

E-ISSN: 2395-1958  
P-ISSN: 2706-6630  
IJOS 2023; 9(4): 43-48  
© 2023 IJOS  
<https://www.orthopaper.com>  
Received: 16-09-2023  
Accepted: 21-10-2023

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## Evaluation of the functional outcome of arthroscopic isolated anterior cruciate ligament reconstruction by peroneus longus tendon autograft

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DOI: <https://doi.org/10.22271/ortho.2023.v9.i4a.3470>

### Abstract

**Background:** Anterior cruciate ligament (ACL) injury is one of the commonest sports injuries, which often markedly reduces activity and hamper the quality of life. The choice of graft material for ACL reconstruction plays a vital role in outcome but still there are conflict about graft selection for ACL reconstruction. The use of peroneus longus tendon autograft is a recent evolution in the field of ACL reconstruction.

**Objective:** To evaluate the functional outcome of arthroscopic isolated ACL reconstruction by peroneus longus tendon autograft.

**Materials and Methods:** This prospective interventional study was included 20 patients with isolated ACL injuries and were treated in the guise of arthroscopic reconstruction by peroneus longus tendon autograft. Lachman test, anterior drawer test, Lysholm score and Tegner activity level score were used to assess functional outcome; American Orthopaedic Foot and Ankle Society (AOFAS) score & Medical Research Council (MRC) grading used to assess donor site morbidity. Final outcome was assessed at 9 months post-operatively.

**Results:** Pre-operative Lachman test was positive grade 3+ in 70% cases which were improved post operatively and negative in 95% cases, anterior drawer test was positive in 100% cases pre-operatively while post operatively at final follow up majority (95%) were negative, Lysholm score improved from  $56.85 \pm 7.30$  to  $92.35 \pm 6.12$ , preoperatively which was poor in 85% cases while were good or excellent in 95% cases at 9-month follow-up. Tegner activity level score increased from  $2.95 \pm 0.94$  preoperatively to  $6.91 \pm 1.21$  at the final visit. The mean AOFAS score at 9 month follow up was  $96.75 \pm 5.71$ , 95% had good or excellent AOFAS score on final post-operative evaluation. MRC grading of eversion and first ray plantar flexion were grade 5 in majority (85%) of study patients at final follow up.

**Conclusion:** Isolated ACL reconstruction by peroneus longus tendon autograft have excellent functional outcome with the advantage of easy to harvest, larger graft diameter and least graft complication.

**Keywords:** Isolated anterior cruciate ligament, peroneus longus tendon autograft, lysholm score, tegner activity level score, AOFAS score, MRC grading

### Introduction

Anterior Cruciate Ligament (ACL) is the most commonly injured ligament of the knee joint. Incidence of ACL tear is 2 lac persons annually in U.S.A resulting in 1,00,000 to 1,50,000 anterior cruciate ligament reconstruction (ACLR) every year [1]. Injuries occur when the biomechanical limits of the ligament exceed either by direct trauma such as RTA/contact sports or by non-contact mechanism specially in some sports where there is a chance of stopping abruptly and slowing down during running [2].

ACL provides translational and rotational stability of the knee joint. Main function of the ACL is to prevent anterior translation of the tibia in relation to femur and it also provides rotational stability both in transverse as well as in frontal planes [3].

Injury to the knee is one of the significant clinical and public health injury-related burdens and the frequent need for surgical reconstruction [4]. Among the devastating knee injuries, ACL tear is the commonest one usually occurs as a result of sporting activities [5].

If left untreated, it can proceed to knee instability and early osteoarthritic changes. Therefore, most of the patients with symptomatic ACL tear eventually undergo ACL reconstruction.

Arthroscopic reconstruction of ACL is the most common ligament reconstructive surgery performed in the whole body [6]. Conservative treatment fails to give the desired and expected outcome. The target of reconstruction of the ACL anatomically, is to regain a steady knee joint which allows return to sporting and other daily activities. Arthroscopic ACLR is performed with different types of autograft and allograft tendons. Several tendon grafts are available for ACLR, which includes bone patellar tendon bone (BPTB), hamstring tendon, peroneus longus tendon, quadriceps tendon autografts, several allografts and synthetic grafts [7, 8, 9]. Thus, graft selection is important regarding the consideration of the long-term outcome and donor site morbidity.

Among the autografts used for ACL reconstruction, BPTB was popular but it has some drawbacks like anterior knee pain and risk of patellar fracture. In addition, invasive approach is required for harvesting BPTB graft which has got fixed length and is weaker in strength than inborn ACL [10]. Hamstring graft can easily harvest with minimal donor site morbidity and strength is also nearer to the inherent ACL. On the contrary, its diameter and size is unpredictable particularly in Asian population. In addition, there may be a potential decrease in hamstring power after harvesting, which is crucial for some athletes who need dominant hamstring power [11]. Complications may occur after harvesting hamstring autograft. Patients undergoing a reconstruction of a torn ACL with hamstring graft were noted to develop infra-patellar paraesthesia due to high incidence of injury to infrapatellar branch of saphenous nerve during the procedure [9]. The graft diameter is one of the vital attentions for ACL reconstruction surgery and graft larger than 8 mm were found to reduce the ACLR failure rate [12]. However, it is very difficult to get quadruple strands hamstring graft of 8 mm diameter.

