bundles pull-through suture method[49]

We describe a new technique for fixation of an avulsion fracture with a small bony fragment. The technique uses a double bundles pull-through suture technique that repairs the anterolateral and posteromedial components of the posterior cruciate ligament simultaneously. Return to the same or a higher level of preinjury sports activity was achieved in 92% of the patients. A total of 83% of the patients had normal or nearly normal ratings using the IKDC rating system. The double bundles pull-through suture technique can avoid the risk of breakage of the small bony fragment, does not require the removal of hardware, and achieved adequate repair in the anatomic situation.

Quadriceps tendon autograft for the lateral collateral ligament and posterolateral reconstruction[50]

In this study, we introduced a reconstructive procedure to restore the lateral collateral ligament (LCL) using a quadriceps tendon-patellar bone autograft. The bone plug was put into a tunnel at fibular head and fixation with interlocking screw and the free tendon part was fixated into a tunnel at the original LCL insertion site in the lateral femoral tunnel. The procedure was designed for unstable knees with concomitant cruciate ligament tears and posterolateral complex injuries.

DISCUSSION

Successful arthroscopic PCL reconstruction is challenging because of the difficulties in arthroscopic techniques, and the reported results have been inconsistent. Variables that affect the results of surgery to restore PCL function include combined associated ligament injuries; difficulty in duplicating the PCL precisely; wide variation in broad femoral insertion footprint; difficulties in accurate placement of the transtibial tunnel; tunnel erosion or migration can occur over time; and high internal graft stresses and graft elongation using the transtibial technique.[51-63] Severe straight posterior laxity or combined injury patterns lead to worse prognoses.[64-67] Arthroscopic reconstruction for PCL can achieve satisfactory results for most patients if adequate surgical principles and techniques are followed.[10,36,37,51-57,59,62,68-71]

Accepted surgical techniques for the treatment of PCL tears include primary repair for PCL avulsion fracture, open or arthroscopic reconstruction using the transtibial or tibial inlay technique and the one bundle or double bundle method. The optimal graft choice remains controversial. The patellar tendon-bone autograft is the most commonly used graft because of its graft-healing potential. However, there is difficulty using this graft in the transtibial technique and the graft donor site may be associated with postoperative anterior knee pain. The Achilles tendon allograft appears to be a popular PCL substitute to avoid donor site problems. However, allograft tissues are not widely available in many countries and disease-transmission risk remains uncertain.

The quadriceps tendon autograft has the advantage of being patient-available, easier arthroscopic technique, suitable size and strength, which makes it an acceptable graft choice for PCL reconstruction.[39,45] The mean cross-sectional area measurements of a 10-mm wide quadriceps tendon averaged 64.4 ± 8.4 mm^2, which is significantly larger than the mean measurements of the patellar tendon, which measured 36.8 ± 5.7 mm. The mean lengths of quadriceps tendons average 87.0 ± 9.7 mm and 85.2 ± 8.4 mm for right and left knees, respectively, compared with the mean lengths of the patellar tendons measured 51.6 ± 6.9 mm and 52.2 ± 4.8 mm. In biomechanical studies, structural tensile property analysis shows that the ultimate tensile failure load for unconditioned quadriceps tendon-bone complexes is at 2173 ± 618 N compared with 1953 ± 325 N for bone-patellar tendon-bone complexes.[72,73] The ultimate tensile failure load of the quadriceps tendon is 1.36 times that of a comparable-width patellar tendon graft.[74] Evidence from anatomical and biomechanical analysis supports using the quadriceps tendon-patella construct for ligament reconstruction.

