Management of Concomitant Posterolateral Rotatory Instability and Anterior Cruciate Ligament Injuries of the Knee

Young Bok Jung, M.D., Ho-Joong Jung, M.D., Yong Seuk Lee, M.D., Sang Hak Lee, M.D., and Young Uk Park, M.D.

Department of Orthopedic Surgery, Chung-Ang University Medical Center, Chung-Ang University School of Medicine, Seoul, Korea

Purpose: Many failures of anterior cruciate ligament (ACL) reconstruction are due to a failure to treat concomitant posterolateral rotatory instability (PLRI). We report the results of reconstruction in cases of combined PLRI and ACL injury.

Materials and Methods: From January 1998 to December 2002, 24 patients were followed-up for a mean of 25 months (range, 12 to 58), postoperatively. PLRI was treated using a biceps tenodesis or posterolateral corner sling (PLCS), through a proximal tibial or fibular head obliquely anteroinferiorly to posterosuperiorly. ACLs were reconstructed using autogenous hamstring 4 bundles with RIGIDfix™ on the femoral side and Intrafix™ with additional staple fixation on the tibial side. Clinical results were evaluated using the Orthopädische Arbeitsgruppe Knie (OAK) and International Knee Documentation Committee (IKDC) knee scoring system. Stability was measured on pull varus stress radiographs using a Telos stress device and by using the manual maximum displacement test using a KT-1000™ arthrometer with 30 degrees of knee flexion.

Results: The mean side-to-side difference in anterior displacement measured on the pull stress radiographs was reduced from a preoperative 7.9 ± 3.4 to 2.1 ± 0.8 mm at the last follow-up, from 2.1 ± 0.8 to 0.4 ± 0.7 mm on varus stress radiographs, and from 6.5 ± 1.3 mm to 2.3 ± 1.3 mm as measured using the KT-1000 arthrometer. The average OAK score improved from 64.1 ± 11.9 to 84.4 ± 9.2 points over the same period. At the final evaluation, 22 of the 24 patients (92%) had a satisfactory result according to the IKDC system.

Conclusion: Based on our experience, we recommend arthroscopically assisted ACL reconstruction and the correction of concomitant PLRI in cases of combined ACL and posterolateral rotatory instability.

Key Words: Anterior cruciate ligament, Posterolateral rotatory instability, Reconstruction
tients with isolated PLRI injuries were operated upon. There were 185 patients with isolated ACL injuries.

Sports injuries were the most common cause of injury and accounted for 17 of the 24 patients (71%). Of these, 8 were from soccer, 5 from skiing, and 4 from basketball. The other cases were of 5 (21%) traffic accidents and 2 (8%) falls. Concomitant injuries in the knee joint were MCL injury in 1 patient and meniscal injuries in 6.

The treatments used for PLRI were biceps tenodesis in 1 patient and modified posterolateral corner sling (PLCS) in 23. Of these, 15 knees were reconstructed using a transtibial tunnel and 8 were operated on using a fibular head tunnel. Five cases with varus instability and PLRI underwent anterior advancement of the LCL and capsule at the lateral epicondyle of the femur. For ligament reconstruction, an autogenous hamstring tendon was used in 21 patients and a tibialis posterior or anterior allograft was used in two.

The average follow up period after reconstruction was 25 months (range 12-58 months). Serial postoperative evaluation were performed at six weeks; six and twelve months; and every twelve months thereafter. In order to evaluate the stability of the knee, a anterior stress radiograph (pull view) and a varus stress view made with a Telos stress device (Austin and Associates, Fallston, Maryland) and a manual maximal displacement test performed with KT1000™ arthrometer (Instrumented Drawer Testing, KT-1000™, MED metric, USA) at 30 degrees of knee joint flexion were used both preoperatively and after the third postoperative month. Physical diagnostic examinations were performed in 30 and 90 degrees of flexion using the Lachman test, the posterolateral drawer test, and the dial test. A positive examination showed more than 10 degrees of external rotation from the normal side and tibial plateau posterior subluxation, as confirmed by finger palpation. In addition, a varus instability test was performed in 30° of knee flexion. In PLRI, classifications were determined as grade I (0-5 mm), grade II (5-10 mm) and grade III (>10 mm). The Orthopadishe Arbeitsgruppe Knie (OAK) and International Knee Documentation Committee (IKDC) knee scoring systems were used for clinical analysis.

