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Clinical Comparison of Patients Undergoing Anterior Cruciate Ligament Reconstruction Using an Allograft or Autograft

Allogreft ve Otogreft Kullanılarak Ön Çapraz Bağ Rekonstrüksiyonu Yapılan Hastaların Klinik Karşılaştırması

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ABSTRACT

Aim: The purpose of this study was to examine the clinical results of individuals who underwent an autograft or allograft repair of the anterior cruciate ligament (ACL).
Material and Methods: Retrospective analysis was done on the patient files of patients who underwent ACL reconstruction between 2014 and 2020 using semitendinosus-gracilis tendon autografts (SGT-A) and tibialis anterior tendon allografts (TAT-A). In this study, the data of 30 patients in each group were included. Knee laxity tests, the Lysholm knee grading system, the Tegner activity score, and the International Knee Documentation Committee (IKDC) score were used to compare patient results.
Results: While there was no significant difference in the Tegner activity score between the preoperative and the final measurement (p=0.241), the IKDC scores and the Lysholm knee ratings changed statistically significantly between the preoperative measurement and the last control visit (p=0.020, and p=0.038, respectively) for both groups in this study. The SGT-A group's Lysholm knee score had a preoperative value of 60.97% and a final control value of 90.48%. The preoperative Lysholm knee score for the TAT-A group was 61.31%, and the final control value was 95.03%. The anterior drawer and Lachman test findings showed statistically significant intergroup (autograft and allograft) alterations in both the autograft and allograft groups (both p<0.001).
Conclusion: In terms of knee function and laxity, this study achieved a better clinical outcome in the allograft group compared to the autograft group.
Keywords: Anterior cruciate ligament; allograft; arthroscopy.

ÖZ

Amaç: Bu çalışmanın amacı, ön çapraz bağın (ÖÇB) otogreft veya allogreft onarımı yapılmış olan bireylerin klinik sonuçlarının incelenmesidir.
Gereç ve Yöntemler: 2014 ve 2020 yılları arasında semitendinosus-gracilis tendon otogreftleri (semitendinosus-gracilis tendon autografts, SGT-A) ve tibialis anterior tendon allogreftleri (tibialis anterior tendon allografts, TAT-A) kullanılmak suretiyle ÖÇB rekonstrüksiyonu yapılmış olan hastaların dosyaları üzerinde geriye dönük olarak analiz yapıldı. Bu çalışmaya her iki grupta da 30 hastanın verileri dahil edildi. Hastaların sonuçlarının karşılaştırılması amacıyla diz laksite testleri, Lysholm diz skorlama sistemi, Tegner aktivite skoru ve Uluslararası Diz Dokümantasyon Komitesi (International Knee Documentation Committee, IKDC) skoru kullanıldı.
Bulgular: Preoperatif ölçüm ile son ölçüm arasında Tegner aktivite skoru bakımından anlamlı bir fark yokken (p=0,241), IKDC skorları ve Lysholm diz skorlamaları, bu çalışmadaki her iki grup için de preoperatif ölçüm ve son kontrol ziyareti arasında istatistiksel olarak anlamlı bir şekilde değişti (sırasıyla, p=0,020 ve p=0,038). SGT-A grubu Lysholm diz skorunun preoperatif değeri %60,97 ve son kontrol değeri ise %90,48 idi. TAT-A grubu için preoperatif Lysholm diz skoru değeri %61,31 ve son kontrol değeri ise %95,03 idi. Ön çekmece ve Lachman test bulguları, hem otogreft hem de allogreft gruplarında gruplar arası (otogreft ve allogreft) istatistiksel olarak anlamlı şekilde değişiklikler gösterdi (her iki p<0,001).
Sonuç: Bu çalışmada diz fonksiyonu ve laksite açısından, otogreft grubuna kıyasla allogreft grubunda daha iyi klinik sonuç elde edilmiştir.
Anahtar kelimeler: Ön çapraz bağ; allogreft; artroskopi.

INTRODUCTION

Injuries to the anterior cruciate ligament (ACL) affect 75/100,000 people annually in the general population (1,2). If left untreated, ACL tears may result in meniscal tears, knee instability, and cartilage abnormalities (3). The two basic methods for treating ACL ruptures are ACL reconstruction or repair. Results from ACL reconstruction were superior to those from ACL repair (4). The choice of graft, or whether to employ autograft or allograft, is one of the critical factors in the effectiveness of the reconstruction. Numerous studies have been carried out to find the most effective graft, and their findings have been documented in the literature (5,6).

