J Orthop Spine Trauma. 2017 June; 3(2):e65806. doi: 10.5812/jost.65806.

Published online 2017 June 30. **Research Article**

Study and Comparing the Short Term Follow up Result for Soft Tissue Autograft and Allograft in ACL Reconstruction Surgery

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Received 2017 April 02; **Revised** 2017 May 03; **Accepted** 2017 June 10.

Abstract

Background: ACL tearing is one of the most common sport injuries. For its reconstruction, different grafts including autograft and allograft are used. In term of complications, postoperative improvement, daily activity, and quality of life comparing allograft and autograft are the preferred method, with minimum complications and maximum effectiveness.
Methods: The method of this study was a prospective randomized study. A total of 38 patients were selected who only have a tear in their ACL and no other associated ligament injury. These 38 patients have been put into 2 groups by random computerized selection and their group has been advising them in closed pockets. Finally, 18 patients were in the allograft division and 20 in the autograft. In the beginning, a physical examination was done as well as a IKDC objective, Lysholm, level of activity, KOOS, and quality of life scoring forms have been filled for all patients before the operation process. Then patients have been operated by the standard arthroscopic method. Graft fixation in the femur bone has been done by the endo-button and in the tibia bone by interference screws (Smith and nephew). In the next step, the above-mentioned scoring forms were filled after 3 months, 6 months, and 1 year after operation. In addition, required physical examinations were done again. In this period of time, the patients have been under exact observation regarding related complications.
Results: All mentioned scoring forms and pivot shift test, Lachman test, and ADT showed significant improvements in patient post-operative period. Lysholm ($P = 0.07$), IKDC objective ($P = 0.8$), level of activity ($P = 0.9$), and KOOS ($P = 0.15$) represented that there are no statically differences between 2 autograft and allograft groups. Infection risk in both groups has been almost same ($P = 0.3$).
Conclusions: All findings clarify that short term result was equal in 2 groups.

Keywords: ACL Reconstruction, Allograft, Autograft

1. Background

The ACL is part of a complex of ligaments that assist stabilize and support the knee joint (1). ACL tearing one is of the most common sport injuries. Its incidence is not clear, however, in the USA, in 1 year, about 100000 reconstruction surgeries are done (1, 2). Its prevalence has been estimated to be 1 in 3000 individuals (3, 4). ACL injury will cause pain, decrease in social activities, sport abilities, quality of life, and finally knee osteoarthritis (1). Considering that the age prevalence is between 15 - 45 years, these periods are most active and efficiency time in each person's life. Its prevalence in a male is more; its reason could be due to more sport activity (1).

ACL reconstruction has become a commonly performed procedure. Today, most ACL surgeries are performed using arthroscopic techniques ("Endoscopic ACL Reconstruction"). The graft - often a tendon - may be taken from many sources, including the patient's own hamstring tendon, patellar tendon, quadriceps tendon, or an allograft (human donor tissue). Additionally, in choosing the type of graft, there is no single consensus yet.

Our purpose in this study is comparing the short term follow up result for soft tissue autograft and allograft in ACL reconstruction surgery.

2. Methods

The method of this study was prospective randomized. This study has been in Imam Khomeini hospital and started in March 21, 2014 to March, 20 2016 at the Imam Khomeini hospital (joint reconstruction research center), 1 year for surgery and 1 year of follow up. The time of study and aim of the study has been explained to all patients.

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Then, advantages and disadvantages of both methods have been clarified for them. These patients have been entered into this study with their own consent. All performers of this study accepted to comply with Helsinki declaration. Patients that just have ACL tears were entered into this study and if they had other associated ligament injuries they were excluded. Patients who have grade 3 and 4 cartilage lesions were also excluded.

Other exclusion criteria were both knee ACL tearing, have had a previous knee surgery, or had a single bundle tearing. Patients with ACL tearing have been diagnosed according to their history and physical examination. Confirmation for complete ACL tearing has been done by an MRI. After diagnosis, being qualified for this study, and getting patient's consent, computer random selection has been done. ACL reconstruction surgery was done by arthroscopy method (from 2 antero-medial and antero-lateral portals). Hamstring for autograft and Posterior tibialis for allograft have been chosen.

