Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Orthopaedic Surgery

Analysis of Surgical Complications and Functional Recovery Following Arthroscopic ACL Reconstruction with Quadriceps Tendon

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DOI: https://doi.org/10.36347/sjams.2024.v12i11.018 | **Received:** 02.10.2024 | **Accepted:** 05.11.2024 | **Published:** 11.11.2024

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Abstract **Original Research Article**

Introduction: Anterior Cruciate ligament (ACL) is one of the most important intra-articular ligaments of the knee joint. It is considered the primary restraint to anterior translation of the tibia on the femur. Nowadays the use of quadriceps tendon (QT) autograft has been steadily increasing for ACL reconstruction. Therefore, this study has been designed to assess the functional recovery and analyze the surgical complications following arthroscopic ACL reconstruction with quadriceps tendon. ***Methods:*** This was a prospective interventional study conducted in the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh during the period from March 2020 to August 2022. In our study, we included 30 patients with anterior cruciate ligament injuries who attended the orthopaedic department within the study period. ***Result:*** The mean ± SD age was 29.73 ± 7.00 years, with the majority (50%) in the 26-35 age group. This study found that 27 (90%) patients were male and 3 (10%) were female. Both Lysholm score and Tegner activity level score significantly increased after 9 months of operation. The postoperative mean VAS score was also significantly (p=0.001) decreased at 9 months after surgery. The majority (80%) of the patients had no complaints, while 16.7% had effusion and 3.3% had an infection. ***Conclusion:*** Our study found that the majority of the patients had no complications. After analyzing the results of the present study, we can say that arthroscopic isolated anterior cruciate ligament (ACL) reconstruction with quadriceps tendon showed satisfactory functional outcomes for the treatment of ACL injury.

Keywords: Arthroscopic ACL Reconstruction, Complications, Functional Recovery, Quadriceps Tendon.

INTRODUCTION

Anterior Cruciate ligament (ACL) is one of the most important intra-articular ligaments of the knee joint. It is considered the primary restraint to anterior translation of the tibia on the femur. It also provides rotational stability to the knee joint during normal gait and activities of daily living [1]. Anterior cruciate ligament injury is a common knee injury with 200,000 cases occurring annually in the United States [2]. Classically, ACL injuries affect people in their prime working time of life. The greatest incidence occurs in 15 to 25-year-old participants of work and pivoting sports. Work-related injuries and accidents are also common. Consequences of ACL injuries include lost time from work and a lower quality of life [3].

Reconstruction of anterior cruciate ligament depends upon the patient's instability symptom, and desire for future participating in pivoting sports. Graft choice is based on the patient's characteristics and goals. Several types of grafts have been used to restore knee stability after an anterior cruciate ligament (ACL) injury. Freedman *et al.*, and Mohtadi *et al.*, have found good clinical results using autografts from the extensor mechanism and the hamstring tendon (HT) [3,4]. Nowadays use of quadriceps tendon (QT) autograft has

been steadily increasing for ACL reconstruction. This was due to significant surgical advances and reliable harvesting techniques for the all–soft tissue QT autograft. Additionally, the QT provides favorable anatomy with low donor-site morbidity and a decrease in anterior knee pain and numbness [5,6]. Cavaignac *et al.*, demonstrated benefits of QT for ACLR include stronger, stiffer tissue and preservation of knee-flexor strength which may allow for more aggressive post-operative rehabilitation [5]. Jennifer et al. reported that the use of a QT graft in ACL reconstruction leads to equal or better functional outcomes than the use of an HT graft [6]. Hofbauer *et al.*, reported that the quadriceps tendon autograft is a very suitable graft for ACL reconstruction. It also provides favorable anatomy, low donor-site morbidity, and positive clinical outcomes [7]. The diameter of the graft is one of the most important considerations during ACL reconstruction. The effect of the autograft diameter on the re-rupture and revision rate of the reconstructed ACL of the knee has been studied intensively and harvesting of small diameter graft can lead to a higher failure rate [8]. Grafts larger than 8 mm were found to reduce the failure rate and provide a protective effect. However, in our country as well as in Asian countries, it is very difficult to get quadruple strands of hamstring graft with a diameter of 8 mm. Therefore, Quadriceps tendon autograft would be an alternative graft option. As far as our knowledge no study was carried out to assess the functional outcome of arthroscopic isolated ACL reconstruction with quadriceps tendon at BSMMU, Dhaka, or any other institution in Bangladesh. Therefore, based on this background, the present study has been designed to assess the functional recovery and analyze the surgical complications following arthroscopic ACL reconstruction with quadriceps tendon.

METHODOLOGY & MATERIALS

This was a prospective interventional study conducted in the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh during the period from March 2020 to August 2022. In our study, we included 30 patients with anterior cruciate ligament injuries who attended the orthopaedic department within the study period.

These are the following criteria to be eligible for enrollment as our study participants: a) Patients aged 18 to 45 years; b) Patients with isolated ACL injury with no concomitant ligament injury; c) Patients with unilateral ACL injury; d) Patients who were willing to participate were included in the study And a) Patients with any history of previous surgery to the affected knee; b) Patients with fracture around the knee (femoral condyle, tibial plateau, patella); c) Patients with meniscal injury; d) Patients with knee osteoarthritis; e) Patients with any history of acute illness (e.g., renal or pancreatic diseases, ischemic heart disease, asthma, COPD etc.) were excluded from our study.

