Original Article

Comparison of Hamstring Tendon Autograft and Tibialis Anterior Allograft Methods in Anterior Cruciate Ligament Reconstruction Surgery: A Retrospective Study

Ön Çapraz Bağ Rekonstrüktif Cerrahisinde Hamstring Tendonu Otogrefti ve Tibialis Anterior Allografti Yöntemlerinin Karşılaştırılması: Retrospektif Bir Çalışma

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ABSTRACT

Objective: The aim of this study was to compare the effectiveness of tibialis anterior allografting and hamstring tendon autografting reconstruction surgery after anterior cruciate ligament (ACL) injury in adult patients.

Patients and Methods: This study was designed as a cross-sectional and retrospective study. Preoperative and postoperative functional parameters of patients who underwent ACL reconstruction surgery with hamstring autograft and tibialis anterior allograft methods due to ACL rupture were compared. Cross-pin and screw-staple were used for femur and tibia fixations, respectively. Lysholm knee scoring scale (LKSS) and Tegner activity level scale (TALS) were used for the outcome measures.

Results: A total of 121 patients (100 males, 21 females) with a mean age of 32.74±7.82 years (ranging from 19 to 52 years) were included. Pain and giving way phenomenon were the most common symptoms. There was a significant difference between the preoperative (32.7±7.8) and postoperative (64.08±7.8) LKSS values of all patients ($p < 0.001$). A significant difference was found between the preoperative (2.37±1.2) and postoperative (5.52±1.4) TALSvaluesof all patients ($p<0.001$). Compared with preoperative and postoperative LKSS and TALS scores, the increase in the allograft group was more prominent (LKSS: 30.27±4.8 vs. 24.43±2.8, TALS: 3.32±1.1 vs. 2.84±0.8). Complications were observed in 5 patients (4.1%), and all of them were successfully treated.

Conclusion: In the light of our study, both hamstring autograft method and allograft method seem to be effective in improving LKSS and TALS inpatients who underwent ACL reconstruction surgery. However, the improvement in the allograft group is more prominent than that of in the autograft group.

Key words: Anterior cruciate ligament; tibialis anterior; hamstring

ÖZET

Giriş: Bu çalışmada erişkin hastalarda ön çapraz bağ (ÖÇB) yaralanması sonrası rekonstrüksiyon cerrahisinde tibialis anterior allogreft ve hamstring tendon otogreft etkinliğinin karşılaştırılması amaçlandı.

Hastalar ve Yöntem: Bu çalışma kesitsel ve retrospektif olarak yürütüldü. ÖÇB yırtığı nedeniyle hamstring otogrefti veya tibialis anterior allografti yöntemleri ile rekonstrüksiyon yapılan hastaların cerrahi öncesi ve cerrahi sonrası 6. ay fonksiyonel parametreleri karşılaştırıldı. Femoral fiksasyon ve tibia fiksasyonu için sırasıyla cross-pin ve biyo bozunur vida-staple kullanıldı. Değerlendirmede Lysholm diz skorlama ölçeği (LDSÖ) ve Tegner aktivite düzeyi ölçeği (TADÖ) kullanıldı.

Bulgular: Çalışmamıza yaşları ortalama 32.74±7.82 yıl olan (19 ile 52 arasında değişen) toplam 121 hasta (100 erkek, 21 kadın) dahil edildi. Ağrı ve dizde boşalma hissi en sık görülen semptomlardı. Tüm hastaların cerrrahi öncesi (32.7±7.8) ve postoperatif 6.ayda (64.08±7.8) LDSÖ değerlerini karşılaştırdığımızda anlamlı bir fark saptandı ($p<0.001$). Tüm hastaların cerrrahi öncesi (2.37±1.2) ve sonrası (5.52±1.4) TADÖ skorları karşılaştırdığımızda anlamlı bir fark saptandı ($p<0.001$). Allogreft ve

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otogreft yapılan hastaların cerrahi öncesi ve sonrası LDSÖ ve TADÖ değerleri karşılaştırıldığında, her iki grupta da cerrahi tedavi öncesine göre anlamlı artış saptanırken, artış miktarları gruplar arası karşılaştırıldığında allogreft grubunda artış daha belirgindi (LDSÖ 30.27±4.8 vs 24.43±2.8; TADÖ 3.32±1.1 vs 2.84±0.8). Toplam 5 hastada komplikasyon görülmüş olup komplikasyon görülme oranı %4.1 olarak saptandı ve hepsi başarılı bir şekilde tedavi edildi.