Finally, in 1 year, 20 patients (19 male and 1 female) with an average of 28 years (SD = 5.4) have been operated by hamstring autograft. Furthermore, 18 patients (all Male) with an average age of 31 years (SD = 5.8) have been operated by Posterior tibialis allograft. All mentioned surgeries have been done by 1 surgeon. Preparation of the grafts with 2 ends running suture was done. Graft fixation in the femur bone has been done by the endo-button associated flipping technique and for the Tibia bone with interference screw through trans-portal technique. The endo-button fixation system used was the Smith and Nephew brand.

After surgery, controlling radiography has been done to determine the location of the endo-button. All patients have used a cane or crutch for a short time, and related rehabilitation has been done according to the standard protocol of our center. In addition, all patients started jumping movements after 4 months and returned to professional exercise after 6 months of surgery.

In 3 months, 6 months, and 1 year after the surgery, gathering patients' information was done by scoring forms that were prepared according to Lysholm, KOOS, level of activity, and IKDC objective. Related physical examination has also been done accordingly. Finally, by statistical analysis, the results of 2 methods were compared. Related data was stated according to mean $\pm$ SD (Coefficient of reliability: 95%).

Our statistical analysis methods were the Chi-square test and t-test, on which the result was significant just when P-Value was < 0.05.

3. Results

The follow up average time had been1 year, the mean age of the patients in the autograft group had been 27.8 years old (SD = 5.4) and for the allograft group, 31.6 (SD = 5.8) (P = 0.1). Considering the sex of the patients is noticeable that in the autograft group, 19 patients (95%) had been male and 1 female (5%), however, in allograft group all 18 patients (100%) had been male (P = 0.3). In the IKDC objective criteria, in the beginning of the study and after pivot shift, Lachman and Anterior Drawer test physical examinations, and all patients have been in C and D categories. At the end of the study all of them were in the A and B categories. In the other words, we were not faced with any failure in any of the groups (Table 1).

In the Lysholm Criteria, in the beginning of the study all patients were in the poor and fair categories, but at the end of study all of them were in the good and excellent categories. It means that Lysholm Criteria's level shows improvement (P = 0.07); there is more clarification in Table 2. In the last step, all patients were in the good and excellent categories and results showed no statistical differences between the 2 groups (P = 0.07).

Study the level of activity has been done according to IKDC (Table 3).

In the beginning of the study, which was before surgery in the autograft group, the level of activity of 6 patients (30%) were 2 and the other patients (70%) has a level activity of 0 and 1. Furthermore, in the allograft group, the level of activity of 7 patients (38%) were 2 and other patients (62%) had a level of activity of 0 and 1 (P = 0.8) (Table 4).

At the end of study, which is after surgery at the autograft group, the level of activity of 5 patients (25%) were 2, 6 patients (30%) were 4, and 9 patients (45%) have 3 levels of activity. In addition, in the allograft group, 5 patients (27.8%) were 2, 5 patients (27.8%) were 4, and 8 patients (44.4%) have 3 levels of activity (P = 0.9) (Table 4).

4.1. Infection

We were faced with just 1 infection case, which was in autograft group. The infection happened10 days after surgery and was healed by an antibiotic and also with irrigation and debridement. There have been no significant statistical differences between the 2 groups (P = 0.3).

4.2. KOOS

Before and after surgery KOOS scores have been compared between the 2 groups. In the beginning of the study, the KOOS for the autograft group was 48.7 (SD = 4.1) and 47.3 (SD = 3.96) for the allograft. There have been no significant statistical differences between the 2 groups (P = 0.2). At the end of follow up phase, these figures for the autograft was

Table 1. Pre-Operation and Post Operation (3 Months, 6 Months and 1 Year), According to IKDC Objective

