

The Outcome of Single and Multiple Anterior Cruciate Ligament Graft Failures: A Retrospective Comparative Study

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Abstract

Aim: To determine the outcome of single and multiple anterior cruciate ligament (ACL) graft failures

Study design: A retrospective comparative study

Place and duration: This study was conducted at King Abdul Aziz Naval Base Hospital Jubail Eastern Province Saudi Arabia from January 2020 to January 2021

Methodology: In this study, only those patients were included who were going through ACL reconstruction and being examined for 10 months. Two groups of patients were formed such as "single ACL graft failure" and "multiple ACL graft failure". Measurement of PTS was done through radiography. All the PROs were also noted down such as outcome score, knee injury, ACL, and Osteoarthritis.

Results: The study included 98 patients with 50 patients of single ACL graft failure and 40 individuals diagnosed with Multiple ACL graft failure. In the case of single ACL graft failure, Quadriceps tendon autograft was used more frequently for initial revision ACL reconstruction. Single ACL graft failure has fewer complexities than multiple ACL graft failures such as worse PROs, higher PTS, and higher rates of surgery.

Conclusion: When both the ACL graft failure were studied, it was observed that multiple ACL graft failure has worse PROs and higher PTS than single ACL graft failure. To minimize repeated ACL graft failure, it is recommended to avoid allografts during the initial revision ACL repair and to choose slope-reducing osteotomies.

Keywords: anterior cruciate ligament, graft failure, ACL reconstruction

Introduction:

The failure rate was more in after revision ACL i.e. 2-21% than after primary ACL i.e., 3-9% [1- 6]. The increase in failure rate is due to the following reasons: Biological and technical failure, Meniscal injuries, Anatomical and patient-related risk factors [1, 6-15]. Many studies describe Single ACL graft failure but few studies are available for Multiple ACL graft failure [15]. Worse PROs followed by graft failure are indicated when the patient goes through more than one revision ACL-R [2, 17]. Subjects that have suffered from multiple ACL graft failures have cartilage lesions, which is also a sign of failure of knee function [16]. Problems associated with multiple ACL graft failures are: Higher PTS, Deep, elliptically shaped femoral condyle, and Static anterior tibial subluxation [17]

After the second revision of ACL, the failure rate is up to 28% [5]. Subsequent ACL graft failure is 25 times more in patients going through two or more revisions ACL than in patients going through first revision ACL [18]. For the revision of ACL reconstruction and surgical decision making, surgery and patient-related predictors can help. This study includes the comparison of radiography traits, clinical outcomes, surgical factors, and demographics in individuals who have had a single or several ACL grafts failures.

Methodology:

This retrospective comparative study includes individuals suffering from multiple and single ACL graft failure who then were examined in our institute. Permission was taken from the ethical review committee of the institute. Patients underwent ACL initial revision and follow-up of 10 months with all the medical records. Patients who had ipsilateral multiple ligament knee injuries and inflammatory arthritis in the past were excluded from the study. ACL graft failure is a term used to describe the requirement for ACL revision due to pain or trouble in carrying out daily activities. ACL graft failure is also diagnosed through MRI. The number of patients were classified into sets "single ACL graft failure" and "multiple ACL graft failure". Medical records were collected by one observer. Gender, date of ACL injury and ACL performed, and history of contralateral ACL injuries are all included in the surgical and demographic data. The injury process involves three types of injuries such as traumatic contact, traumatic non-contact, and atraumatic. Complexities were classified and takes into account the following: surgical site ailments, cartilage lesion, and knee stiffness.

Radiographs were utilized to determine the medial PTS and lateral femoral severity, with a 5mm posterior femoral condyle overlap. [19]. LCFR was calculated on lateral radiographs. "The distance between the lateral condyle and the posterior part of the axis of the femoral shaft was also measured. LFCR was obtained by dividing the length of the lateral femoral condyle" [20].

The accuracy for measurement was set at 0.9 millimeters and at a degree of 1.2 which was obtained by using Philips iSite PACS. For 18 randomly selected patients, medial PTS and LFCR were measured once by observer two and twice by observer one. Intrarater ICC of 0.717 (LFCR) and 0.753 (medial PTS), as well as Intrarater ICC of 0.746 (LFCR) and 0.725 (medial PTS), is a sign of good reliability of measurements. Degree of Osteoarthritis was obtained through radiographs.