Data Collection: Patients with the diagnosis of anterior cruciate ligament injury were selected based on inclusion and exclusion criteria. The patients were diagnosed clinically and radiologically. After taking informed consent, a detailed history and physical examination of each patient were performed. Tests like WBC count, ESR, serum creatinine, HbsAg, Anti-HCV, ECG & Echocardiogram were carried out routinely in all patients for anesthetic fitness and to support the diagnosis of injury. A structured case record form was used to interview and collect data. The outcome of arthroscopic isolated ACL reconstruction with quadriceps tendon was measured by using the Lysholm score, Tegner activity level score, and visual analogue scale (VAS). Follow-up was performed at 2 weeks, 6 weeks, 3 months, 6 months, and 9 months after surgery.

Statistical Analysis: All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. A paired Student 't' test & Fisher Exact test were performed to compare preoperative and postoperative quantitative data and the Wilcoxon Rank Sum test was done to compare preoperative and postoperative qualitative data. A p-value <0.05 was considered as significant. Statistical analysis was performed by using SPSS 23 (Statistical Package for Social Sciences) for Windows version 10. The study was approved by the Ethical Review Committee of Bangabandhu Sheikh Mujib Medical University.

RESULTS

Table 1: Baseline characteristics of our study patients

Baseline characteristics	N	P (%)
Age (in years)		
18-25	10	33.3%
26-35	15	50.0%
36-45	5	16.7%
Mean±SD	29.73 ± 7.00	
Gender		
Male	27	90.0%

Baseline characteristics	N	P (%)
Female	3	10.0%
Occupation		
Service holder	12	40.0%
Businessmen	8	26.7%
Housewife	3	10.0%
Others	7	23.3%
Site of involvement		
Right anterior cruciate ligament injury	21	70.0%
Left anterior cruciate ligament injury	9	30.0%
Mechanism of injury		
Sports injury	17	56.7%
Road traffic accident	7	23.3%
Fall from height	4	13.3%
Domestic injury	2	6.7%

The study involved 30 patients. Among them, 10 (33.3%) were aged 18-25 years, 15 (50%) were 26-35 years, and 5 (16.7%) were 36-45 years, with the youngest and oldest participants being 18 and 45 years, respectively. The mean ± SD age was 29.73 ± 7.00 years, with the majority (50%) in the 26-35 age group. In terms of gender distribution, 27 (90%) were male and 3 (10%) were female, with a male-to-female ratio of 9:1. The maximum number (40%) of participants were service holders. Most patients (70%) had right ACL injuries, while 30% had left ACL injuries. Most of our study patients (56.7%) had sports injuries.

Table 2: Clinical features of the study population(n=30)

Presentation	Frequency	%
The feeling of insecurity in the knee	30	100%
Swelling of knee	10	33.3%
Pain	7	23.3%

In Table 2, we found that among 30 subjects feeling of insecurity was the predominant complaint (100%), followed by swelling which was found in 10(33.3%) cases, and pain was found in 7 (23.3%) patients.

Table 3: Distribution of study population according to clinical test (n=30)

Clinical test		Preoperative	Postoperative	P-value
Lachman test	Negative	0(0%)	28(93.3%)	<0.001[s]
	Grade 1	0(0%)	2(6.7%)	
	Grade 2	8 (26.7%)	0(0%)	
	Grade 3	22 (73.3%)	0(0%)	
Anterior drawer test	Negative	(0%)	27(90%)	<0.001 [s]
	Grade 1	1(3.3%)	3(10%)	
	Grade 2	10 (33.3%)	0(0%)	
	Grade 3	19 (63.3%)	0(0%)	

Table 3 shows that the Preoperative Lachman test and Anterior drawer tests were grade 2 in 8 (26.7%) and 10 (33.3%) patients, and grade 3 was found in 22 (73.3%) and 19 (63.3%) cases respectively. At 9 months after surgery, the Lachman test and the Anterior drawer test were negative in most of the subjects (93.3%) and (90%) respectively. Significant (p<00.1) improvement was observed after surgery.

Table 4: Distribution of study population according to Lysholm score, Tegner activity score & VAS scale (n=30)

	Preoperative	Postoperative	P-value
Lysholm score	48.57±7.41	89.63±4.18	<0.001
Tegner activity score	3.03±1.03	7.10±1.12	<0.001
VAS score	0.90±1.77	0.20±0.48	0.001

Table 4 shows that the preoperative Lysholm score was 48.57±7.41 and at postoperative the score improved to 89.63±4.18 with a significant p-value (<0.001). In this study, the mean preoperative Tegner

activity level score for 30 study patients was 3.03±1.03 which was 7.10±1.12 at final follow-up after 9 months postoperatively. The preoperative mean VAS score was 0.90±1.77 and the postoperative mean VAS score was significantly (p=0.001) decreased (0.20±0.48) at 9 months after surgery.