Commonly used autograft choices include hamstring tendons, quadriceps tendons, and bone-patellar tendon-bone (BPTB). The anterior and posterior tibial tendons, the Achilles tendon, and the peroneal tendon are available as allograft possibilities. Despite the fact that ACL reconstruction treatments have a success record of greater than 90%, the topic of graft selection is still up for dispute (5,6). Although hamstring tendon utilization has increased recently, quadriceps tendon autografts have also become more common (7).

Numerous research on the choice of autografts or allografts for ACL restoration has been undertaken (5,6). These research studies investigated the benefits and drawbacks of both autografts and allografts (5,6). This study investigated the differences between the functional outcomes in patients undergoing ACL reconstruction surgery using semitendinosus and gracilis tendon autografts (SGT-A) or tibialis anterior tendon allografts (TAT-A).

MATERIAL AND METHODS

Study Design and Participants

A retrospective analysis was performed on patient files of patients who underwent SGT-A- and TAT-A-based ACL reconstruction between 2014 and 2020. Patients under the age of 18 years, those who had surgery in the same knee before, those who had ACL tears along with traumatic fractures or avulsion fractures, those who had surgery in the same extremity, those who did not adhere to the treatment and rehabilitation plan, those who did not finish a 24-month follow-up period, and/or those who lacked the necessary documentation were excluded from the study. It was noted that 51 patients had operations using TAT-A and 72 patients had operations using SGT-A between 2014 and 2020. Six patients in the TAT-A group failed to complete the 24-month follow-up, and 15 patients in the TAT-A group were eliminated from the study because their files were missing. In the SGT-A group, seven patients had previously undergone surgery on the same knee, 15 patients did not complete their 24-month follow-up, and 20 patients were not included in the study because their files were missing. In the final sample, the data of 30 patients in each group were analyzed. The methods for the scientific investigation were explained to the patients, and their consent was obtained. Documents were examined. The Malatya Turgut Özal University Faculty of Medicine's ethical committee granted the study permission on August 20, 2021 (decision number 2021/58). The informed consent form was signed by all patients involved in the study.

Surgical Technique

Spinal anesthesia was administered to all patients. The anesthesia was followed by the application of a tourniquet. In the TAT-A group, an allograft of a freeze-dried, radioirradiated tibialis anterior tendon was utilized. In the SGT-A group, semitendinosus and gracilis tendons were utilized. The semitendinosus and gracilis tendons in the SGT-A group were cut through an oblique incision made about 2 cm medial to the ipsilateral knee's tibial tuberosity. The two groups of tendons were doubled, and the grafts were produced. A femoral tunnel was first made once the tendon’s thickness was established, and then a tibial tunnel with the same diameter as the tendon was made. The Endobutton loop device was then used to attach the tendons to the femoral cortex. A bioabsorbable screw was used in the tibial fixation, and the remaining tendon was fixed with a staple screw (U screw).

Postoperative Follow-up

Exercises and a rehabilitation program were initiated by the Physical Therapy and Rehabilitation Department of our hospital on the first day after the operation. A hinged brace was placed so that the patient could fully extention and flexion the knee at 90°. The patients were allowed to walk using double crutches by bearing as much weight as they could on their knee, and were then discharged after a mean period of five days. The braces were removed after three weeks. The patients started flat racing approximately four months later, and they were advised to return to active sports activities six months after surgery. The study analyzed patients who underwent control visits for at least 24 months following surgery. Both active and passive flexion and extension movements were evaluated. The Lachman test, the anterior drawer test, and the pivot-shift test were all given a positive or negative evaluation.

The performance of the knee was assessed using the Lysholm knee score. A score of 91 to 100 was considered exceptional, 84 to 90 was considered decent, 65 to 83 was considered average, and 65 was considered low (8). A score of 0 on the Tegner activity scale implied eligibility for sick leave or a disability pension due to knee issues, whereas a score of 10 showed eligibility for professional sports participation (2). The knee exam employed the International Knee Documentation Committee (IKDC) score system. The IKDC score is a crucial factor in determining if post-injury care was successful. The existence of mobility restrictions (restricted flexion and/or limited extension) was assessed in the patients.

Sample Size

According to the calculation made using the G*power 3.1 program, the required sample size was determined to be 58 (where each group consisted of 29 patients) with an effect size of 0.80, a margin of error of 0.05, a confidence level of 0.95, and a population representation of 0.90 (9).