Sonuç: ÖÇB rekonstrüksiyonunda hem hamstring otogreft uygulaması hem de allogreft uygulaması ÖÇB rekonstüksiyon cerrahisi geçiren hastalarda LDSÖ ve TADÖ skorlarının iyileşmesinde etkili bir yöntemdir. Ayrıca, allogreft grubundaki iyileşme otogreft grubundaki iyileşmeye göre daha belirgindir.

Anahtar sözlükler: Ön çapraz bağ; tibialis anterior; hamstring

Introduction

Anterior cruciate ligament (ACL) injuries still remain an important health problem affecting the activities of daily living (ADL) and mobility adversely despite their early detection and appropriate treatment methods (1,2). Surgical treatment is indicated in active young athletes or incase of combined ligament injuries, meniscal lesions, instability of knee joint or pain not responding to the conservative treatments(3-5) . In this context, different surgical methods have been described. Although different techniques such as primary or supportive suture repair of the ligament were defined, the accepted and established approach is the anatomical reconstruction with grafting (6-9).

There are mainly three types of grafting methods described in the literature, including allograft, autograft, and synthetic grafts. Yet synthetic grafts are not used because of poor clinical and surgical outcomes (3,6-9). Concerning the autografts; patellar tendon, hamstring tendon, and quadriceps tendon autografts are used. While faster recovery, being less painful and swelling and providing earlier/better joint range of motion (ROM) are the advantages of hamstring tendon autograft compared to patellar bone-tendon-bone (PBTB) graft, poorer fixation is the disadvantage. On the other hand, allografts are prepared by a series of processes such as freezing, drying, and irradiating of donor's patellar tendon or tibialis anterior tendon. The major disadvantages are the risk of communicable disease, slower recovery and fixation and higher costs (3,10).

Both allografts and autografts are frequently used in ACL reconstruction surgery and along with the increase in clinical use, the number of studies and the level of evidence in this field are also increasing (3,5,6,8,10,11). However, the issues of how the construction should be done, advantages and disadvantages of allograft and autograft methods are still controversial. Accordingly, the aim of this study was to compare the impacts of hamstring tendon autografting and tibialis anterior allografting methods in ACL reconstruction surgery.

Patients and Methods

Study Design

This study was designed as a cross-sectional and retrospective trial. Patients who underwent ACL reconstruction surgery either with hamstring autografting or tibialis anterior allografting methods in our center were enrolled. Preoperative and postoperative 6th month data of the two methods were compared.

Approval was obtained from the hospital ethics committee for this study with the number 2017/23.

Participants

The inclusion criteria were;

- Patient who underwent ACL reconstruction surgery between the January 2012 and September 2017 in the Department of Orthopedics and Traumatology, Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital.
- Patients underwent tibialis anterior allografting or hamstring tendon autografting for primary reconstruction surgery
- Patients who don't have missing data as regards the preoperative and postoperative follow-up periods.

Patients who met any of the following criteria were excluded; patients who underwent surgery before the January 2012 or after the September 2017, reoccurrence cases, receiving ACL treatment with a technique rather than tibialis anterior allografting or hamstring tendon autografting, and having missing data during the follow-up period.

Surgical Technique

Preperation before the surgery

All surgical procedures were performed by the same physician. The patient was suspended in a supine position and the knee was lowered gently down to allow a ROM of 0-120 degrees (Figure 1A). Arthroscopic examination was performed before the graft was removed in all cases, confirming the ACL rupture (Figure 1B). Detected meniscus lesions or chondral lesions were treated at this time or after graft removal.

