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Anterior cruciate ligament reconstruction with the peroneus longus tendon

Peroneus longus tendonu ile ön çapraz bağ rekonstrüksiyonu

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Amaç: Peroneus longus tendon (PLT) otogrefti kullanılarak ön çapraz bağ (ÖÇB) rekonstrüksiyonu yapılan hastaların sonuçları değerlendirildi.

Çalışma planı: Çalışmaya, ÖÇB yetmezliğinin rekonstrüksiyonu için PLT otogrefti ve tespit materyali olarak interferans çivisi kullanılan 29 hasta (27 erkek, 2 kadın; ort. yaş 30; dağılım 21-39) alındı. On dört hastaya (%48.3) rekonstrüksiyon sırasında parsiyel menisektomi yapıldı. Sonuçlar, en az beş yıllık takip dönemi sonunda Lysholm skorlama sistemi ve Uluslararası Diz Dokümantasyon Komitesi'nin (IKDC) skorlama sistemine göre değerlendirildi.

Sonuçlar: IKDC skorlama sistemine göre, 17 hasta (%58.6) normal veya normale yakın, 12 hasta (%41.4) ise anormal veya ileri derecede anormal olarak değerlendirildi. Lysholm skorlama sistemine göre 23 hastada (%79.3) iyi veya mükemmel sonuç elde edildi. Ortalama Lysholm skoru 83.7 (dağılım 45-100) bulundu. Radyografik değerlendirmede, 10 hastanın diz ekleminde hafif, bir hastada orta derecede dejeneratif değişiklikler gözlendi. Sağlam tarafla karşılaştırıldığında, hastalarda fleksiyon ve ekstansiyon kaybı gözlenmedi. Ligamantöz stabilite açısından yapılan Lachman testinde 12 hasta (%41.4) normal olarak değerlendirilirken, dokuz hastada 1+, beş hastada 2+, üç hastada ise 3+ anteroposterior laksite bulundu. Pivot-shift testinde 13 hastada (%44.8) negatif sonuç alınırken, 10 hastada 1+, altı hastada 2+ kayma vardı. İki hastada (%6.9) greftin alındığı bölgede parestezi, disestezi ve hafif ya da orta derecede ağrı yakınması görüldü. Hiçbir hastada PLT alınmasından dolayı ayak bileği fonksiyonunda bozulma ve sportif aktivitelerde zorlanma görülmedi.

Çıkarımlar: Sonuçlarımız, ÖÇB rekonstrüksiyonunda PLT'nin greft kaynağı olarak iyi bir seçenek olabileceğini göstermektedir. Böylece, diz bölgesinden otogreft alınmasının doğurabileceği olası yan etkiler de önlenmiş olacaktır.

Anahtar sözcükler: Ön çapraz bağ/yaralanma/cerrahi; diz eklemi; hareket açıklığı, eklem; tendon transferi.

Objectives: The aim of the study was to evaluate the results of anterior cruciate ligament (ACL) reconstruction using a peroneus longus tendon (PLT) autograft.

Methods: The study included 29 patients (27 males, 2 females; mean age 30 years; range 21 to 39 years) who underwent ACL reconstruction using a PLT autograft and interference nail fixation. Fourteen patients (48.3%) also had partial meniscectomy during surgery. The results were assessed according to the Lysholm scores and the International Knee Documentation Committee (IKDC) scale at the end of at least five years of follow-up.

Results: According to the IKDC scale, 17 patients (58.6%) were rated as normal or nearly normal, and 12 patients (41.4%) were rated as abnormal or severely abnormal. The mean Lysholm score was 83.7 (range 45 to 100), with excellent or good results in 23 patients (79.3%). Radiographic examination showed mild (n=10) or moderate (n=1) degenerative changes in the knee joint. Compared with the normal side, no flexion or extension losses occurred in the affected knees. Stability of the ACL was assessed by the Lachman test, which showed normal findings in 12 patients (41.4%), while nine patients had 1+, five patients had 2+, and three patients had 3+ anteroposterior laxity. Pivot-shift test was negative in 13 patients (44.8%); ten patients had 1+ pivot glide, and six patients had 2+ pivot shift. Two patients (6.9%) complained of mild to moderate pressure pain, paresthesia and dysesthesia at the donor site of PLT. No patient experienced ankle joint dysfunction or difficulty in sports activities due to PLT graft transfer.

Conclusion: Our data show that PLT can be an appropriate autograft source for ACL reconstruction, avoiding potential complications of autografts obtained from the knee region.

