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# 한 개의 신선동결 동종아킬레스건을 이용한 후방십자인대 및 후외방구조의 동시 재건술

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**목적**: 슬관절의 후방 및 후외측 불안정성을 동종 아킬레스건 1개를 나누어 동시에 재건하는 수술 방법을 보고하고자 한다.

**대상 및 방법**: 슬관절의 후방 및 후외측 불안정성으로 수술받은 42명(45예)을 조사하였다. 남자 38명, 여자 4명이었고, 평균 나이는 39세였다. 수술 방법은 이식건으로 동종 아킬레스건을 2:1 넓이로 나누어 큰 것은 (Ø10 mm) 후방십자인대, 작은 것은 (Ø8 mm)은 후외측 재건술에 사용하였다. 먼저 후방십자인대에 대하여 관절경적으로 10 mm 신선 동결 동종 아킬레스건을 이용하여 후방십자인대 잔유물을 보존한 채로 경경골 접근법, 단일절개, 단일가닥방법으로 재건술을 시행하였으며, 후외측 불안정성에 대해서는 작은 이식건을 사용하여 변형된 8자 모양으로 고정하여 외측부 인대 및 슬와비골 인대를 재건하였다. 평균 추시 기간은 25개월이었다. 임상적 평가는 운동범위, 후방전위검사, 내반 부하 검사, 복와위 외회전(dial) 검사, Lysholm 점수와 Tegner 점수 및 후방전위 방사선검사로 평가하였다. 평균 추시기간은 25개월 이었다.

**결과**: 후방 전위 검사에서 수술 전 Grade II 5예, Grade III 40예, 추시관찰 시 정상 22예, Grade I 18예, Grade II 5예로 호전되었다. Dial 및 내반 부하 검사는 수술 전 45예 모두 양성에서 수술 후 36예에서 정상, 9예에서 양성을 보였다. 수술 후 10도 이상 굴곡제한을 보이는 경우가 3예 있었으나 나머지는 모두 정상 관절 운동 범위를 보였다. Lysholm 점수는 수술 전 평균 50점에서 수술 후 83점으로 호전되었다($p<0.05$). Tegner 활동 점수는 수술 전 평균 2.1에서 수술 후 4.6점으로 호전되었다 ($p<0.05$). 슬관절 90도 굴곡위에서 시행한 후방 긴장 방사선 소견상 수술 전 평균 16 mm에서 수술 후 4.1 mm로 호전되었다 ($p<0.05$). 후방 전위 검사, 내반 부하 검사, dial 검사 등의 임상적 검사와 방사선 사진에서 후방 전위 정도를 비교하였을 때 모든 환자에서 수술 전보다 나은 결과를 보였다.

**결론**: 슬관절의 만성 후방 및 후외측 불안정성을 동종 신선 동결 아킬레스건을 이용하여 동시에 재건해 좋은 결과를 얻을 수 있다.

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## Introduction

Although posterior cruciate ligament (PCL) injury was thought to be rare compared to anterior cruciate ligament (ACL) injury and respond to conservative treatment, there has been advancement in treatment and prognosis because of development of diagnostic methods, surgical technique and many investigation on anatomy and biomechanics of PCL. In many cases, complex PCL injury combined with posterolateral corner (PLC) injury comes more commonly than isolated PCL injury. In these cases, treatment of a PCL reconstruction will not guarantee good results. To obtain excellent results and adequate stability, combined surgery is necessary. And many kinds of operation method were introduced[1,5,10,15,17].

We performed combined reconstruction surgeries of PCL and PLC in patients with PCL rupture and posterolateral instability at a time using a fresh frozen Achilles tendon allograft. The goal of this study is to analyze the clinical and radiologic results of this combined surgery.