Preparation of hamstring tendon graft

After tuberosity tibia and pesanserinus fascia were palpated, a slight oblique 4-5 cm incision was carried out from 2 cm medial and 1 cm superior of tibial tuberosity. Grasilis and semitendinosus tendons were palpated under the fascia and dissected from the fascia with blunt dissection (Figure 1C). The grasilis and semitendinosus grafts obtained were wetted with saline and the musculoskeletal parts were cleaned with the aid of bisturia. The grafts were placed on the graft preparation board (Figure 1D). After the proximal and distal parts of the grasilis and semitendinosus tendons intertwined in opposite directions (i.e. the proximal of the grasilis was positioned distally to the semitendinosus, and the proximal of the semitendinosus was positioned distally), both tendons were fixed by using 2/0 vicryl.

Tibialis anterior allografting

Lifeling Tissue Bank® brand tibialis anterior allograft, which was prepared as fresh frozen according to American Association of Tissue Banks standards and approved by Food and Drug Administration, was used. Allografts were transferred by cold chain method in allograft-treated patients. It was stored in sterile conditions at +5 °C prior to operation. Then, when sufficient softness was achieved in the physiological saline, the graft preparation procedures were applied in the same manner.

Table 1. Knee Bracing Settings

Day	Knee Bracing Settings
0	Operation day
2	15 degrees
5	30 degrees
8	45 degrees
11	60 degrees
14	75 degrees
17	90 degrees
20	105 degrees
23	120 degrees
26	6x5 min maximum flexion without knee bracing
29	6x5 min maximum flexion without knee bracing
32	6x5 min maximum flexion without knee bracing

Opening tibial tunnel, placing the graft, and fixation

After opening the femoral and tibial tunnels, the grafts were placed into the tunnel with a guide of wire (Figure 1E). Femoral fixation was done with transfix screw. Tibial fixation was done with biodegradable screw and staple (Figure 1F). Elastic bandage was applied and knee brace was recommended after surgery.

Rehabilitation Protocol Used After ACL Surgery in Our Clinic

- Controlled weight loading
- Quadriceps strengthening exercises
- Angle of the knee brace is set according to the Table 1.
- Complete weight loading at the 32nd day
- Third month light sports such as walking and 6th month heavy sports such as football.

Outcome Measures

Lysholm knee scoring scale (LKSS) was designed to evaluate patients after knee ligament injuries in 1982 and it comprises mainly 8 items. The original version of the questionnaire was English and it was adapted to Turkish in 2013. The Turkish version of the LKSS is valid and reliable (12). Tegner activity level scale (TALS) is a scale that

provides a standardized method of grading work and sporting activities. The TALS is scored from 0 point to 10 points. Sick leave or disability pension because of knee problems referes to the level 0 while competitive sports-soccer, football acitivites refer to the level 10 (13).

Statistical Analysis

The data were analyzed using Statistical Package for the Social Sciences (SPSS, Inc, Chicago IL, USA) program. Descriptive data are given as mean, standard deviation, count (n), percentage (%). Categorical variables were compared using Chi Square Test. After checking the normal distribution with Kolmogorov Smirnov Test, Paired t test or Wilcoxon signed rank test was used for comparing baseline and post-surgery data. Between-group comparisons were administered using Student's t test or Mann Whitney U test. The confidence value of 95% was selected and p value of 0.05 or less was considered significant.

Results

A total of 121 patients (100 males, 21 females) with a mean age of 32.74±7.82 years (ranges 19 to 52) were included. Demographical features of the groups are summarized in Table 2. No significant difference was observed between the groups in terms of age, gender, symptoms, and physical examination findings ($p>0.05$ for all). Concerning the concommitant disorders with the ACL injury, cartilage and meniscal lesions were detected in 10 and 39 patients, respectively. Eight of 10 patients with cartilage lesions underwent debridement and two of them underwent microfracture surgery. Meniscal repair and partial menisectomy were applied to 12 and 15 patients for the medial meniscus lesions, respectively. Lateral meniscus repair was administered in 10 patients and partial menisectomy for lateral meniscus were carried out in two patients. There was no significant difference between the groups in terms of the concomitant knee lesions ($p>0.05$). LKSS and TALS did significantly improve after the surgery compared to the baseline values in both groups. When the change levels (delta values) were compared between the groups ($p<0.01$), the increase was more prominent in the allografting group than the autografting group ($p<0.05$) (Table 3).