	Pre-Operation		Post-Operation (3 Months)		Post-Operation (6 Mo Months)		Post-Operation (1 Year)	
	C, D	A, B	C, D	A, B	C, D	A, B	C, D	A, B
Autograft								
NUM	20	-	1	19	1	19	-	20
PER, %	100	-	5	95	5	95	-	100
Allograft								
NUM	18	-	-	18	-	18	-	18
PER, %	100	-	-	100	-	100	-	100
Sum								
NUM	38	-	1	37	1	37	-	38
PER, %	100	-	2.6	97.4	2.6	97.4	-	100
P value	0.6		0.3		0.3		0.6	

Table 2. Mean of Lysholm Scores According to Allograft and Autograft Methods in Different Periods (3 Months, 6 Months, and 1 Year)[a]

Periods	Group			P Value
	Autograft	Allograft	SUM	
Pre- operation	56.9 ± 7.35491	59.2778 ± 8.68945	58.0263 ± 7.99489	0.36
Post- operation (3 months)	88 ± 7.96704	86.8333 ± 3.20386	87.4474 ± 6.13672	0.566
Post-operation (6 months)	90.8 ± 3.17225	90.5 ± 1.20049	90.6579 ± 2.41925	0.708
Post-operation (1 year)	92.2 ± 1.54238	91.3333 ± 1.28338	91.7895 ± 1.47333	0.07

[a]Values are expressed as mean ± SD.

Table 3. Patients Level of Activity

Level of Activity	What is the Highest Level of Activity That You Can Perform Without Significant Knee Pain (or Swelling or Giving Way or…)?
4	Very strenuous activities like jumping or pivoting as in gymnastics or football
3	Strenuous activities like heavy physical work, skiing or tennis
2	Moderate activities like moderate physical work, running or jogging
1	Light activities like walking, housework or gardening
0	Unable to perform any of the above activities due to knee pain

78.2 (SD = 2.3) and for allograft was 77.04. (SD = 2.58), which shows improvement considering the KOOS criteria in both groups, without any significant differences between the 2 groups (P = 0.151) (Table 5).

4. Discussion

ACL Reconstruction is one of the most common surgical procedures in orthopedics. Despite the high frequency of this type of surgery, there are many comments and considerations in choosing the suitable graft (5). An ideal graft is the graft that has the highest safety grade, lowest failure risk, and the lowest morbidity in donor site and rapid incorporation (6). In addition, at the same time it should be cost benefit and available.

Generally, there is no universal definition for failure of ACL reconstruction, however, the below items could be mentioned (6):

1- Patient perception of instability develops in a previously ACL-reconstructed knee

2- When postoperative pain and/or stiffness occur in a stable ACL-reconstructed knee

Table 4. Level of Activity Pre and Post Operation at Period Time

	Pre- Operation		Post- Operation (3 Months)		Post- Operation (6 Months)		Post- Operation (1 Year)	
	Autograft	Allograft	Autograft	Allograft	Autograft	Allograft	Autograft	Allograft
Level 0								
NUM	6	7	-	-	-	-	-	-
PER, %	30	38.9	-	-	-	-	-	-
Level 1								
NUM	11	9	3	5	1	2	-	-
PER, %	55	50	15	27.8	5	11.1	-	-
Level 2								
NUM	3	2	17	13	19	16	5	5
PER, %	15	11.1	85	72.2	95	88.9	25	26.3
Level 3								
NUM	-	-	-	-	-	-	9	8
PER, %	-	-	-	-	-	-	45	44.4
Level 4								
NUM	-	-	-	-	-	-	6	5
PER, %	-	-	-	-	-	-	30	27.8
P Value	0.8	0.3	0.4	0.9				

Table 5. KOOS Pre and Post Operation at Period Time[a]

Group/Symptom	Pre- Operation			Post- Operation (1 Year)		
	Autograft	Allograft	P Value	Autograft	Allograft	P Value
Stiffness	56.2 ± 11.52	54.94 ± 11.26	0.73	73.7 ± 5.64	72.61 ± 4.93	0.53
Pain	51.4 ± 7.38	49.77 ± 7.55	0.5	83.2 ± 3.39	81.22 ± 3.15	0.72
Function, daily living	58.2 ± 7.023	57.44 ± 8.07	0.76	80.75 ± 4.44	4.84	0.84
Function, sports and recreational activities	40 ± 8.18	37.22 ± 8.75	0.31	76.8 ± 5.8	76.05 ± 4.35	0.66
Quality of life	38.05 ± 10.22	37.5 ± 10.5	0.87	76.85 ± 5.85	74.27 ± 5.54	0.17
KOOS final score	48.77 ± 4.1	47.37 ± 3.96	0.26	78.26 ± 2.3	77.042.58 ±	0.151

[a]Values are expressed as mean ± SD.