To overcome these possible complications, some Orthopaedic surgeons are therefore attempting to use the peroneus longus tendon as a graft and in most cases the peroneus longus tendon graft is thick enough to maintain the knee stability. During the last few years peroneus longus tendon graft in the form of tripled or doubled tendon has gained popularity and increasingly used as a graft for ACL reconstruction because of the easiness of the technique and low donor site morbidity [7, 8].

Therefore, the main purpose of this prospective interventional study was to evaluate the functional outcome and donor site morbidity of arthroscopic ACL reconstruction with peroneus longus tendon autograft.

### Materials and Methods

This prospective interventional study was conducted at Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from July 2019 to September 2021. Twenty (20) patients, between 20-45 years with isolated ACL injury patients receiving conservative treatment for adequate duration but remain symptomatic, without associated meniscus injury and posterior cruciate ligament injury were purposively included after getting approval from the ethical committee. However, multi-ligament injuries of the knee, associated with fractures around the knee (Tibial plateau, patella, femoral condyles etc.), patient with history of previous knee surgery, knee stiffness and osteoarthritis were excluded. Assessment was

done preoperatively and postoperatively at 1st POD, after 2 weeks, 4 weeks, 6 weeks, 3 months, 6 months and 9 months final follow up. Functional outcome was assessed by Lachman test, anterior drawer test, Lysholm score and Tegner activity level score. American Orthopaedic Foot and Ankle Society (AOFAS) score & Medical Research Council (MRC) grading of eversion and first ray plantar flexion were used to assess donor site morbidity. Rehabilitation protocol was followed accordingly. Pre-operative assessments include a complete history, a thorough clinical examinations and associated injuries were noted. To assess the injury, preoperative X-ray and MRI of the affected knee was carried out. The cases were treated by arthroscopic reconstruction of ACL by peroneus longus tendon autograft. After spinal anaesthesia patient's affected limb was examined properly for clinical reconfirmation of isolated anterior cruciate ligament injury. After proper preparation, knee was distended with saline. After introducing the arthroscope, a systematic knee examination was done to assess the pathology. A torn ACL was usually visualized as failing to extend to its normal femoral attachment. Peroneus longus tendon was harvested by giving incision 2-3 cm above and 1cm behind the lateral malleolus.

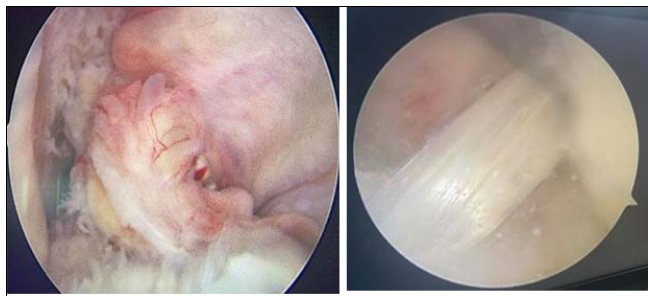


**Fig 1:** Peroneus longus tendon (White shiny tendinous)



**Fig 2:** Peroneus longus tendon after harvest

The tendon was folded in double and was placed together using a number 5 ethibond suture and using Krakow's technique. The remaining ACL tissue was removed by basket forceps and shaver. Then femoral and tibial tunnel was made. After that, graft with Endobutton was passed through the tibial tunnel to femoral tunnel with the help of passing suture. After confirmation of passage of endobutton through femoral tunnel, the tibial end was fixed with a biodegradable interference screw at knee in full extension. Patient was discharged on 2<sup>nd</sup> POD ensuring wound was healthy and patient was compliant regarding physiotherapy. Stiches were removed on 14th POD. Follow-up was recorded on 2 weeks, 4 weeks, 6 weeks, 3 months, 6 months and after 9 months.



**Fig 3:** a) Torn ACL (Arthroscopic view) b) Reconstructed ACL



**Fig 4:** Postoperatively at final follow up a) Power of eversion b) Power of first ray plantar flexion at donor ankle

All the data was compiled, sorted and analyzed statistically by using Statistical Package for Social Science (SPSS-26.0), IBM®, Armonk, USA. The significance of the results as determined in 95.0% confidence interval and a value of  $p < 0.05$  considered statistically significant.

**Results**

This prospective interventional study was carried out to assess the functional outcome of arthroscopic isolated ACL reconstruction by peroneus longus tendon autograft and assessment of donor site morbidity. A total of 20 cases were enrolled for the study.

Table-1 shows age distribution of patients and Mean age of all patients was  $27.35 \pm 4.03$  years (21-36 year), where in maximum patients belonged to 20-25 years of age (40%).