Table 5: Distribution of study population by postoperative complications (n=30)

Complications	Frequency	Percentage
No complains	24	80%
Infection	1	3.3%
Effusion	5	16.7%

In Table 5, the complications of these patients were treated conservatively. During the study, the majority (80%) of the patients had no complaints, followed by five patients had effusion (16.7%) and only one patient had an infection (3.3%).

DISCUSSION

In this study, the mean ±SD age was 29.73±7.00 years. Half (50%) of the patients were 26-35 years of age. Akoto et al. found the mean age was 29 ± 10 years. [9] Todor et al. found the mean age was 30.64 ± 8.71 years in their study [10]. The current study demonstrated that the majority (90%) of the study subjects were male with a male and female ratio of 9:1. Concurrent study denoted almost the same findings [1,9,10].

In our study, feeling of insecurity (100%) was the predominant complaint after ACL injury followed by swelling (33.3%) and pain (23.3%). Evan *et al.*, reported that most patients in their study had feelings of insecurity and giving way at the time of injury. Other symptoms include pain and swelling, decreased range of motion, and difficulty in ambulating [11].

The preoperative Lachman test and Anterior drawer test were grade 2 in 8 (26.7%) and 10 (33.3%) cases respectively. These tests were grade 3 in 22 (73.3%) and 19 (63.3%) cases respectively. However, the Lachman test and Anterior drawer test were negative in 28 (93.3%) and 27 (90%) respectively after 9 months of surgery. Sharma *et al.*, stated that Anterior drawer grades were improved to grade I in 86% of patients and 12% of patients had grade II laxity. In addition, only 2% of patients had Grade III laxity after surgery which was Grade III in 24% of patients preoperatively. Postoperative Lachman test also showed good improvement from preoperative 30% (grade III) to 2% which was statistically significant [1]. Akoto *et al.*, found significant differences regarding postoperative knee stability, measured by the Lachman test from their preoperative values [9].

In our study, Lysholm score and Tegner activity level score significantly increased after 9 months of operation. A retrospective cohort study performed by Akoto *et al.*, found significant differences in Tegner score, subjective or objective IKDC score, knee stability (Lachman Test and Pivot-Shift Test; Side-to-Side Difference), functioning test (One-Leg Hop Test; Thigh Circumference) or donor site morbidity at the follow up from their preoperative values. They concluded that QT graft fixation using the press-fit technique was a reliable method for primary ACL surgery [9].

Todor et al. performed a study on 39 patients undergoing ACL reconstruction and they observed that postoperative Lysholm, modified Cincinnati and the general SF-36 scores were significantly improved from their preoperative values [10]. Saurabh *et al.*, showed that the average Lysholm score was improved from a pre-operative value in the postoperative period ($p<0.05$). They recommended that CQTB autograft is a valuable option for ACL reconstruction [12].

A retrospective cohort study carried out by Galan *et al.*, concluded that the use of all inside FQT for ACL reconstruction in a young, high-demand sports population, present at 5 years showed good to excellent results, functionally and objectively, with low rates of complications [13].

Khanna et al. showed IKDC score in the bone quadriceps tendon after 9 months of follow-up showed significant improvement. The postoperative Lachman showed significant improvement from their preoperative values [14].

Cavaignac *et al.*, found that bone quadriceps grafts provided equivalent or superior functional outcomes than hamstring grafts more than three years following ACL surgery [5]. Using a free QT graft can minimize donor site morbidity without compromising the results. Overall, donor site morbidity is minimal with the quadriceps graft, both with a normal or minimally invasive harvesting technique [15-17].

Still, the QT is the least used graft for primary ACL reconstruction, with about 10% of the reconstructions being performed with a quadriceps graft [5,18]. It is expected that the use of this graft will increase in the future 30 as data shows good anatomical and biomechanical characteristics of the QT graft [19-21]. Mouarbes *et al.*, compared QT-A to HT-A and BPTB-A. Patients who received QT-A surgery had statistically considerably higher ratings than those who had HT-A surgery, even though there was no statistically

significant difference in the Lysholm score between those who had BPTB- and QT-A surgery [22].

In our study, the number of cases with complications after surgery was very low. Only 1 (3.3%) patient developed an infection and 5 (16.7%) patients had effusion which was treated conservatively. Galan et al found that 5.15% of the patients presented with anterior knee pain [13]. There were no readmissions or re-operations for complications reported by Todor *et al.*, [10]

Limitations of the study

Our study was a single-center study, so it didn't represent the whole community. We took a small sample size due to our short study period. After evaluating those patients, we did not follow up with them for the long term and did not know other possible interference that may happen in the long term with these patients.

CONCLUSION AND RECOMMENDATIONS

In our study, we found that the VAS score significantly decreased in the postoperative state while the Lysholm score and Tegner activity score significantly improved after surgery among our patients. The majority of our patients had no complications. After analyzing the results of the present study, it can be concluded that arthroscopic isolated anterior cruciate ligament (ACL) reconstruction with quadriceps tendon showed satisfactory functional outcomes for the treatment of ACL injury.

So further study with a prospective and longitudinal study design including a larger sample size needs to be done to validate the findings of our study.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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