Hamstring tendon grafts have become popular for PCL reconstruction in recent years. However, a single-strand semitendinosus tendon seems to be insufficient for PCL reconstruction. The maximum tensile load of a single-strand semitendinosus tendon was inferior to that of the ACL (1216 N to 1725 N, respectively).[39] The cross-sectional area of a single-strand semitendinosus tendon tended to be much smaller than that of a central 10 mm patellar tendon from the same donor (13.6 mm^2 and 36.9 mm^2, respectively). For ligament reconstruction, a 4-strand graft of semitendinosus and gracilis tendons was generally adequate with a suitable graft size. The ultimate failure load and stiffness measured in the 4-strand tendon group was the highest among three commonly used grafts.[(38)] Although the quadruple tendon graft had greater translation during continuous loading, the quadruple tendon graft provided the strongest primary fixation strength.

For the fixation of the hamstring tendon graft in PCL reconstruction, bioabsorable screws, suture to screws, and Mersilene tape to screws have been used.[(58,63,66,75)] When using tendon grafts for PCL reconstruction, a double fixation at both the femoral and tibial sides may be an effective method for augmentation of the initial fixation stability.[(8)] We think that additional fixation near the bone tunnel using an interference screw combined with external suspension fixation will achieve more rigid and adequate graft fixation during the early postoperative stage and avoid progressive graft elongation.[(43)]

The results of PCL reconstruction using the transtibial tunnel technique have been inconsistent, and very few authors have been able to report satisfactory results after long-term follow-up. Some authors have reported excellent results using a single-bundle graft and the transtibial tunnel technique.[(36,37,53-57)] However, others have shown difficulties duplicating the promising results.[(64,66,71,76)] Some researchers recognized several weaknesses and limitations inherent in the clinical studies of PCL reconstruction. The series were a combination of acute and chronic cases. The surgical outcome analyses included isolated and combined reconstructions as well as fresh and chronic cases that may have influenced the preoperative scores and stability tests.

Residual ligament laxity after PCL reconstruction may be related to the techniques in the optimal graft tension, the best angle of knee flexion, and the mode of fixation. The results of an excellent biomechanical study showed that a 15-lb tension to the graft at 20 degrees to 30 degrees of knee flexion was optimal in PCL reconstruction. There were no statistical differences in the failure load between interference fixation and post fixation despite different modes of fixation failure.[(77)]

Graft abrasion caused by sharp graft angulation at the graft-tunnel margin of the proximal tibia (the "killer turn") may cause graft failure after PCL reconstruction using the traditional anteromedial route tibial tunnel. The results of a biomechanical study revealed that the anterolateral route tibial tunnel significantly reduced the sharp graft angulation at the graft tunnel margin of the proximal tibia which was regarded to be a better choice when arthroscopic PCL reconstruction was performed with the trans-tunnel technique.[(78)]

The tibial inlay technique for PCL reconstruction was developed to decrease the disadvantages in the transtibial technique. The tibial inlay technique approaches the PCL insertion site directly and achieves anatomic fixation which has the advantages of avoidance of killer-turn and graft thinning or elongation, better biomechanics, and graft healing. However, it is a technically demanding procedure with many challenges, including patient positioning, balancing of incisions, proximity to the neurovascular structures, graft selection, and tibial graft fixation.[(11,17,22,79-82)] In addition to these challenges, the tibial inlay technique necessitates the removal of all remaining posterior cruciate ligament tissue. In many patients, there are substantial posterior cruciate ligaments and meniscofemoral ligament attachments that can be preserved and used during the arthroscopic reconstruction. Usually, it is not the procedure of choice for primary PCL reconstruction. This technique does have a role in certain primary PCL reconstruction and revision procedures in which the transtibial tunnel is found to be poorly positioned.[(47,48,83-86)]

A technique of PCL reconstruction using hamstring tendon grafts with PCL remnant augmentation became popular for several advantages. The hamstring graft could act as an independent PCL reconstruction and maintain the PCL remnant tension. The PCL remnants and synovium may be beneficial to ligament healing and postoperative rehabilitation.[(87)] This procedure significantly contributed to the posterior stability and proprioception of the knee joint, the remnant femoral fibers and meniscofemoral fibers were preserved to be healed with a graft and subsequently form an integrated structure.[(88)]