2. Surgical technique

ACLs were reconstructed using autogenous hamstring 4 bundles with RIGIDfix™ femoral fixation and Intrafix™ tibial fixation (Mitek Products, Westwood, Massachusetts) and in addition staple fixation at the tibial side. The surgical technique used for PLRI was the modified PLCS method using the tibial tunnel or the fibula head tunnel. If reconstruction was performed through the tibial tunnel, we used the method of Albright1 (Fig. 1). Here we briefly describe the commonly used fibula head tunnel method. The patient was placed in the supine position, and the end of the operating table was lowered to allow the patient’s knee to be flexed by 90 degrees. After making an incision from the lateral epicondyle of the femur to the fibula head, the location of lateral collateral ligament and the insertion of biceps femoris tendon of the fibula head were confirmed. The dissection was made from the fibula neck to the surface of the peroneal muscle origin while carefully protecting the peroneal nerve. An ACL guide (Acufex Microsurgical, Mansfield, Massachusetts, 1988) was inserted to the bare bony surface between the LCL and the biceps femoris tendon, and a 5-6 mm diameter tunnel was prepared from the anteroinferior of the fibula to the posteroinferior fibula obliquely according to the graft diameter. A wire loop was then passed and the edge of tunnel was then chamfered with a rasp. Protecting the peroneal nerve with a curet helps to prevent injury when reaming the fibula head. The isometric point was examined after inserting a guide pin 5-10 mm anterior distally from the lateral epicondyle of the femur. The direction of the guide pin for the tunnel was cephalad in order to reduce the killer turn. After confirming that the isometric point was <3 mm in 120° of flexion and extension of the knee, the tunnel of the same diameter as the 4 hamstring 4 bundles was enlarged and chamfered with a rasp. The autogenous hamstring tendon was then passed using a

Fig. 1. Schematic diagrams of the posterolateral corner sling through a tibia tunnel using Albright’s method.
wire loop that had already been passed through the fibula head tunnel, under the iliotibial band and the LCL, and the graft was taken out to the medial side of the femur using a terminal holed guide pin and regular tension at 15-20 lbs with 20 cyclic loadings. An bioabsorbable interference screw, which was 1 mm larger than the tunnel diameter was fixed in the femoral tunnel (Fig. 2).

3. Post-operative rehabilitation

Postoperative care was performed using a splint for 2-3 weeks under full extension and a brace was subsequently applied for 3-4 weeks. From 1 day after surgery, patients were requested to exercise in order to strengthen the quadriceps and improve SLR. From 2-3 days after surgery, passive flexion and extension exercises were performed. Limited weight bearing only was permitted until 6 weeks after surgery. At six weeks after surgery, patients were allowed to ride a bicycle but hamstring exercises were not permitted until 4 months. From 3-6 months after surgery, simple exercises and indoor bicycle riding were permitted. Sports activities such as soccer were allowed after 8-10 months when quadriceps power had recovered to more than 80% of that of the contralateral normal side.

RESULTS

Clinically, the mean OAK score was 64.1 (range 45-81) points preoperatively and 84.4 (range 61-100) at the last follow-up. At the last evaluation, seven of the twenty-four patients (30%) had an excellent result, fourteen (58%) had a good result, two (8%) had a fair and one (4%) had a poor result; thus, twenty-one patients (88%) had a satisfactory result according to the OAK score (Table 1). The difference between the score before the reconstruction and that at the last follow-up evaluation was significant (p<0.05). With use of the IKDC evaluation form at the last evaluation, the result for eight of the twenty-four patients was rated as A (normal) and that for fourteen was rated as B (near normal), so that twenty-two of the twenty-four patients (92%) had a satisfactory result according to IKDC system (Table 1).