Statistical Analysis

The IBM SPSS Statistics for Windows, version 25.0 software program was used for data analysis. In statistical comparisons, the level of statistical significance was accepted as 0.05. The mean, standard deviation, number, and percentage were used as descriptive statistics for the variables. The chi-square test was used to evaluate independent categorical data. The McNemar chi-square and marginal homogeneity tests were used for dependent group categorical data. The two-sample t-test (t-test) of the

difference between the two means was used in the comparison of two independent groups. The multivariate normal distribution and homogeneity of variance were controlled. Parametric analysis methods were used because the distributions were provided. In repeated measurements, the two paired samples t-test was used in pairwise comparisons within the group. Two-way ANOVA was used to compare changes over time between the groups.

RESULTS

At the clinic, 30 patients received ACL reconstruction using semitendinosus and gracilis tendon autografts and 30 patients underwent ACL reconstruction using tibialis anterior tendon allografts throughout the designated study period. In terms of age, follow-up time, or injury-surgery duration, there was no statistically significant difference between the autograft and allograft groups (Table 1).

Both the etiology and intraarticular pathologies that could accompany an ACL tear, such as a medial meniscus tear, a lateral meniscus tear, and cartilage abnormalities, did not show any significant intergroup differences (Table 2). Meniscorraphy, cartilage abnormalities, or microfracture applications did not significantly differ during the surgical intervention (Table 3). All meniscus tears were repaired. Meniscectomy was not performed. Arthroscopic irrigation surgery was performed in one patient from each group because of high C-reactive protein (CRP) levels and sedimentation. Patients recovered after treatment with the provided therapy. One patient with an infection in the autograft group suffered from an ACL rupture owing to trauma at 20 months, and this patient underwent corrective surgery. One patient in the allograft group experienced an ACL rupture after a fall and subsequently underwent corrective surgery. Regarding postoperative infections and re-rupture, there was no discernible difference between the autograft and allograft groups (Table 3). Participants from the SGT-A and TAT-A groups experienced no limited extension at the most recent control visit. Twenty-four (80.0%) and six (20.0%) patients in the SGT-A group displayed limited flexion, compared to the other patients. Limited flexion was present in 25 (83.3%) and 5 (16.7%) of the TAT-A group patients, respectively (Table 3).

The mean Tegner activity score and the mean IKDC score were compared between intra- and intergroup (autograft and allograft) to determine the changes over time (Table 4). Between the autograft and allograft groups, there was no discernible difference in that the Tegner activity score changed over time between the preoperative and the final measurement (p=0.241). Between the autograft and allograft groups, there were substantially different changes in terms of the IKDC score over time between the preoperative and the final measurement (p=0.020).

The results of comparing intra- and intergroup (autograft and allograft) changes in the Lysholm knee score over time were shown in Table 4. The SGT-A group Lysholm score had a preoperative value of 60.97% and a final control value of 90.48%. The preoperative Lysholm score for the TAT-A group was 61.31%, while the control value at the end was 95.03%. Between the autograft and allograft groups, there were substantially different changes in the Lysholm score over time between the preoperative and the final measurement (p=0.038, Table 4).

Table 2. Comparison of the etiology, presence of medial meniscus tear, lateral meniscus tear, cartilage defect

	SGT-A (n=30)	TAT-A (n=30)	p
Etiology, n (%)			
Sports	16 (53.3)	16 (53.3)	
Falls	9 (30.0)	12 (40.0)	0.415
Trauma	5 (16.7)	2 (6.7)	
Medial meniscus tear, n (%)	9 (30.0)	10 (33.3)	0.781
Lateral meniscus tear, n (%)	4 (13.3)	3 (10.0)	0.687
Cartilage defect, n (%)	3 (10.0)	4 (13.3)	0.687

SGT-A: semitendinosus and gracilis tendon autografts, TAT-A: tibialis anterior tendon allografts

Table 3. Comparison of the meniscorraphy, cartilage defect, microfracture, postoperative infections, re-rupture

	SGT-A (n=30)	TAT-A (n=30)	p
Meniscorraphy, n (%)	11 (36.7)	10 (33.3)	0.787
Microfracture, n (%)	3 (10.0)	4 (13.3)	0.687
Post-op infections, n (%)	1 (3.3)	1 (3.3)	0.754
Re-rupture, n (%)	2 (6.7)	1 (3.3)	0.754
Limitation, n (%)	6 (20.0)	5 (16.7)	0.500

SGT-A: semitendinosus and gracilis tendon autografts, TAT-A: tibialis anterior tendon allografts

Table 4. Intragroup and intergroup comparison of Tegner activity score, IKDC score, and Lysholm knee score

