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PŮVODNÍ PRÁCE

Is Peroneus Longus Allograft Good Alternative for Anterior Cruciate Ligament Reconstruction: a Comparison Study

Je alograft šlachy *m. peroneus longus* vhodnou alternativou pro rekonstrukci předního zkříženého vazu: srovnávací studie

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ABSTRACT

PURPOSE OF THE STUDY

To compare the early clinical results of patients who had anterior cruciate ligament (ACL) reconstruction with peroneus longus allograft versus hamstring tendon autograft.

MATERIAL AND METHODS

Forty patients who underwent ACL reconstruction were included in the study. Patients were grouped by their graft preference. Lachman and Pivot-shift tests were performed to the patients. Laxity was measured by KT-1000 arthrometer test with 15, 20 and 30 pound power. The maximum force values of nonoperated knee and the operated knee were recorded with Cybex II isokinetic dynamometer (HUMAC) and compared to each other. International Knee Documentation Committee (IKDC) form, modified Lysholm and Cincinnati evaluation forms were compared between two groups.

RESULTS

Twenty patients included into peroneus longus allograft (Group 1) and 20 patients were included into hamstring autograft group (Group 2). The mean age of patients Group 1 and 2 were 34.25 ± 6.73, and 29.6 ± 4.55, respectively. No significant difference was noted between two groups at modified Lysholm, Cincinati and IKDC scores ($p > 0.01$). There was no statistically significant difference between the Lachman and Pivot hift levels ($p > 0.01$). No significant difference was found in KT-1000 device measurements between groups according to the performed techniques ($p > 0.01$). There was no statistically significant difference between Cybex extension-flexion 60 /sec measurement and extension 240 /sec measurement of the patients ($p > 0.01$).

DISCUSSION

Allografts can be preferred because of the advantages, such as lack of donor site morbidity, short operative time, large graft, small incision, minimal scar, good cosmetic appearance, less postoperative pain, less movement restriction, and less arthrofibrosis. However, there are disadvantages, such as disease transmission, low biocompatibility, immune response, long recovery time, and high cost. Although it is difficult to compare the stability and functionality of allografts and autografts because of the differences in graft processing, fixation methods, and surgical techniques in studies, similar clinical results are reported in long-term follow-ups

CONCLUSIONS

Graft preference is dependent on surgical experience, patient age, activity status, comorbidities, presurgical status, and patient decision. Allograft ACL reconstruction is a good alternative to arthroscopic ACL reconstruction performed with hamstring tendon graft.

Key words: anterior cruciate ligament, peroneus longus allograft, hamstring autograft, ACL reconstruction.

INTRODUCTION

Anterior cruciate ligament (ACL) is the most frequently injured structure in the knee, after the meniscus. Injuries of the ACL result in permanent and serious dysfunctions as it has a substantial function in the knee. Approximately 70% of ACL injuries are caused by sports participation (21). Partial or total ACL tear risk accounts for approximately 70% of acute traumatic hemarthroses resulting from sports injury. Anterior instability occurs in time in acute or chronic ACL failure. Moreover, this instability damages the cartilage and meniscuses over time (4).

The surgical treatment plan is more prominent in ACL injuries in young, active, and sportive individuals. Surgical treatment of ACL rupture is more frequently performed as there are improvements in arthroscopic surgical techniques and rehabilitation (1, 7).

The patellar tendon, hamstring tendon, or more rarely quadriceps tendon can be used as autograft in ACL reconstruction. Allografts materials are also used for reconstruction. Techniques differ according to the fixation type of grafts to the opened tibial and femoral tunnels (10).

This study aimed to compare the early functional and clinical results of patients who underwent ACL reconstruction with peroneus longus allograft and patients who underwent ACL reconstruction with hamstring tendon autograft.

MATERIAL AND METHODS

This study was approved by the Institutional Review Board/Ethics Committee with reference number 2016-037. The study was conducted according to the ethical principles stated in the Declaration of Helsinki.

Twenty patients with peroneus longus tendon allograft and with adequate follow-up (Group 1) and 20 patients with hamstring tendon graft and with adequate follow-up (Group 2) were included in the study between August 2017 and September 2019 (Table 1).

Semitendinosus and gracilis tendon grafts were harvested for the ACL reconstruction in Group 1. Both tendons were stitched together and folded over themselves. Four-strands hamstring autografts were obtained and appropriate tendon thickness was achieved. In Group 2, after freeze thaw of the allograft, the tendon was made 3-strands to obtain the required tendon thickness. Both tendons were stretched with 10 minutes to avoid stress elongation before the fixation.

Toggleloc™ Device with ZipLoop (Zimmer Biomet) knotless system was used in both groups for the fixation of the grafts.