The mean side-to-side difference in anterior translation (and standard deviation) measured on the anterior stress radiograph (pull view) was 7.9 ± 3.4 mm preoperatively and 2.1 ± 0.8 mm at the last follow-up evaluation and that on varus stress view was 2.1 ± 0.8 mm preoperatively and 0.4 ± 0.7 mm at the last follow-up. The difference between the values before the reconstruction and those at the last follow-up evaluation were significant (p<0.05). The mean side-to-side difference as measured with the KT-1000 arthrometer was 6.5 ± 1.3 mm preoperatively and 2.3 ± 1.3 mm at the last follow-up. The difference between the value before the reconstruction and that at the time of last follow-up was significant (p<0.05) (Table 2). A physical examination of instability showed that all patients were positive by the Lachman test preoperatively. At the last follow-up Lachman test, all patients were negative, though 8 showed slight residual insta-

<table>
<thead>
<tr>
<th>Table 1. Final follow-up OAK and IKDC scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OAK score</strong></td>
</tr>
<tr>
<td>Excellent</td>
</tr>
<tr>
<td>Good</td>
</tr>
<tr>
<td>Fair</td>
</tr>
<tr>
<td>Poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Preoperative and final follow-up clinical data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preop.</strong></td>
</tr>
<tr>
<td>OAK knee score</td>
</tr>
<tr>
<td>Pull stress (NL-ABN difference)</td>
</tr>
<tr>
<td>Varus stress (NL-ABN difference)</td>
</tr>
<tr>
<td>KT1000 MMT (NL-ABN difference)</td>
</tr>
</tbody>
</table>

*, Orthopadische Arbeitsgruppe Knie scoring system; †, Anterior stress radiographs using the Telos stress device (Austin and Associates, Fallston, Maryland); ‡, Manual maximum displacement test in 70° of knee flexion using a KT-1000™ arthrometer (Instrumented drawer testing, KT-1000™, MED metric, USA). NL, normal; ABN, abnormal.
bility (less than grade I). According to the posterolateral drawer test, 17 patients showed grade II instability and 7 grade III instability, preoperatively. Although all patients showed more than grade II instability preoperatively, at the last follow-up, 20 patients showed the same stability to the contralateral side, remained 4 patients showed grade I instability. At 30° of knee joint flexion, 13 patients (54%) showed a varus instability preoperatively but no varus instability at the last follow-up. The complications of surgery experienced in this study were, knee joint stiffness in 2 patients, one received adhesiolysis arthroscopically at 6 months after index surgery, and recovered almost normal motion (0-135). There were no other complications. One case received an arthroscopic examination as a result of a hemarthrosis and loss of motion due to reinjury at 18 months after surgery. This resulted in a hematoma due to partial ACL graft tendon rupture and was treated by hematoma debridement. No recurrence of knee joint instability was noted.

**DISCUSSION**

PLRI of the knee joint is a pathological instability that is caused by a posterolateral tibial subluxation when an external rotation force is applied to the knee joint. This injury is not normally found isolated and usually occurs in the setting of other injuries such as ACL or PCL tears. However, in the presence of other injuries, a posterolateral knee injury may go undiagnosed or be misdiagnosed because of swelling and tenderness at the lateral side in the acute setting and difficulty of performing a physical examination in the chronic setting. A physical examination of the PLRI illustrates the various methods adopted. Hughston reported that a posterolateral drawer test and an external rotation recurvatum test are useful for making a diagnosis. In these cases, a physical examination was conducted using the posterolateral drawer and the dial test and we palpated the subluxation of posterior tibia condyle by positioning small 4 fingers at the posterolateral aspect of the popliteal fossa. During these examinations, we always strived to test under muscle relaxed conditions and sometimes a muscle relaxant was used. Also, under anesthesia, we repeated examinations to confirm posterolateral corner injuries. Preoperatively, all 24 patients in the present series had posterolateral instability with a positive posterolateral drawer and dial test at 30° and 90° of knee flexion that was 10° greater than that of the uninjured lower extremity. Twenty of 24 knees (83%) with posterolateral instability were successfully surgically corrected as determined by the posterolateral drawer test.

Various surgical techniques for PLRI reconstruction have been reported but most were partial reconstructions of the posterior structures and thus more work is needed. Hughston and Jacobson reported a method that moves the arcuate complex with bone advancement, and Clancy reported a method of rerouting the biceps tendon to the lateral epicondyle, with excellent results in 50 cases. However, the above methods are not anatomical reconstructions, and results vary. We have not had good clinical experiences using the above two methods and they are no longer used.