## Materials and methods

Forty-two patients (45 cases) with combined PCL rupture and posterolateral rotatory instability (PLRI) were studied from January 2003 to February 2008. There were 38 males and 4 females. Mean age was 39 years (range, 15~66 years). Mean interval after trauma was 12.4 months (3~25 months). The causes of injuries were traffic accident in 30 patients, sports injury in 12

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patients (4 during Taekwondo, 4 during skiing, 3 during running and 1 during wrestling). There were associated injuries of 10 meniscus tear. Seven cases of medial meniscus injury was done partial meniscectomy, and 3 cases of lateral meniscus injury was repaired. Mean follow up period was 25(12~40) months. All patients had been operated by a single surgeon. The indication for surgery was as follows: (1) posterior drawer over grade II, (2) posterolateral instability over 10 degrees compared to healthy knee in dial test, (3) normal range of motion (ROM) of the knee.

Used graft was a fresh frozen Achilles tendon allograft, which was divided by two size, larger one(Ø 10 mm) for PCL reconstruction and smaller one(Ø 8 mm) for PLC reconstruction (Fig. 1). Arthroscopic reconstruction of the PCL was performed using transtibial, single incision, and single bundle technique with 10 mm fresh frozen Achilles allograft tendon. Femoral tunnel position in joint cavity was 7 mm from articular margin on 1 o'clock (left knee) or 11 o'clock (right knee) direction. Allograft tendon, which was substitute anterolateral bundle of the PCL, was fixed in the femoral tunnel with an interference screw. The remnant of the PCL was preserved as much as possible. Tibial tunnel opening in posterior aspect was made 10 mm below the articular surface (Fig. 2). After PCL reconstruction, reconstruction procedure for posterolateral instability was performed using modified figure of "8" technique as described by Larson and Metcalf1[7]. Skin incision from lateral femoral condyle to anterior part of the fibula head was made. A 7 mm drill hole was made into the fibular head from anterior to posterior, angling slightly superiorly from anteroinferior to posterosuperior in the fibular head to pass allograft tendon. Then the fibular tunnel was dilated to 8 mm diameter. Another 2 bone tunnel of 8 mm diameter was made into the lateral femoral epicondyle and the anatomical attachment site of popliteus tendon after iliotibial band splitting. After adequate tunnels were made, a fresh frozen Achilles allograft tendon of 8mm diameter was passed through the fibular tunnel and fixed to the femoral tunnel with interference screws under iliotibial band. Bony side of graft was fixed to the anatomical attachment site of popliteus tendon and soft tissue side to lateral epicondyle with 10 N tension at 30° flexion with neutral rotation. The allograft tendon func-