Key words: Anterior cruciate ligament/injuries/surgery; knee joint; range of motion, articular; tendon transfer.

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Anterior cruciate ligament (ACL) reconstruction is performed using different grafts. Good clinical results have been obtained using patellar, quadriceps, hamstring tendon autografts and allografts.[1] Although, these grafts are used commonly nowadays, disagreements about the choice of the suitable graft have still been persisted because of their some disadvantages. In many studies, the best alternative has been tried to determine with the comparison of results of patients which was treated using different grafts.

It has been demonstrated that many problems can occur following the application of autologous patellar tendon graft.[2-6] While the hamstring tendon grafts have greater mechanical strength than a bone-patellar tendon-bone complex, patients treated with hamstring tendon grafts are less likely to suffer patellofemoral pain and extension loss.[7-9] Using the hamstring tendon can cause a significant change in hamstring muscle strength.[7,10-13] Hamstring function is very important after ACL reconstruction in order to protect the reconstructed ACL from anterior drawer force, which is exerted by quadriceps contraction.[14,15] The advantages of the allograft are shorter operation and anesthetic time and good cosmetic results, however high costs, delayed corporation, disease transmission and immunological reaction represent disadvantages.[9,16,17]

The peroneus longus tendon (PLT) is as strong as the ACL and may substitute for it. In addition, there have been several studies in which regeneration potential in the harvested tendon has been observed.[18-21]

In our study, the clinical results of ACL reconstruction in which was used PLT as an alternative graft source were evaluated.

Patients and methods

Between 1997 and 2004, PLT autografts were used in 64 patients for the reconstruction of ACL ruptures. The indications for reconstruction were functional instability during daily or sports activities and complete rupture or absence of the ACL as verified arthroscopically. The operative technique was standardized in all patients and is described in detail below. In this study, 29 patients, who had at least 5 years of follow-up, were evaluated (27 males, 2 females; mean age 30 years; range 21 to 39 years).

Surgical technique

The PLT, about 10 centimeters long, was harvested from above and below the lateral malleolus with two separate incisions in injured leg (Figure 1). The graft was tensioned by hand before implantation. The tibial and femoral stumps of the torn ACL were excised to allow the anatomical ACL attachment sites to be seen. A 2.2 mm K-wire was inserted from the lateral femoral condyle cortex to the posterosuperior portion of the femoral ACL attachment site with the aid of a femoral drill guide. The tibial drill guide was used to insert another K-wire from the anteromedial aspect of the tibia to a point just posteromedial to the center of the tibial ACL attachment site.

The K-wires were then over-drilled with a cannulated reamer according to the maximum diameter of the graft (7 to 9 mm). After chamfering the sharp edges in the joint of the tunnels with a sharp osteotome, the graft was introduced into the tunnels as single strand. No patients required notchplasty. The graft was first fixed at the femoral site with an interference nail (7x25 mm- Hipokrat, Izmir) using the press-fit technique.[22,23] The tibial site was then fixed with another interference nail during manual tensing of the graft (Figure 2).

Figure 1. Peroneus longus tendonunun **(a)** Distal of the PLT was found by using an oblique incision which was performed 2 centimeters below the lateral malleolus, **(b)** Proximal of the PLT was found by using a longitudinal incision which was performed 8 centimeters above the lateral malleolus. **(c)** The PLT was pulled towards proximal after its distal portion was cut.

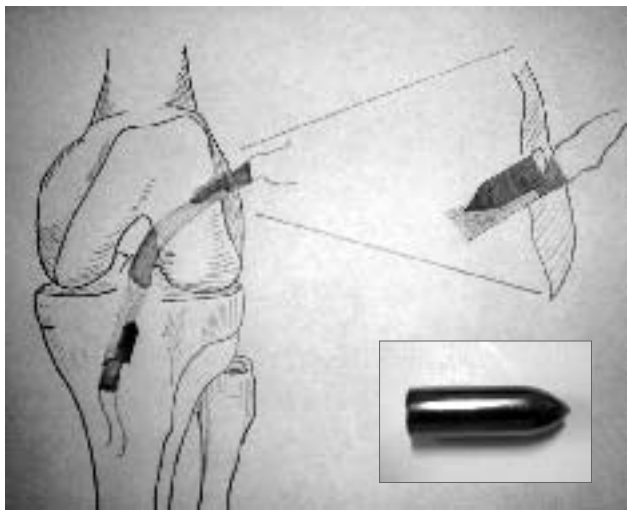

Figure 2. Interference nail (small figure). The graft was first fixed at the femoral site with an interference nail using press-fit technique. The tibial site was then fixed with another interference nail during manual tensing of the graft.