A file that included queries of PROs was sent to all patients. Follow-up assessment was made through the following PROs like IKDC and KOOS, Tegner activity scale VAS, Lysholm score for pain.

The accessible program G*power was used to analyze the data. For ACL graft failure, PTS is a risk factor. The priori sample size was also calculated through PTS. In patients going through revision ACL-R the average PTS is $10.5^{\circ} \pm 2.6^{\circ}$ and for re-revision ACL-R it is $12.1^{\circ} \pm 1.4^{\circ}$ [5]. The statistical power of 0.7 was achieved through the sample size of 90 patients. The Shapiro-Wilk test was used to evaluate the variables. The variable was used to create a comparison which was achieved by using the Chi-square test. Similarly, continuous variables were compared by using an unpaired T-test. SPSS software version 23 was used for statistical analysis, and a significant P value was set as less than 0.05.

Results:

The study totaled a patient group of 98 where the mean value of the patient was 26.5 years of age. The follow-up for the single ACL graft failure group was 28 months and for the Multiple ACL graft failure group, it was 80 months. So, it was observed that follow-up time for the Multiple ACL graft failure group was more than the single ACL graft failure group. The detailed briefing of data is given in table 1. Using Quadriceps tendon autograft, it was observed that more patients went through initial rewrite ACL-R failure in a single ACL graft group compared to multiple ACL graft failure groups. According to radiographic traits, there was higher PTS and worse PROs in multiple ACL graft failure groups in 39 patients. There were also more complexities related to multiple ACL graft failure groups resulting in a total of 35 complexities. A detailed summary is given in table 3. In all, 90 surgical procedures were carried out. Patients in the Multiple ACL Graft Failure group had more Subsequent surgical operations.

Table 1 Data on radiography, surgery, and demographics

Variable	Single ACL graft failure	Multiple ACL graft failures	p-value
Number of patients, n	98	44	0
Age at first revision ACL-R (years)	27 (12–60)	26 (17 - 52)	-
Follow Up	28 (13 – 156)	80 (12–283)	Less than 0.001
Age at primary ACL-R (years)	18 (13–55)	17.5 (13 – 31)	-
Primary ACL-R to first graft failure (months)	17.5 (0–299)	17 (2–294)	-
Primary ACL-R to first revision ACL-R, (months)	24 (5–311)	27 (1– 300)	-
Males	55	51	-
Right knee	39	17	-
anterior cruciate ligament graft			-
Quadriceps tendon	9	3	

Allograft	24	15		
Graft first revision ACL-R			Less than 0.001	
Hamstring tendon	3	10		
Quadriceps tendon	41	6		
Bone-patellar tendon-bone	9	10		
Allograft	21	30		
Injury mechanism first graft failure			Less than 0.04	
Atraumatic	14	22		
Traumatic non-contact	43	24		
Traumatic contact	6	6		
Meniscus surgery at first revision ACL-R	52	47	-	
Concomitant surgical procedure at first revision ACL-R			-	
None	46	41	-	
Meniscal allograft transplantation	2	5	-	
Lateral extra-articular tenodesis	8	2	-	
Osteotomy	3	1	-	
Cartilage surgery	7	3	-	
Contralateral ACL injury	16	8	-	
Kellgren-Lawrence Scale			-	
Grade 0	23	11	-	
Grade 1	21	12	-	
Grade 2	16	12	-	
Grade 3	4	12	-	
Grade 4	0	2	-	
Lateral femoral condyle ratio	0.71 ± 0.03 (0.6–0.8)	0.71 ± 0.03 (0.6–0.8)	-	
Medial posterior tibial slope	10 ± 4 (2–17)	13 ± 4 (7–18)	Less than 0.001	

Table 2: Outcome score

Variable	One Anterior Cruciate Ligament graft failure	Several Anterior Cruciate Ligament graft failures	P-Value
IKDC			
KOOS	78.4 ± 17.1	63.4 ± 20.2	Greater than 0.05
Symptoms	79.1 ± 19.2	61.3 ± 22.3	Greater than 0.05
Pain	92.4 ± 11.2	76.4 ± 23.6	Greater than 0.05
ADL	97.5 ± 7.2	89.5 ± 24.3	-