Complications were seen only in 5 patients (4,1 %). Superficial tissue infection was seen in four patients and they were successfully treated with antibiotic therapy. Deep tissue infection was seen in one patient and was treated with an early arthroscopic surgery. While 115 patients (95%) reached the aimed postoperative results with standard rehabilitation program, six of the 44 patients (13,65%) in the autografting group required aggressive and prolonged rehabilitation program upon conculting to the department of physical and rehabilitation medicine.

Discussion

In this study, we aimed to compare the effectiveness of hamstring autografting and tibialis tendon allografting methods in ACL reconstruction surgery. There are two main findings of this study. First, both methods were effective in improving the LKSS and TALS. Second, the improvement levels were more prominent in the allografting groups.

Studies comparing hamstring autograft with allograft methods have been reported previously in the literature. Yang et al. (14) compared these two methods for ACL reconstruction in cohort design studies involving 175 patients. Although the allograft group showed increased laxity and immunologic response in the early postoperative period, both groups gave similar results in the long-term (mean one year) follow-up. Kaeding et al. (15) reported an increased risk of recurrent rupture in allografting compared with autografting in young adults who were followed-up for an average of 2 years. They found that the use of allografts was preferred by surgeons in relatively advanced level of injury and less active patients, with a reduction in the risk of recurrent ACL ruptures. Kim et al. (16) have shown that hamstring autografts showed better maturation than tibialis anterior

Table 2: Clinical and demographical features of allograft and autograf methods

Variables	Allograft (N=77)	Autograft (N=44)	P value
Age (year)	33.03±7.5	32.25±8.2	0.602
Age Distribution (year)			0.982
- <30	32 (41.6)	19 (43.2)	
- 31-40	31 (40.3)	17 (38.6)	
- >40	14 (18.1)	8 (18.2)	
Gender	65 (84.4)	35 (79.6)	0.496
- Male	12 (15.6)	9 (20.4)	
- Female			
Involvement Side	37 (48.1)	24 (54.5)	0.492
- Right	40 (51.9)	20 (45.4)	
- Left			
Symptoms			
- Pain	55 (71.4)	34 (77.2)	0.483
- Feeling of Instability	59 (76.6)	36 (81.8)	0.503
- Locking	22 (28.6)	12 (27.2)	0.878
Physical Examination Findings			
- Lachman's Test	72 (93.5)	34 (77.2)	0.349
- Anterior drawer test	65 (84.4)	40 (90.9)	0.489
- Pivot Shift Test	38 (49.3)	27 (61.3)	0.202
- Mc Murray Test	30 (38.9)	19 (43.1)	0.649
Cartilage			
- Debridement	4 (5.1)	4 (9.1)	0.408
- Microfracture	2 (2.5)	0 (0)	
Medial Meniscus			0.136
- Medial meniscus repair	5 (6.4)	7 (15.9)	
- Partial menisectomy	8 (10.2)	7 (15.9)	
Lateral Meniscus			
- Lateral meniscus repair	5 (6.5)	4 (9.1)	0.111
- Partial menisectomy	2 (2.6)	1 (2.2)	

- Categorical and continuous variables were compared using Chi Square test and Student's t test, respectively.
- The data are shown as mean ± standard deviation or n, (%).

Table 3: Lysholm Knee Scoring Scale and Tegner Activity Level Scale of the Allograft and Autograft Groups

Variables	Baseline	Post-treatment	Change Values	P value
LKSS				
- Allograft	62.44±8.7*	92.71±6.4	30.27±4.8	**<0.001**
- Autograft	66.95± 5.0*	91.39±5.2	24.43±2.8	
TALS				
- Allograft	2.38±1.3**	5.70±1.4	3.32±1.1	**0.010**
- Autograft	2.36±1.0**	5.20±1.4	2.84±0.8	

LKSS: Lysholm knee scoring scale, TALS: Tegner activity level scale

- Between-group changes were compared using Student's t test.
- Bold p values denote significance.

* There was a significant difference between the groups regarding the preoperative LKSS values (p=0.002).