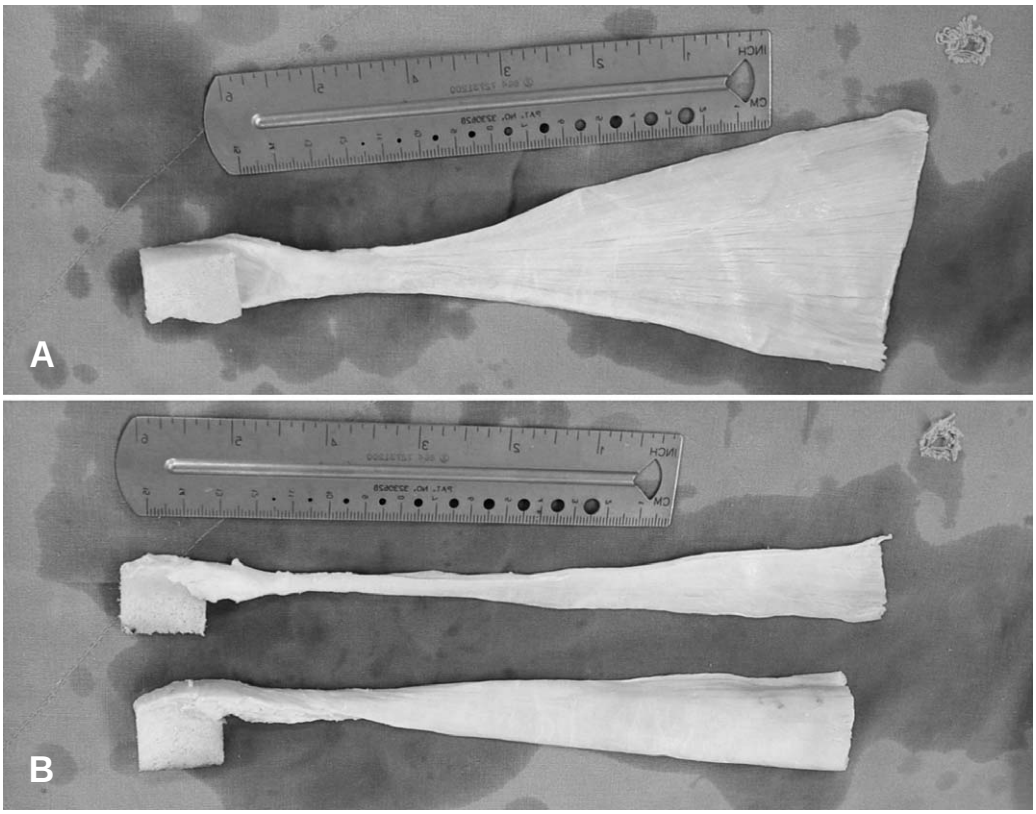


**Fig. 1.** A fresh frozen Achilles tendon allograft was divided by two (**A**), larger one (Ø 10mm) for PCL reconstruction and smaller one (Ø 8mm) for PLC reconstruction (**B**).

tions as lateral collateral ligament (anterior part to the fibular head) and popliteofibular ligament (posterior part to the fibular head) (Fig. 3). After the PLC reconstruction, preloading was performed approximately 20 times with 10~15 lbs. Then tibial fixation of PCL was performed with bio-absorbable screw and post-tie spiked-washer with 80 N tension at 70° flexion with anterior drawing

Post-operative knee immobilization was maintained for 4 weeks with the knee extended at 0 degree in long leg splint with posterior padding on proximal leg. Active ROM exercise was started at four weeks after surgery. Patients gained full range of motion at postoperative 3 months.

For clinical evaluation range of motion, posterior drawer test, varus stress test, prone external rotation (dial) test, Lysholm score and Tegner activity scale were checked preoperatively and final follow-up period[25]. And posterior stress radiographs were checked with contralateral knee to evaluate the degree of posterior drawer.