Follow-up treatment

Isometric quadriceps and flexion exercises were made at once. Over 90° knee flexion was not permitted to the 45 days. The patients were mobilized using crutches, with the possibility of full loading as tolerated. Daily activities were permitted increasingly step by step to the fourth week. Sports specific exercises were commenced at week 12. No return to original sports was permitted earlier than 6 months postoperatively. No braces or splints were used.

Graft test

Ten human cadaver feet, frozen at -20°C, were used (mean age 70 years; range 64 to 81 years) for biomechanical test of the PLT. After the specimens had thawed at room temperature during 12 hours prior to testing, 10 PLTs, 10 centimeters lengths, were prepared in conformity with the surgical technique. The mean diameters of the tendons were 7.5 millimeters (range 7- 8 mm). The grafts were fixed upper and bottom grips of the test machine (Zwick-Z020, Ulm, Germany) by means of special clamps.

The graft was pretensioned to 10 N. Tensile loading at a velocity of 50 mm per minute was applied in the test machine. The loading was continued until graft rupture and failure load were recorded. Maximum load at failure ranged from 1820 to 2200 N (mean 1950 N). No specimens were displaced from the grips.

Follow-up assessment

At least five-year follow-up assessments of the patients were performed by an independent examiner, not by their surgeons (mean 6 years 7 months; range 5 to 9 years). Patients' knees were examined using the Lysholm score system and the guidelines formulated by the International Knee Documentation Committee (IKDC).[24,25]

Results

In the study, surgery was performed on 21 right and 8 left knees. Approximately 75 % of accidents occurred while the subjects were playing football or as a result of falls. Reconstruction was performed within 3 weeks of injury in 14 patients, between 3 and 12 weeks from injury in 9 patients and after more than 12 weeks from injury in 6 patients. Partial meniscectomy at the time of reconstruction was performed in 14 patients (48.3 %). The others had intact menisci at the time of surgery. According to the IKDC scores, seventeen (58.6 %) patients received a final rating of normal or nearly normal, and 12 (41.4 %) received a rating of abnormal or severely abnormal. The Lysholm scores of 23 (79.3 %) patients were categorized as good or very good. The mean Lysholm score was 83.7 (range 45 to 100) points.

International Knee Documentation Committee

The evaluation of the IKDC is subjective for IKDC A and B and objective for IKDC C and D. Subjective patient evaluation; 15 (51.7 %) of the patients described the functioning of their knee joints as normal, and 14 (48.3 %) patients reported that the knee joint operated on had no effect on their levels of activity or frequency of participation in sporting activity. Objective patient evaluation; the range of motion of the knee joint undergoing surgery was compared with that of the intact and healthy contralateral side. The difference between the two was determined. We observed no extension or flexion loss in our patients.

In the examination of ligamentous stability using the Lachman test we were able to verify normal anteroposterior laxity in 12 patients (41.4 %) while nine patients had 1+, five patients had 2+, and three patients had 3+ Lachman test scores. In the results of the pivot-shift test; 13 patients (44.8 %) had normal scores. Ten patients had 1+ pivot glide and six patients had 2+ pivot-shift. No patients had a grossly positive pivot-shift test result. At 5 years postoperatively, light

to moderate crepitation was identified in the patellofemoral joint in 6 (20.7 %) patients. But patellofemoral pain was not reported by our patients.

Donor Site Morbidity

Twenty-seven (93.1 %) patients reported no complaints in the region of the transplant harvest site, although 2 (6.9 %) patients experienced light to moderate pressure pain and dysesthesias and paresthesias in the region of the extracted PLT. No patients experienced any impairment in their sports activities and ankle joint dysfunction due to transplant harvest abnormality.

Radiographic results

At the final follow-up, 18 (62.1 %) patients had no degenerative change in any compartments of the knee joint (Figure 3). Ten patients had mild degenerative change, and one patient had moderate degenerative change in all compartments of the knee joint.

Function test

1-legged hop test was performed as a functional test for patients. Seventeen (58.6 %) patients passed this with results between 90% and 100%.

Complications

No patients had any neurovascular problems in the knee joint region. No arthrofibrosis or adhesions developed. Graft rupture occurred in 3 of the patients at the end of the follow-up period. No knee joint punction of the operated knee due to significant joint effusion was required. Four patients exhibited only minimal or moderate joint effusion. Septic arthritis was diagnosed in one patient. He was treated arthroscopically by joint irrigation and was administered a 6-week course of intravenous antimicrobial therapy. In this patient, removal of the interference nails was not necessary therefore his results were not excluded from the study.