Recent studies generally agree that the most consistent and important structures for reconstruction in the posterolateral corner are the popliteus tendon, the popliteofibular ligament, and the lateral collateral ligament. Albright performed a reconstruction of the posterolateral ligament by passing it through the lateral aspect of the tibia. Fanelli and Larson reported that a fibular head tunnel along with a 1 cm of anterior lateral epicondyle tunneling by passing the tendon medially with a bioabsorbable screw fixation at the lateral side had better results than the tibial tunnel. Of these two reconstruction methods that were performed through the lateral tibia plateau tunnel and through the fibula head, the latter is technically easier and better in terms of isometricity than the lateral tibia tunnel. We recently performed the modified Larson technique using an autogenous hamstring tendon, which was used to similar anatomically reconstruct the lateral collateral ligament and popliteofibular ligament. Because

![Fig. 3. Schematic diagrams of lateral collateral ligament reconstruction using biceps femoris tendon harvested with a double knife.](image-url)
this method also needs grafts passing through the fibula head, the proximal tibiofibular joint should be normal condition.

If the PLRI is more than grade III, a more anatomical ligament reconstruction passing through the lateral tibia plateau and fibula head is recommended. In particular, it is better to perform combined reconstruction of LCL with concomitant grade III varus instability. In grade III posterolateral injuries, we performed additional LCL reconstruction in 5 patients by using 12-13 cm of the biceps tendon and an interference screw inserted into 7-10 mm anterior to the center of the lateral epicondyle (Fig. 3)

Experienced clinicians recommend correction of varus osseous malalignment and varus thrust gait prior to surgical reconstruction for severe lateral and postero-lateral ligament deficiency. They preferred an operative technique for high tibial osteotomy and results of this procedure in patients with associated ACL-deficiency have been described previously. We experienced one case of combined rupture of the ACL and PLRI that initially was treated by medial open wedge osteotomy, but the instability remained after osteotomy, and secondary reconstruction was performed because of remaining anterior instability and PLRI.

CONCLUSION

Injuries to the posterolateral structures of the knee can easily be missed during knee examinations, especially when there is a concomitant ACL tear. Suspicion of posterolateral complex injury is important for the accurate diagnosis of posterolateral rotatory instability combined with cruciate ligament injuries. Based on our experience, we recommend arthroscopically assisted ACL reconstruction and the correction of concomitant PLRI in cases of combined ACL and posterolateral rotatory instabilities.

REFERENCES


전방 심자 인대 손상과 동반된 후외측 회전 불안정성의 치료

정영복 · 정호중 · 이용석 · 이상학 · 박영욱
중앙대학교 의과대학 정형외과학교실

목적: 많은 경우에서 전방심자인대 재건술 후에 실패의 원인으로써 동반된 후외측 불안정성의 미교정이 거론되고 있다. 전방심자인대 손상에 동반된 후외측 불안정성에 대하여 동시에 수술적 치료를 시행한 환자에 대한 결과를 보고하고자 한다.

대상 및 방법: 1998년 1월에서 2002년 12월까지 추시된 24명의 환자를 대상으로 평균 추시 기간은 25개월(12-58)이었다. 후외측 불안정성은 이두근 건 고정술, 후외측 재건술을 경골 터널 내지는 비골 두 터널 방법을 이용하여 시행하였다. 전방심자인대는 모든 경우에 자가 슬관건을 이용하여 대퇴부는 RIGIDfix™를 이용하여 고정하였고, 경골부는 Intrafix™ 고정과 함께 추가적인 staple 고정을 실시하였다. 임상적 결과는 Orthopadische Arbeitsgruppe Knie (OAK)와 International Knee Documentation Committee (IKDC) 점수를 이용하여 평가하였다. 이학적 검사 및 KT-1000™ 관절 계측기와 스트레스 방사선 사건을 이용하여 불안정성 정도를 평가하였다.

결과: 수술 전과 최종 추시 결과 비교에서 전방스트레스 방사선 사건의 평균 측정된 정상측과의 전위차이가 7.9 mm에서 2.1 mm로, 내반스트레스 검사상에서는 1.9 mm에서 0.4 mm로, KT-1000™ 관절 계측기에서는 6.5 mm에서 2.3 mm로 호전되었다. OAK 점수에서는 수술 전 64.1점에서 84.4점으로 향상되었고, IKDC 기준으로는 92%에서 만족할 만한 결과를 얻었다.

결론: 전방심자인대 손상에 동반된 후외측 불안정성을 전방심자인대 재건술과 함께 교정함으로써 좋은 결과를 얻을 수 있었다.

색인 단어: 전방심자인대, 후외측 불안정성, 재건술