** No significant difference was observed between the preoperative TALS values between the groups (p=0.956).

Figure 1: Preoperatif and Perioperative Images, Positioning of the patient (A), Arthroscopic imaging (B), Preparation of the graft (C), Prepared autograft (D), Placing the autograft (E), Placing U staple for tibial fixation (

allografts in retrospective cohort studies. Grassi et al. (17) Studies comparing hamstring autograft with allograft methods have been reported previously in the literature. Yang et al. (14) compared these two methods for ACL reconstruction in cohort design studies involving 175 patients. Although the allograft group showed increased laxity and immunologic response in the early postoperative period, both groups gave similar results in the long-term (mean one year) follow-up. Kaeding et al. (15) reported an increased risk of recurrent rupture in allografting compared with autografting in young adults who were followed-up for an average of 2 years. They found that the use of allografts was preferred by surgeons in relatively advanced level of injury and less active patients, with a reduction in the risk of recurrent ACL ruptures. Kim et al. (16) have shown that hamstring autografts showed better maturation than tibialis anterior allografts in retrospective cohort studies. Grassi et al. (17) compared the surgical outcomes of graft selection in revision ACL reconstruction in their meta-analysis published in 2017. Autografts yielded better results in revision surgery with lower laxity and complication rates than allografts. However, allografts and autografts yielded similar results except for the irradiated allografts. The study results reported in the data vary according to the study population. In general, allografting methods shorten the surgery duration and make the rehabilitation easier. Lack of donor site morbidity is another disadvantage of autografting. In our center, we commonly use hamstring tendon graft and tibialis anterior allograft. We use the Lifeling Tissue Bank® brand tibialis anterior allograft, fresh frozen in compliance with the American Association of Tissue Banks standards,

approved by the Food and Drug Administration. Therefore we have compared these two methods in our study. According to our results, a significant improvement in LKSS and TALS values was observed in both graft groups after surgery compared with baseline, but when the change levels between groups were compared, the improvement in the allograft group was significantly higher. While an increase of 30.27 was observed in the allograft group for LKSS, an increase of 24.43 was observed in the autograft group. There was a mean increase of 3.32 in the allograft group and an increase of 2.84 in the autograft group.

Although different methods were described for femoral fixation, commonly used methods are endobutton and cross-pin methods. Price et al. (18) performed a randomized controlled trial comparing the endobutton and cross-pin methods in hamstring autografting. These two methods showed similar results during the 2 years of follow-up. The need for scoping for the endobutton application is a significant disadvantage of radiation exposure. For tibia fixation, the screw is an effective fixation material. Since there was noscopy in the operating room in our center and the cross-pin application showed very good stabilization, we used cross-pin for femoral fixation and screw-staple for tibia fixation in our patients.

Bansal et al. (19) published a meta-analysis in 2017 to determine the risk of infection according to graft method after ACL reconstruction. They included 21 studies to compare hamstring or bone-patellar tendon-bone autograft after literature review. Allograft patients were excluded. Overall the infection risk was low in their report besides the infection rate was higher in the hamstring autograpting group. When we look at the complication rate between allograft and autograft groups, it is seen that allograft has less complication rate. Hemoglobin, postoperative pain, and limitation of knee flexion may develop in the donor area of autograft treated patients. These complications can affect postoperative functionality and rehabilitation process (18). In our study, complications were observed in 5 patients and the complication rate was 4.1%. Four patients developed superficial infection and were treated with antibiotic therapy. In one patient, deep tissue infection developed and was treated arthroscopically with early intervention. Although no specific test was used to evaluate the outcome of rehabilitation in our study, 6 patients who had autograft had pain, ROM limitation, prolonged and challenging rehabilitation program.

Limitations

We have some important drawbacks to this study. Frist, lack of the etiologic factors for the ACL rupture and time between the injury and operation is a limitation. The retrospective design is a limitation as well.

Conclusion

In the light of our results, both hamstring autografting and allografting methods seem to be effective in improving LKSS and TALS in ACL reconstruction. However, the improvement in the allograft group is more prominent than that of in the autograft group. However, in the autograft method, postoperative pain, donor-site morbidity, limitation in ROM can be seen and make the rehabilitation process challenging. Further studies comparing these two methods in prospective cohort designs are awaited

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