Paired T-test was used as a statistical method. P value

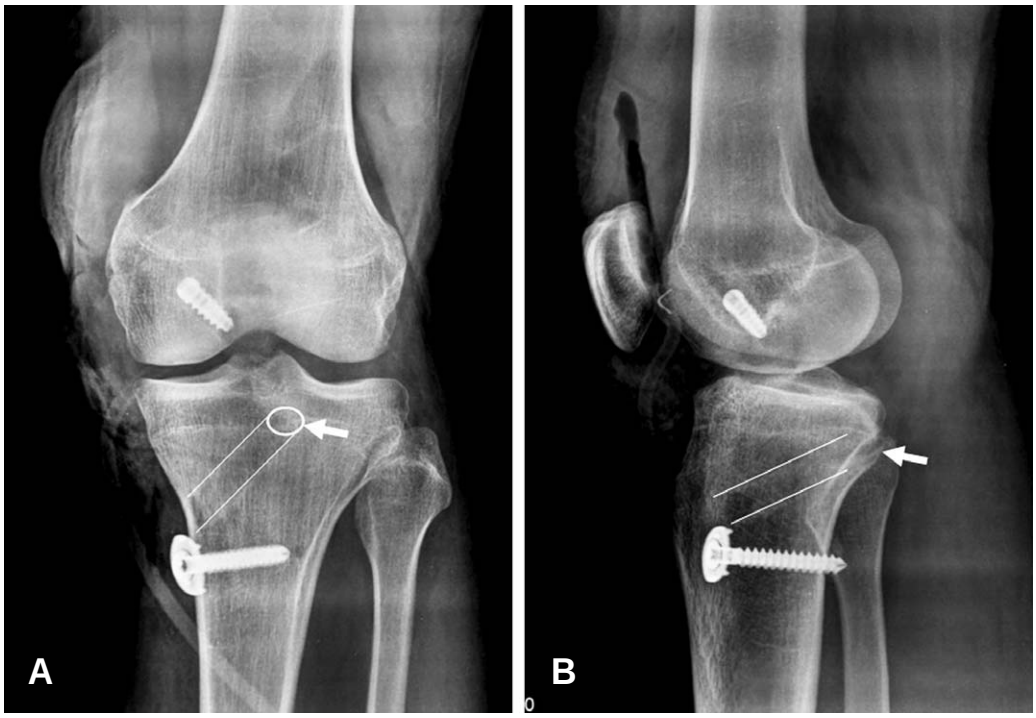


**Fig. 2.** These radiograms show after arthroscopic PCL reconstruction - single incision, single bundle, transtibial technique using Achilles tendon allograft. Tibial tunnel opening in posterior aspect (arrows) was made 10 mm below the articular surface.

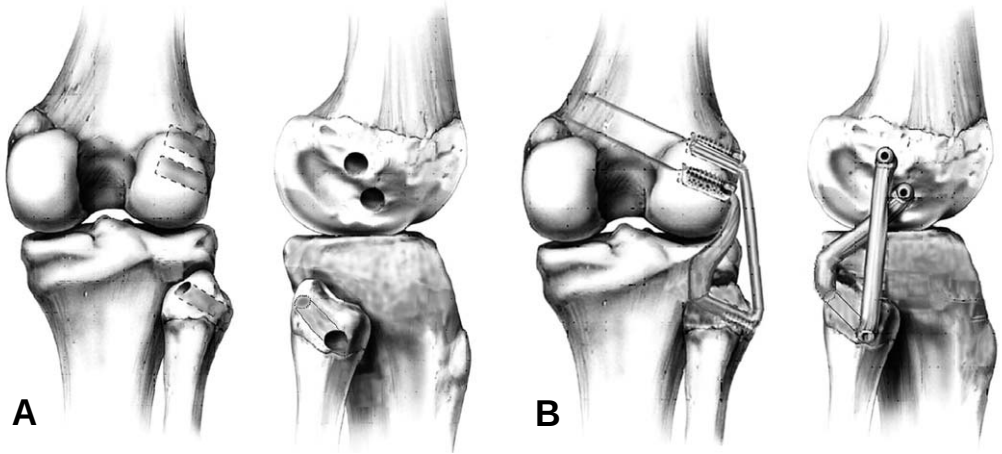


**Fig. 3.** These drawings show posterolateral reconstruction methods. (**A**) These show bone tunnel positions of the lateral femoral condyle and fibular head. (**B**) These show graft placement and fixation.

<0.05 was considered to be significant.

## Results

The range of motion deficit over 10o flexion was 3 cases at final follow-up period. Preoperatively, posterior drawer test was 5 cases in grade II and 40 cases in grade III posterior instability. At final follow-up period, 22 cases returned within normal condition, 18 cases grade I and 5 cases grade II posterior instability. Preoperatively, posterolateral drawer test regarding displacement over 10 degrees in dial test as positive was all patients positive result. At final follow-up period only 9 cases showed positive dial test. External rotation degree at final follow-up was decreased from mean 15 degrees (12-20) preoperatively to mean 5 degrees (2-10) ($p<0.05$). One case was positive in varus test. In functional assessment at final follow-up, Lysholm score was improved from mean 50(31-80) preoperatively to mean 83(73-90) ($p<0.05$) and Tegner activity scale improved from mean 2.1(1-4) preoperatively to mean 4.6(3-6) ($p<0.05$).

In posterior stress radiographs, posterior displacement was improve from mean 16(11-25)mm preoperatively to 4.1(1-10)mm after treatment($p<0.05$).

## Discussion

The incidence of PCL injury is less than that of ACL injury. The natural history of the disrupted PCL is still debated[23,26]. Isolated, mild to moderate PCL injury is treated by conservative treatment successfully. But isolated PCL injury with severe posterior instability or multiple ligament injury is indicated for operative treatment [20].