	SGT-A (n=30)	TAT-A (n=30)	p^2
Tegner, mean±SD			
Preoperative	5.20±1.30	5.60±1.33	0.241
24-month control	4.97±1.30	5.53±1.41	
p^1	**0.032**	0.489	
IKDC, mean±SD			
Preoperative	31.01±3.79	29.40±3.36	**0.020**
24-month control	91.01±4.88	92.94±3.75	
p^1	**<0.001**	**<0.001**	
Lysholm score, mean±SD			
Preoperative	60.97±6.61	61.31±8.38	**0.038**
24-month control	90.48±1.51	95.03±2.92	
p^1	**<0.001**	**<0.001**	

IKDC: international knee documentation committee, SGT-A: semitendinosus and gracilis tendon autografts, TAT-A: tibialis anterior tendon allografts, SD: standard deviation, p^1: within-group pairwise comparison (two paired samples t-test), p^2: between groups repeated measures two-way ANOVA

Table 1. Homogeneity of distribution for age, duration of follow-up, and injury-surgery time in the groups

	SGT-A (n=30)	TAT-A (n=30)	test value	p
Age (years)	25.50±4.96 [18-34]	25.20±5.65 [18-37]	0.218	0.828
Duration of follow-up (months)	23.87±0.57 [23-25]	23.67±0.61 [23-25]	1.315	0.194
Time from injury to surgery (weeks)	7.87±2.53 [4-12]	8.10±3.26 [4-14]	-0.310	0.758

SGT-A: semitendinosus and gracilis tendon autografts, TAT-A: tibialis anterior tendon allografts, test value: independent samples t-test value, descriptive statistics were reported as mean±standard deviation [minimum-maximum]

The pivot-shift, anterior drawer, and Lachman test final follow-up results were compared within and between groups (autograft and allograft), and the results were shown in Table 5. Due to an equal number of patients in the autograft and allograft groups, both intragroup and intergroup assessments of the pivot-shift test findings did not reveal any statistically significant differences (p=1.000, Table 5). Results of the anterior drawer test revealed statistically significant differences between the autograft and allograft groups in both intragroup and intergroup analyses (p=0.001, Table 5). Results of the Lachman test revealed statistically significant differences in the autograft and allograft groups in both intragroup and intergroup analyses (p=0.001, Table 5).

DISCUSSION

The selection of grafts is a topic of discussion due to the rise in surgical procedures for ACL injuries. The choice of graft, the patient's age, the existence of additional diseases, the amount of activity, and the patient's compliance with the treatment all contribute to the success of ACL reconstruction surgery (10). In this study, it was observed that the IKDC and Lysholm scores exhibited better clinical results in terms of knee function in the allograft group, and the anterior drawer and Lachman test results exhibited better clinical results in terms of knee laxity for this group. Hamstring and BPTB grafts are the most frequently used grafts in ACL restoration procedures, followed by quadriceps tendons (11). The use of BPTB grafts has some drawbacks, including patellar and knee pain, patellar fractures, patellar tendonitis, a loss of complete extension, a weakening of the quadriceps muscle, and a decrease in extensor mechanism strength (12). Reduced adaption time due to bone-to-bone union in the tunnel and usability of the graft in stiff fixations are benefits of using BPTB grafts. Due to their firmness, strength, and low rate of morbidity at the donor site, four-strand gracilis and semitendinosus tendon autografts are frequently employed in orthopedic procedures (13). The benefits of allografts include quick recovery times, low rates of surgical complications, and easy limitless access to grafts of the required length and thickness (14,15). In both laboratory and clinical tests, autografts outperformed allografts, according to Lin et al. (16). In terms of knee function and laxity, this study achieved a better clinical outcome in the allograft group compared to the autograft group.

An autograft was used in 32 patients and an allograft was used in 29 patients in a study by D'Ambrosi et al. (17) that evaluated the use of autografts and allografts in patients having ACL restoration. There was no significant difference in the Tegner activity score, the subjective IKDC score, or the Lysholm score between the two groups. No statistically significant difference between the mean subjective IKDC score and the allograft and autograft groups was reported in the study by Razi et al. (18). In a study by Yang et al. (19), the Lysholm knee scores were 90.9 in the allograft group and 91.8 in the autograft group at the last control visit. In terms of the Lysholm knee score, the subjective IKDC score, and the Tegner activity score, the study by Cengiz et al. (20) study found no evidence of a significant difference between the groups. According to certain research, there was no discernible difference between the autograft and allograft groups in terms of the IKDC, Tegner activity, or Lysholm knee scores (21,22). In this study, according to the Tegner activity scale, patients returned to their prior activity levels in both groups. In terms of knee functions as measured by the IKDC and Lysholm knee scores, the allograft group did better than the autograft group.