From the outcome analyses in our series, the average Lysholm knee scores were 86-89 points at final assessment. For return to sports activity evaluated using IKDC scores, 55-59% of the patients could return to strenuous or moderate activities after reconstruction. For subjective knee function, 85-86% of the patients rated their reconstructed knees as normal or nearly normal status. For ligament laxity, 56-58% revealed grade 1 ligament laxity when measured using the KT-1000 arthrometer tests. Approximately 9 to 15% of the patients had grade 2 knee posterior laxity. For the functional test, 81-85% recovered to 90% of the normal knee. In the IKDC final rating, 81-82% of the patients rated as nearly normal or normal. Significant improvement in the posterior laxity was achieved using our techniques.

PCL injury is frequently associated with multiple ligamentous injuries. The PCL plays an important role in the posterolateral stability of the knee, and its injury may cause mild to moderate PL instability. The coupled posterolateral displacement after cutting the PCL was 173% of the intact knee.(89) With an intact PCL, the coupled PL displacement after cutting the popliteus tendon and lateral collateral ligament was 299% of the intact knee. When the PCL was cut together with the popliteus tendon and lateral collateral ligament, the coupled PL displacement was 367%. In a knee with PL instability, injury of the PCL must be considered. Injury to the PCL further increased the PL instability and caused posterior translation of the knee.(89) Unlike isolated PCL injuries, there is a consensus of opinion that surgical reconstruction is indicated in knees with combined PCL and posterolateral instabilities. Commonly employed methods of reconstruction of the posterolateral corner include popliteus reconstruction, lateral collateral reconstruction or advancement, and a combination of the two.(71,90)

Thigh muscle atrophy and incomplete thigh muscle strength recovery seemed inevitable after PCL injuries especially in the patients who were not competitive athletes and were not motivated to follow strenuous muscle training and only modified their sports and daily activity. More aggressive muscle training program should always be emphasized to recover thigh muscle strength.

CONCLUSION

Successful PCL reconstruction is still a challenge because of its complexities in structures and variable reconstruction techniques. The clinical outcomes have been inconsistent and dependent on the injury condition. With adequate surgical principles and techniques, patients with symptomatic posterior knee instability and multiple ligament injuries undergoing PCL reconstruction can achieve satisfactory results. In recent years, great progress has been made in basic knowledge and surgical techniques in PCL injuries which has resolved some of the controversy about the choice of graft tissue, bundle reconstruction, location of tunnel placement, transtibial or tibial inlay technique, knee position when securing the graft, and fixation methods.

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後十字韌帶傷害之手術治療

陳志華

後十字韌帶主要功能爲維持膝關節向後的穩定度並當作阻止脛骨向後移位的主要構造。後十字韌帶也是維持對內外翻及旋轉穩定度的重要結構。後十字韌帶傷害發生機轉主要是當膝部在彎曲時，直接在脛骨上部的直接撞擊或遭受到過度伸直或在內外翻受外力傷害。嚴重的後十字韌帶斷裂而造成膝關節不穩定或有合併其它韌帶傷害或慢性後十字韌帶傷害而有症狀及在年輕活動力強的病人等情況，皆應考慮開刀重建。開刀重建的主要目的，是重作一條新的後十字韌帶，以回復其維持向後穩定的功能。目前後十字韌帶重建手術主要是在關節鏡下進行。常用的重建移植物有股四頭肌自體移植物及腿後肌腱自體移植物。手術方法主要是單股後十字韌帶重建。近來也發展雙股重建術以期望完全重建正常解剖構造以回復較正常之運動功能。本研究中，將列出作者對於後十字韌帶重建手術之觀念及發展之手術方法，包括基礎研究、手術技巧、臨床結果分析及不同術式之比較研究。(長庚醫誌 2007;30:480-92)

關鍵詞：關節鏡，後十字韌帶，肌腱移植物，腿後肌腱移植物，股四頭肌移植物，重建

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