Lachman and pivot shift tests were routinely performed in all patients and assessed as negative, 1 (+), 2 (+), and 3 (+). Laxity was measured using the KT-1000 arthrometer. The highest force values of the operated and intact knees were compared. The modified Cincinnati and Lysholm scales, evaluation forms, and International Knee Documentation Committee (IKDC) activity scale were compared in two groups (22). Power measurement of the quadriceps and hamstring muscle groups in the patients' operated and non-operated extremities were performed using Cybex II isokinetic dynamometer (HUMAC). Peak torque values at flexion and extension positions were determined at 60°/sec and 240°/sec frequency during measurements.

The Number Cruncher Statistical System 2007 (Kaysville, Utah, USA) software was used in the statistical analysis. Mann-Whitney U test was used for the two-group comparison for the parameters with abnormal distribution. The Fisher-Freeman-Halton test, Fisher's exact test, and Yates' continuity correction test (Yates' correction chi-square) were used to compare qualitative data. Wilcoxon signed-rank test was used for intragroup comparisons of abnormal parameters. Significance was evaluated at a $p < 0.05$.

Table 1. Demographic changes

		n	%
Gender	**Male**	37	92.5
	Female	3	7.5
Side	**Right**	21	52.5
	Left	19	47.5
Graft	**Allograft**	20	50.0
	Autograft	20	50.0

RESULTS

Seventeen (85%) patients were male, and 3 (15%) were female in Group 1. Of these, 15 (75%) underwent right, and 5 (25%) underwent left knee surgery. The mean age was 34 ± 6.73 (range: 21–46) years. The mean follow-up duration was 22.35 ± 5.48 months.

All patients in Group 2 were male. Six (30%) patients underwent right, and 14 (70%) patients underwent left knee surgery. The mean age was 29.6 ± 455 years (range: 19–40). The mean follow-up duration was 29.8 ± 8.5 months (8–42). The mean modified Lysholm scale score was 97.70 ± 5.94 in Group 1 and 91.75 ± 12.98 in Group 2. The mean modified Cincinnati scale score was 28.60 ± 2.52 in Group 1 and 27.90 ± 2.33 in Group 2. The Lysholm activity level was excellent in 90% (n = 18), good in 5% (n = 1), and moderate in 5% (n = 1) in Group 1 and excellent in 70% (n = 14), good in 10% (n = 2), and moderate in 20% (n = 4) in Group 2. There was no significant difference between two groups in Lysholm activity levels ($p > 0.05$) (Fig. 1, Table 2). The modified Cincinnati activity level was excellent in 90% (n=18) and good in 10% (n = 2) in Group 1 and excellent in 75% (n = 15) and good in 25% (n = 5) in Group 2. There was no significant difference between two groups

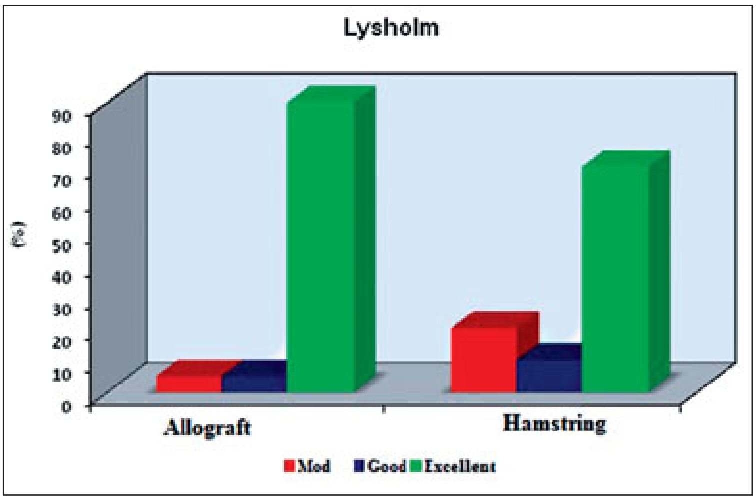

Fig. 1. Comparison of Lysholm scale according to the grafts.

Table 2. Comparison of Lysholm scale according to the grafts

Lysholm		Total (n=40)	Allograft (n=20)	Autograft (n=20)	p
	Mean±SD	94.72 ± 10.41	97.70 ± 5.94	91.75 ± 12.98	[b]0.123
	Min-Max	60–100	74–100	60–100	
	Moderate	5 (12.5)	1 (5)	4 (20)	[c]0.367
	Good	3 (7.5)	1 (5)	2 (10)	
	Excellent	32 (80)	18 (90)	14 (70)	

[b] Mann-Whitney U test [c] Fisher-Freeman-Halton test

Table 3. Comparison of Modified Cincinnati scale according to the grafts

Modified Cincinnati		Total (n=40)	Allograft (n=20)	Autograft (n=20)	p
	Mean±SD	28.25 ± 2.42	28.60 ± 2.52	27.90 ± 2.33	[b]0.192
	Min-Max (Median)	21–30 (29.5)	21–30 (30)	23–30 (28.5)	
	Good	7 (17.5)	2 (10,0)	5 (25)	[a]0.407
	Excellent	33 (82.5)	18 (90,0)	15 (75)	

[a] Fisher exact test [b] Mann-Whitney U test

in the modified Cincinnati activity levels ($P > 0.05$) (Fig. 1, Table 3).