3- Complete graft tears with > 6 mm of anterior tibial displacement as compared to healthy knee

4- Positive pivot shift test graded +2 or +3 compared to the healthy knee

5- Extensor mechanism dysfunction

In the recent decade between autograft groups, hamstring tendon has been used more than the other graft. Morbidity in the donor site in the hamstring graft is in lowest level contrasting the other graft (7). Hypothesis says tacking hamstring tendon will cause a 20% decrease in knee flection, which is extremely important in athletics. The chosen allograft has been taken from the transplant bank, in which this study has been done. Its preparation has been done according to AATB (The American Association of Tissue Banks) criteria and in sterilizing it, the gamma ray has not been used. However, there are still concerns in using the allograft for the following items in long terms: infection transmission, delayed graft incorporation and remodeling, increased laxity, and long-term failure (8, 9).

As we have already explained, hamstring autograft has the lowest morbidity in the donor site contrasting it with other autografts. In our study, in a short time period (1 year), this autograft has been compared with a soft tissue

allograft, especially in the posterior tibialis allograft.

A total of 44 patients had been referred, 6 of them were excluded from this study due to having previous ligament injuries. With that said, 38 patients were followed up (20 case autograft and 18 case allograft). These patients have been followed up for 1 year.

We have not faced any failure. We faced just 1 infection case in the autograft group, which had happened 10 days after surgery and was healed by an antibiotic and also with Irrigation and Debridement. There have been no significant statistical differences between the 2 groups (P = 0.3). In other studies, infection risk had been reported as 1.7% to 0.14%, which means there were no significant differences between the 2 groups (10).

At the end of study, all patients have the same scores according to Lysholm, IKDC Objective, Level of activity, and KOOS, which is shown in Table 6.

Table 6. Outcome of Patients According to Lysholm, IKDC Objective, Level of Activity, and KOOS Scores

Variables	Autograft	Allograft	P Value
Lysholm	92.2	91.3	0.7
IKDC objective	100% A and B	100% A and B	0.3
Level of activity	2, 3, 4	2, 3, 4	0.3
KOOS	78.2	77.04	0.15

Considering mentioned hypothesis (donor site morbidity and 20% decreases in knee flexion) and also considering the same result in short term follow up, it seems that the allograft could be the preferred method contrasting with the autograft. Although many studies have been done in comparing both grafts, we could not easily prefer one to the other.

Therefore, in a study in 2015, Jia et al., compared allograft and autograft in ACL reconstruction. Eventually, they concluded that allograft reconstruction is as effective as the autograft reconstruction; however, the allograft can lead to more tunnel widening, evidently in the tibial tunnel, particularly (5).

In addition, in the study of Macaulay et al., both types of allograft and autograft can have excellent results in ACL reconstruction and lead to a high percentage of patients' satisfaction. However, there is a difference between the graft options. It is important to talk with the patient so that he has the best information when choosing a graft (11).

Additional pre-operative rehabilitation and consequently post-operative rehabilitation significantly improves the patient's functional outcome of ACL reconstruction (12).

In addition, rehabilitation protocol was the same for all patients, however, physiotherapy centers where patients referred to were different, which may cause different outcomes.

4.1. Conclusion

In ACL reconstruction surgery, any graft patient's symptoms such as pain, disability, giving way, and decrease in activity level would be improved. All methods have their own advantages and disadvantages, which have made the challenge of choosing a method. In our study, with a 1 year follow up, no significant differences have been registered, however, we could not generalize these results to long term follow up results. In the other words results could be changed according to duration of the follow up.

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