Recently, anatomical reconstruction of PCL is used. And remnant PCL is remained in most of PCL injuries, reconstruction of anterolateral bundle of PCL with fresh frozen Achilles allograft tendon via transtibial technique is commonly used without resection of PCL remnant[4,14]. Many authors reported good results of operative treatment but not in all cases. So there seems to be no consensus on the best method of treatment[9,23].

Since PCL injury is usually accompanied by posterolateral rotator instability(PLRI), coexisting injuries have to be treated to obtain good results. Numerous techniques for reconstruction of the posterolateral structures have been suggested[1,6,11,19,22]. Both reconstruction of normal anatomical structure and the method of stabilization by tightening of specific structure were used for operative treatment. Mainly lateral collateral ligament, popliteus tendon and popliteofibular ligament were reconstructed by surgery.

Hughston and Jacobson[8] described reconstruction technique in which the PLC complex is transported proximally with the bone. Although the technique is adequate for mild to moderate posterolateral instability, this reconstruction is not isometric and not anatomic and stretches out over time consequently. Clancy[3] reported rerouting of the biceps femoris tendon to the lateral femoral epicondyle. Although this technique is easy, other authors have questioned sacrificing the dynamic stabilizing effect of the tendon as well as the quality of posterolateral tissue that is advanced secondarily[5,13]. Müller[21] reported popliteus bypass technique. Although this technique can give posterolateral stability with the knee extended, it is non-isometric technique and less effective to resist external rotational force. Fanelli and Larson[6] advocated reconstruction of the PLC complex with the modified fibular tunnel method shows statistically significant stability than reconstruction using tibial tunnel technique. Kanamori et al.[12] evaluated the effects of the biceps femoris tenodesis and popliteofibular ligament reconstruction on knee biomechanics. They suggested that the popliteofibular ligament reconstruction could reproduce the primary function of PLC more closely by restoring external tibial rotation, as compared to the biceps tenodesis.

Maynard et al.[20] reported that the lateral collateral ligament is main structure resisting against varus force at any angles of flexion. And their results indicated that the popliteofibular ligament contributed to posterolateral stability. Fanelli and Edson[5] introduced split biceps tendon technique.

Veltri and Warren[27,28], Lee et al.[18] and LaPrade et al.[15,16] reported popliteofibular ligament reconstruction and popliteus tendon bypass reconstruction techniques. In this method, popliteus tendon, popliteofibular ligament and lateral collateral ligament are reconstructed using 2 stranded split Achilles allograft tendon. But too large incision and overcorrection is the disadvantage of the method.

In this study, modified Larson and Metcalf's "figure of 8" method was used[17]. Lateral collateral ligament and popliteofibular ligament was reconstructed using Achilles allograft tendon via fibular tunnel technique. In this method, the lever arm of the external rotational force of

the tibia is longer than that of popliteus bypass method using corner sling by Albright and Brown[1]. And smaller incision is used.

Apsingi et al.[2] reported about a comparison of modified Larson and 'anatomic' posterolateral corner reconstructions in knees with combined PCL and posterolateral corner deficiency. They reported a significant difference was not found between the two reconstructions. Both reconstructions restored external rotation and varus laxity to normal. The three-stranded anatomical reconstruction did not perform better than the modified two-strand Larson technique.

Jung et al.[10] reported about posterolateral corner reconstruction for PLRI combined with PCL injuries: comparison between fibular tunnel and tibial tunnel techniques. They reported in grade 2 chronic PLRI with little or no varus instability associated with injury to the PCL, a posterolateral reconstructive procedure with a single sling through the fibular tunnel offers advantages of less surgical morbidity and operation time, as well as better rotational stability, over reconstruction through the tibial tunnel.