Post-treatment IKDC activity levels were intense activity in 20% (n = 4), moderate activity in 5% (n = 1), low activity in 50% (n = 10), and sedentary activity in 25% (n = 5) in Group 1 and intense activity in 35% (n = 7), moderate activity in 10% (n = 2), low activity in 30% (n = 6), and sedentary activity in 25% (n = 5) in Group 2. There was no significant difference between two groups in the IKDC activity levels ($p > 0.05$) (Table 4).

Lachman test results were found negative in 45% (n = 9), positive in 40% (n = 8), and ++ positive in 15% (n = 3) in Group 1 and negative in 45% (n = 9), positive in 35% (n = 7), and ++ positive in 20% (n = 4) in Group 2. Pivot shift test results were positive in 35% (n = 7) in Group 1 and 30% (n = 6) in Group 2. There was no statistically significant difference between two groups in Lachman and pivot shift levels ($p > 0.05$).

Intact and operated side measurements under KT-1000 device power of 30 pound showed no statistically significant difference between two groups ($p > 0.05$). The 3.20 difference between intact and operated side was found statistically significant in Group 1 ($p < 0.01$). Moreover, the 3.55 difference between intact and operated sides were found statistically significant in Group 2 ($p < 0.01$) (Fig. 2).

There was no statistically significant difference between two groups in the Cybex II (Humac) extension-flexion 60 °/sec measurement and extension 240 °/sec measurement ($p > 0.01$).

DISCUSSION

Recently, incidences of ACL injuries increase as a result of the growing number of play-fields and individuals playing sports irresponsibly. Together with the improvement in arthroscopic surgery, arthroscopic ACL recon-

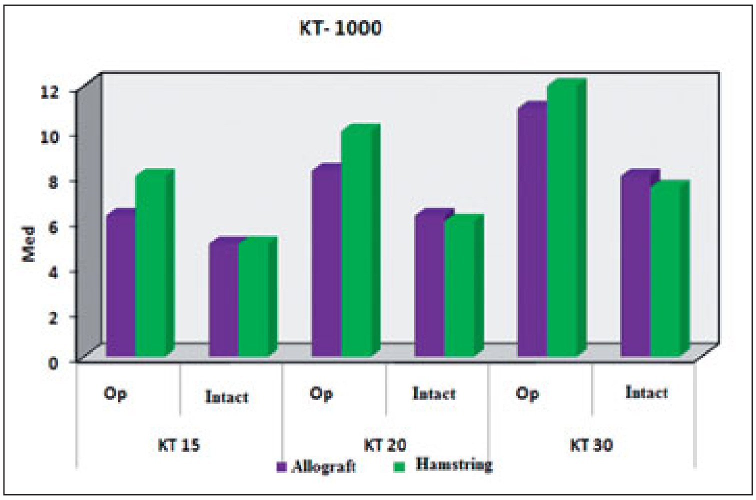

Fig. 2. Comparison of KT-1000 measurements according to the grafts.

Table 4. Comparison of IKDC activities according to the grafts

		Total (n=40)	Allograft (n=20)	Autograft (n=20)	p
IKDC Activity_1	Intensive activity	19 (47.5)	7 (35)	12 (60)	[c]0.352
	Moderate activity	10 (25)	6 (30)	4 (20)	
	Low activity	10 (25)	6 (30)	4 (20)	
	Sedentary	1 (2.5)	1 (5)	-	
IKDC Activity_2	Intensive activity	1 (2.5)	-	1 (5)	[c]0.479
	Low activity	10 (25)	4 (20)	6 (30)	
	Sedentary	29 (72.5)	16 (80)	13 (65)	
IKDC Actvity_3	Intensive activity	11 (27.5)	4 (20)	7 (35)	[c]0.571
	Moderate activity	3 (7.5)	1 (5)	2 (10)	
	Low activity	16 (40)	10 (50)	6 (30)	
	Sedentary	10 (25)	5 (25)	5 (25)	

[c] Fisher-Freeman-Halton test

struction surgery has become a common technique performed by orthopedic surgeons. It is estimated that primary ACL surgery is the sixth most common orthopedic surgery in the USA (5).