Discussion

ACL reconstruction is one of the most operations in orthopedic surgery. However, bone-patellar tendon-bone complex, hamstring tendon autografts, and allografts are commonly used as the graft sources, which graft is the most suitable has still been controversial.[1,4-7] Donor site morbidity has been reported following the application of autologous patellar tendon grafts including kneeling pain, tendon shortening, patellar chondromalacia, patellar fractures, patellar tendon ruptures, patellofemoral pain syndromes and persistent quadriceps weakness.[2-6] Hamstring tendon grafts have greater mechanical strength than a bone-patellar tendon-bone complex and patients treated with hamstring tendon grafts are less likely to suffer patellofemoral pain and extansion loss.[7-9] Furthermore it has been shown that using hamstring tendon caused an important alteration on the strength of the hamstring muscle.[7,10-13] Although the primary function of the hamstring muscles is to flex the knee

Figure 3.(a) Anteroposterior knee radiography of the patient who was performed ACL reconstruction, which was performed seven years ago, by using PLT graft. **(b)** Lateral knee view of the same patient.

or to decelerate extension of the knee, the hamstring muscles also regulate rotation, and control anterior translation of the tibia.[7,14] Hamstring function is very important after ACL reconstruction in order to protect the reconstructed ACL from anterior drawer force, which is exerted by quadriceps contraction.[15] Therefore, preservation of the hamstring muscle strength is of particular importance for athletes with ACL injuries.[7] Harvesting the semitendinosus-gracilis tendons may impact on the functioning of active knee flexion.[13] Muscle performance may not reach the same degree of strength as that on the healthy side.[26] The loss of knee flexion strength following the harvesting of the hamstring tendons may be more significant than has been estimated.[27] For these reasons we used the PLT in ACL reconstruction in our patients. This protected dynamic support supplied from hamstring muscles to the reconstructed ACL.

Because of knee joint complications involving patellar and hamstring tendon grafts in ACL reconstruction, PLT graft has been preferred. In addition, there have been many studies about the regeneration potential of harvesting tendons.[18,19] The regeneration potential of the harvested tendons for graft has been shown both clinically and at MRI.[10,18,20,21] So that we think the PLT can also regenerate. This thought has been supported that patients did not complain about their ankles. Our MRI evaluations which are conducted in these patients' operated legs will be exhibited. Biomechanically, PLT is as strong as native ACL. Noyes et al. reported that the maximum tensile load of ACL is 1725 N.[28] In our study, the maximum tensile load of single-strand PLT is 1950 N, although the mean age of cadavers who were performed PLT graft test was 70 years. PLT was preferred because of this biomechanical behavior. A positive pivot-shift phenomenon was observed in 16 patients and there were 3 + Lachman test scores in three patients. These results are parallel to those reported by Aglietti et al.[8] Eriksson et al. observed manual laxity (according to the Lachman test) after treatment using the semitendinosus tendon. [29] The same laxity was observed in our patients. Aglietti et al. reported a slight loss of extension in 3 % of patients in their hamstring group.[8] There was no extension or flexion loss in our patients. Furthermore, no patellofemoral pain was reported by our patients.

Marder et al. reported that 64 % of their patients had returned to their previous level of activity.[30] Similar results were recorded by other studies.[31,32] In another study, following ACL reconstruction using the hamstring tendons 54 % of patients resumed sporting activity.[8] At physical examination, dysesthesias and paresthesias were determined in the region of the extracted PLT in 2 (6.9 %) patients. The sural nerve is a wholly sensory nerve providing sensation to the lateral border of the foot. Numbness in its area of distribution is generally well tolerated; the nerve is therefore frequently harvested for nerve grafting elsewhere in the body.[33] In our study, no patients experienced any evident impairment in their activities as a result of numbness in the sural nerve area. Nonetheless the sural nerve should be protected when the PLT is harvested from below the lateral malleolus.

The limitations of this study are related to the ankle joint. The effect on the ankle joint of the harvested graft was not measured. However any clinical pathology did not observed in our patients after harvesting tendon grafts even if they have actively made sports, walking analyses and the study of muscle strength could not be performed to evaluated functional state in ankle. Secondly, our MRI study about the regeneration potential of the harvested tendon has still been continued. Finally it has short follow-up period. However our results show that PLT can be a good option as a graft source in ACL reconstruction, long term studies are necessary to support these findings.

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