The patients' knee laxity tests were assessed. There was no statistically significant difference between the autograft and allograft groups in the study by Cengiz et al. (20) and the intergroup evaluations of the pivot-shift test results. There was a statistically significant difference between the autograft and allograft groups in both the intra- and intergroup assessments of the anterior drawer and Lachman tests. In this study, it is believed that the most important factors affecting success in ACL reconstruction are proper graft selection according to the clinical experience of the surgeon and the physical activity level of the patient, correct implementation of the surgical procedure, postoperative patient compliance, and an appropriate rehabilitation program (20). In the trial by Yang et al. (19), the Lachman test resulted in a negative result in 76.5% of patients receiving allografts and a positive result in 23.5% of patients at the last control visit. The Lachman test was negative in 77.8% of the autograft group and positive in 22.2% at the most recent control visit. The pivot-shift test was negative in the allograft group in 81.3% of cases and positive in 18.7% of cases at the most recent control visit. The pivot-shift test in the autograft group was negative in 96.7% of cases and positive in 3.3% at the last control visit (19). Similar objective and subjective findings were seen in patients who underwent repair using allografts and hamstring tendon autografts in this investigation during the long-term

Table 5. Intragroup and intergroup comparison of pivot-shift, anterior drawer, and Lachman test results

			SGT-A (n=30)		**TAT-A (n=30)**		**p²**
			24-month control		24-month control		
			Negative	Positive	Negative	Positive	
Pivot-Shift, n (%)	Preoperative	Negative	27 (90.0)	0 (0.0)	25 (83.3)	0 (0.0)	1.000
		Positive	3 (10.0)	0 (0.0)	5 (16.7)	0 (0.0)	
		p¹	0.250[a]		0.063[a]		
Anterior Drawer, n (%)	Preoperative	Negative	7 (25.9)	0 (0.0)	8 (27.6)	0 (0.0)	**<0.001**
		Positive	20 (74.1)	3 (100)	21 (72.4)	1 (100)	
		p¹	**<0.001**[a]		**<0.001**[a]		
Lachman, n (%)	Preoperative	Negative	13 (48.1)	0 (0.0)	6 (23.1)	0 (0.0)	**<0.001**
		Positive	14 (51.9)	3 (100)	20 (76.9)	3 (100)	
		p¹	**<0.001**[b]		**<0.001**[b]		

SGT-A: semitendinosus and gracilis tendon autografts, TAT-A: tibialis anterior tendon allografts, p¹: within-group pairwise comparison ([a]: McNemar, [b]: marginal homogeneity test), p²: between groups comparison

follow-up period (19). In the Bistolfi et al. (23) trial, patients who underwent either autografts or allografts and were followed up with for an average of 10 years experienced nearly the same functional results. Freshly frozen allografts were demonstrated in this study to be a viable alternative for ACL restoration. Autografts and nonirradiated allografts for primary ACL reconstruction showed equal patient-reported clinical results and graft failure rates in the study by Dhillon et al. (24). In terms of knee laxity, this study was found to be more successful in the autograft group compared to the allograft group (19). In this study, knee laxity results were found to be more successful in the allograft group.

After ACL reconstruction, a restriction in the range of motion of the knee joint was noted. Potential causes of the restricted range of motion include the patient's noncompliance with the rehabilitation program, failure to place the graft in the proper position and tone, infections that developed after the surgery, and the patient's preoperative range of joint motion. Studies in the literature established the criteria for arthrofibrosis, which has a reported frequency range of 614%, as a limited extension larger than 10° and a limited flexion less than 125° (25-28). According to studies in the literature, the rates for loss of extension greater than 6° and the loss of flexion greater than 16° are 12-15% and 8-50%, respectively (29,30). In the current investigation, neither the SGT-A group nor the TAT-A group experienced any limited extension during the final control visit. Six (20%) patients in the SGT-A group and five (16.7%) patients in the TAT-A group had limited flexion at the most recent control visit. No discernible difference was reported in the study by Yang et al. (19) between patients who employed autografts or allografts in terms of extension and flexion. In this study, there was no discernible difference in the range of joint mobility limitation between the autograft and allograft groups.

CONCLUSION

In terms of knee function and laxity, this study achieved a better clinical outcome in the allograft group compared to the autograft group. The study's shortcomings included the patients' low average age, the absence of body mass indices, the exclusion of graft thicknesses, and the short follow-up period (less than 25 months).

Ethics Committee Approval: The study was approved by the Clinical Researches Ethics Committee of Malatya Turgut Özal University (20.08.2021, 58).

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