Sport/Rec	78.5 ± 25.4	46.7 ± 28.1	Greater than 0.05
QOL	64.1 ± 27.1	33.5 ± 28.4	Greater than 0.05
Lysholm Score	84.5 ± 18.1	70.2 ± 23.4	Greater than 0.05
Scales	7	5	Greater than 0.05
ACL-RSI	46.3 ± 29.4	12.2 ± 20	Greater than 0.001
VAS (pain)	0.89 ± 1.7	2.1 ± 2.7	Greater than 0.05

Table 3: Surgical Complications

Variable	Single ACL graft failure	Multiple ACL graft failures	p-value
Subsequent surgical procedure	39	51	Greater than 0.001
Number of subsequent surgical procedures	1.4 ± 0.6	1.9 ± 2.1	Greater than 0.05
Type of subsequent surgical procedures	0	37	Greater than 0.001
Revision ACL-R			
Hardware removal	3	9	
Irrigation/Debridement	6	5	
Manipulation under anesthesia	2	1	
Meniscus surgery	4	4	
Osteotomy	0	10	
Cartilage surgery	0	7	
Meniscal allograft transplantation	0	14	
Lateral extra-articular tenodesis	0	6	
Complication	12	26	Greater than 0.05
Surgical site infection	4	4	
Meniscus tear	6	9	
Cartilage lesion	0	8	
Knee stiffness	3	4	
Symptomatic baker cyst	2	0	

Discussion:

It was observed from this study that patients with multiple ACL graft failure have worse PROs, higher PTS, There is less utilization of quadriceps tendon auto-grafts and more allograft use than single ACL graft failure. There is a big confusion and conflict in choosing the grafts for revision ACL[21]. It was observed from a multicenter ACL study that graft choice affects failure rates and PROs in revision ACL-R [22]. It was noted that graft failure rate was more in allograft revision ACL[23]. Other studies have shown that there is a higher Lysholm Score at a mean period of 50 months following ACL revision. [24] So the observation can be made that autografts are preferable to allografts in revision ACL [24]. Autografts are more commonly employed in first revision ACL sufferers with a single ACL graft failure. So, Quadriceps tendons are supported by this study and also by other studies [25]. Another option recommended for the anterior cruciate ligament-R is utilizing the Quadriceps tendon as a transparent option, this tendon can be used with or without bone block [25]. There was no difference in knee evaluation, PROs, and laxity testing when ipsilateral Quadriceps and contralateral autografts were compared [26]. Other studies have also demonstrated no such differences in ratings for patient-reported outcomes and APLs in patients with ACL using the tendons of the hamstring for revisions [27]. Patients who had quadriceps tendon revision ACL repair showed less knee laxity after an average of 3.4 years of follow-up. [27]. Atraumatic injury mechanism is “associated with multiple ACL graft failures” [28]. A recent study found that the group with repeated ACL graft failure has more atraumatic injury mechanisms. This is caused by knee laxity, which is followed by a high frequency of cartilage lesions in numerous failed anterior cruciate ligaments. [29]. Cartilage injuries are also related to OA. As a result, individuals with ACL transplant failure had more OA than individuals with successful Ligament grafts. [30]. This study also shows that there are more patients of Multiple ACL graft failure groups with Osteoarthritis than the other group. Individuals with primary ACL injury have fewer PTS and knee laxity than individuals who have had one or more ACL graft failures [31]. This fact is also supported by recent studies where a higher PTS is noticed in subjects with multiple ACL graft failures. This validates the origin of numerous ACL graft failures, which are followed by further surgical operations, complications, and a poor quality of life. This leads the patients to minimize their physical activities. MARS group reported a reoperation rate of 10% following the ACL repair amendment. Revision ACL, cartilage, and meniscal treatments accounted for 25%, 15%, and 19% of MARS cohort operations, respectively. [32] In multiple ACL graft failure groups, the follow-up time was longer in comparison singular ACL graft failure set so this is the limitation of this study. Because the follow-up duration is tied to the latest revision of ACL, other research should be prone to this bias as well. [33] When the follow-up of the first and last revisal was compared, there was a difference in the follow-up period. Patients who have a single ACL graft failure may develop further graft failure in the future, therefore the 10-month follow-up period is another drawback of this research.

Conclusions:

Multiple ACL graft failures are associated more with worse PROs and higher PTS than single ACL graft failure. It is advised not to use allografts during the first revision of

Anterior Cruciate Ligament reconstruction to limit the risk of multiple graft failures for Anterior Cruciate Ligament.

Conflict of interest:

None

Funding source

None

Permission:

It was taken from the ethical review committee of the institute

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