Sidles et al.[24] reported isometric point between fibular head and lateral femoral epicondyle. The anterior aspect of the fibular head is more isometric to the posterior aspect of the lateral epicondyle. The posterior aspect of the fibular head is more isometric to the anterior aspect of the lateral epicondyle. So we used this theory for PLC reconstruction with more isometric point. Lateral collateral ligament was reconstructed from anterior aspect of the fibular head to the posterior aspect of the lateral epicondyle, and popliteofibular ligament from posterior part to the fibular head to anatomical site of popliteus tendon.

Although excellent results with numerous procedures using autogenous graft such as patella bone patella tendon bone graft, hamstring tendon and quadriceps femoris tendon were reported, Achilles allograft tendon is widely used recently[7]. And the results with Achilles allograft tendon have comparable to that of autogenous graft. Decreased operation time and morbidity of donor site, stable fixation are advantage of procedure with allograft. And anatomical reconstruction can be achieved by this method. But disadvantage of this method such as disease transmission, long healing time compared to that of autogenous graft, stretch of the graft are considerable problems. Achilles tendon allograft is large enough for single tendon reconstruction. In our technique a single fresh frozen Achilles tendon allograft raft was used, which was divided by two size, larger one(Ø 10 mm) for PCL reconstruction and smaller one(Ø 8 mm) for PLC reconstruction.

Our technique using a single fresh frozen Achilles tendon for simultaneous PCL and PLC reconstruction support methods of the Apsingi et al.[2] and Jung et al.[10] is more anatomic and less invasive, less operation time, and similar rotational stability than previously described other methods[15,16,18,27,28].

## Conclusion

We had successful results by combined reconstruction of the PCL & PLC with a fresh frozen Achilles tendon allograft in patients with PCL and posterolateral rotatory instability at a time.

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= ABSTRACT =

# Combined Reconstruction of Posterior Cruciate Ligament and Posterolateral Corner with a Fresh Frozen Achilles Tendon Allograft

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**Purpose**: The purpose of this study is to report a result of the technique that reconstruct posterior cruciate ligament (PCL) and posterolateral corner (PLC) simultaneously using a fresh-frozen Achilles tendon allograft.

**Materials and Methods**: Forty two patients (45 legs) underwent PCL and PLC reconstruction were included. There were 38 males and 4 females. Mean age was 39 years. Used graft was a fresh frozen Achilles tendon allograft, which was divided by two size, larger one (∅ 10 mm) for PCL reconstruction and smaller one (∅ 8 mm) for PLC reconstruction. Arthroscopic reconstruction of the PCL was performed using transtibial, single incision, and single bundle technique with 10mm fresh frozen Achilles allograft tendon first. After PCL reconstruction, reconstruction procedure for posterolateral instability was performed using modified figure of "8" technique using smaller gtaft. For clinical evaluation, range of motion, posterior drawer test, varus stress test, prone external rotation (dial) test, Lysholm score, Tegner activity scale and posterior stress radiograph were used. Mean follow up period was 25 months.

**Results**: Preoperatively posterior drawer test was 5 cases in grade II and 40 cases in grade III posterior instability. At final follow-up 22 cases returned within normal condition, 18 cases grade I and 5 cases grade II posterior instability. Though all patients showed positive result over 10 degrees in dial and varus stress test preoperatively, but only 9 cases showed positive both test at final follow-up. The range of motion deficit over 10° flexion was 3 cases. Lysholm score was improved from mean 50 preoperatively to mean 83($p<0.05$) and Tegner activity scale improved from mean 2.1 preoperatively to mean 4.6($p<0.05$). In posterior stress radiographs, posterior displacement was improve from mean 16mm preoperatively to 4.1mm after treatment($p<0.05$). All patients had improved compared to their pre-operative status as measured by physical examination such as posterior drawer test, varus stress test, dial test.

**Conclusion**: We had successful results by combined reconstruction of the PCL & PLC with a fresh frozen Achilles tendon allograft in patients with PCL and posterolateral rotatory instability at a time.

**Key Words**: Posterior cruciate ligament, Posterolateral corner reconstruction, Modified figure of "8" technique, Achilles tendon allograft

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