There are various preferences related to technique, graft, and fasteners in ACL surgery. Synthetic grafts are not used anymore because of their failures, sterilization problems, and high cost (15) Currently, the choice of graft is one of the most important and most controversial issues in the success of ACL surgery. Moreover, 90–100% of successful results were reported even in the long term for ACL surgery with autograft and allograft. There is no consensus on the optimal graft preference even though there are similar outcomes regardless of the graft preferences and stated reports for the advantages and disadvantages on each individual graft (23). Presently, none of the grafts have normal ACL specialties, and the search for the ideal graft is still continuing. Graft preference is dependent on the surgical experience, tissue status, patient age, activity status, comorbidities, presurgical status, and patient decision (3, 17).

Bone-patellar tendon-bone (BPTB) autografts, which are considered as a gold standard in ACL reconstruction, have many disadvantages and advantages, such as shortened time of adaptation because of the bone-to-bone union in bone tunnels, and can be used with rigid fasteners. These are several unintended complications, such as decreased quadriceps power, loss of extension, and pain in front of the knee.

Recently, hamstring tendon autograft and allograft use is increasing together with some advantages (3, 23). The most important advantage of hamstring tendon autograft is that there is little or no damage to the patient. It is also mechanically stronger than ACL and BPTB autograft. The size of the cross-sectional area increases vascularization and ligamentization. In contrast, unreliable fixation and union problems are the disadvantages (8, 16). Allografts can be preferred because of the advantages, such as lack of donor site morbidity, short operative time, large graft, small incision, minimal scar, good cosmetic appearance, less postoperative pain, less movement restriction, and less arthrofibrosis. However, there are disadvantages, such as disease transmission, low biocompatibility, immune response, long recovery time, and high cost. Although it is difficult to compare the stability and functionality of allografts and autografts because of the differences in graft processing, fixation methods, and surgical techniques in studies, similar clinical results are reported in long-term follow-ups (3, 23). We did not find any significant difference between the two groups in terms of clinical and functional outcomes in the early postoperative period. We would like to emphasize that the lack of effect of graft preference on treatment course between these two groups is based on the surgeon's own practice and experience.

A study reported that the anatomical approach makes tunnel placement more horizontal and thus provides better anteroposterior and internal rotational stability in the coronal plane in accordance with biomechanical studies (18). A study conducted that comparison of the transtibial and anatomically opened femoral tunnels, they found that the more horizontal graft localization in addition to anteroposterior translational stability provides better rotational control (19). A study compared the anteroposterior and rotational stability subsequent to transtibial and anatomic technique. Adequate stability in anteroposterior translational and rotational forces could not be achieved in patients who underwent transtibial reconstruction. Anatomic repair was found to be more stable against anterior and internal rotational forces (9, 10, 12). Studies have shown that non-anatomical graft placement has an adverse effect on graft alignment and knee function (6, 10). The cadaver studies showed that more anatomical reconstructions enhanced the stability of the knee. They showed this by determining the significantly declining anteroposterior and internal rotational laxity (9, 13). This study aimed to enhance the stability of the knee by horizontal graft placement by opening femoral tunnels anatomically using femoral footprints and bone landmarks. Stability showed no difference in this evaluation between the two groups. Our study showed that graft preference has no impact on the stability of the knee.

In recent series of the meta-analysis that compared the outcomes of ACL reconstruction with allografts and autografts, there is no difference in clinical outcomes, and autograft outcomes are better (2, 17). A study reported that, in 338 patients who underwent repair with various grafts, cases with allograft reconstruction have better postoperative joint range of motion, but the autograft group has better IKDC scores (11). A study reported that 26 patients with autografts and 64 patients with allografts for an average of 45 months follow-up time, IKDC A–B outcome in allograft and autograft groups as 48% and 38%, respectively (8). In our study, IKDC activity and Lysholm and modified Cincinnati scores were satisfactory, and there was no significant difference between the groups.

A study reported that intraarticular humoral response was 14% in patients with allografts and 8% patients with autograft (20). Another study showed that post-reconstructive immune response is different between allograft and autograft reconstructions, but the clinical relevance of this difference cannot be revealed (14). In our study, there was no finding that suggested any disease and immune response in both groups. No significant difference was found between the examination findings of the assessment of knee kinematics and results of the assessments using KT-1000 device under all forces.

CONCLUSIONS

Graft preference is dependent on the surgical experience, tissue status, patient age, activity status, comorbidities, presurgical status, and patient decision. We did not observe any disease transmission or immune response that has been reported in literature in the ACL reconstruction group. As a result, we suggest that allograft ACL reconstruction is a good alternative to arthroscopic ACL reconstruction performed with hamstring tendon graft.

Compliance with Ethical Standards:
After approval by the institutional review board. The research reported in the paper was undertaken in compliance with the Helsinki Declaration and the International Principles governing research on animals.

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