**Table 1:** Age composition of study populations (N=20)

Age Group (in year)	Frequency	Percentage (%)
20-25	8	40
26-30	7	35
31-35	4	20
36-40	1	5
Total	20	100
Mean± SD (Range)	27.35±4.030 years (21-36 year)	

N: Total number of patients

In this study, most of the study patients were male (90%). Maximum patients in our study were student (35%). Among rest, 25% were athlete, 20% were service holder, 15% were doing business and 5% was housewife.

Majority study patients had injured from sports injury (60%), while 30% had injured from road traffic accident and rest

10% had injured from history of fall (Table 3).

**Table 2:** Cause of injury among study patients (N=20)

Cause of injury	Frequency	Percentage
Sports	12	60
Road Traffic accidents	6	30
History of fall	2	10
Total	20	100

In this study, most of the study patients had suffered from injury over right knee joint (60%).

**Table 3:** Duration from injury to operation among study patients (N=20)

Duration from injury to operation (in months)	Frequency	Percentage
<6	13	65
6-12	5	25
>12	2	10
Mean± SD (Range)	4.85±3.569	

Here, the mean duration from injury to operation was  $4.85 \pm 3.569$  months (range: 1.5 -14 months), where in majority study patients had suffered for <6 months (65%). Among rest, 25% suffered for less than 06-12 months, 10% for >12 weeks (Table 4).

**Table 4:** Intraoperative graft diameter (mm) of study patients (N=20)

Graft diameter (mm)	Frequency	Percentage
7.50	2	10
8.00	8	40
8.50	8	40
9.00	2	10
Mean ± SD (Range)	8.25±0.414 (7.50-9)	

Table 4 shows the mean thickness of intraoperative doubled peroneus longus tendon autograft (mm) was  $8.25 \pm 0.414$  mm (range: 7.50-9 mm). The maximum thickness was 9 mm & while minimum was 7.5 mm.

Lachman’s test shows that pre-operatively majority study patients had grade 3+ Lachman’s test grading (70%), while post-operatively after 9 months, majority (n=19, 95%) patients were negative for Lachman’s test (p value <0.001) (Table 6).

**Table 5:** Evaluation of function by Lachman’s test (N=20)

Lachman’s test grade	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
Negative	0(0)	19(95)	$2 \times 10^{-6}$
Grade 1+	0(0)	1(5)	
Grade 2+	6(30)	0(0)	
Grade 3+	14(70)	0(0)	

Wilcoxon Rank Sum test was performed

Table 6 shows that pre-operative anterior drawer test with foot in neutral position was positive in all of the study patients, while post-operatively after 9 months, majority (n=19, 95%) patients were negative for anterior drawer test (p value <0.001).

**Table 6:** Evaluation of pre- and post-operative anterior drawer test (N=20)

Anterior drawer test	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
Negative	0(0)	19(95)	4×10 <sup>-6</sup>
Positive	20(100)	1(5)	

McNemar’s test was performed.

**Table 7:** Evaluation of pre- and post-operative Lysholm knee score (N=20)

Lysholm knee score	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
Mean± SD	56.85±7.30	92.35±6.115	4.21×10 <sup>-14</sup> †
<b>Interpretation</b>			
Poor (<65)	17(85)	0(0)	2×10 <sup>-6</sup> Ψ
Fair (65-83)	3(15)	1(5)	
Good (84-90)	0(0)	5(25)	
Excellent (>90)	0(0)	14(70)	

†Paired T test, Ψ Wilcoxon Rank Sum test was performed

Table 8 shows the mean preoperative Tegner activity level score for 20 knees was 2.95±0.94 (range: 2 to 5). The mean postoperative Tegner activity level score after 9 months was

6.90±1.21 (range: 4 to 9). The improvement was statistically significant (p value <0.001).

**Table 8:** Evaluation of pre- and post-operative Tegner activity level score (N=20)

Tegner activity level score	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
Mean ± SD	2.95±0.94	6.90±1.21	3.4×10 <sup>-14</sup> †
<b>Score</b>			
2	8(40)	0(0)	4.7×10 <sup>-5</sup> Ψ
3	6(30)	0(0)	
4	5(25)	1(5)	
5	1(5)	1(5)	
6	0(0)	4(20)	
7	0(0)	9(45)	
8	0(0)	3(15)	
9	0(0)	2(10)	

Paired T test, Ψ Wilcoxon Rank Sum test was performed

Table 9 shows that the mean preoperative AOFAS score was 100±0.00. The mean postoperative AOFAS score after 9 months was 96.75±5.711 (74-100). Majority study patients (95%) had good or excellent AOFAS score for graft donor site morbidity on post-operative assessment.

**Table 10:** Evaluation of the power of eversion by MRC grading (n=20)

MRC grade	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
4	0(0)	3(15)	0.250
5	20(100)	17(85)	

Wilcoxon Rank Sum test was performed

**Table 9:** Evaluation of pre- and post-operative AOFAS score (n=20)

AOFAS score	Pre-operative n (%)	Post-operative final follow-up (9 months) n (%)	P value
Poor (0-50)	0(0)	0(0)	0.125 Ψ
Fair (51-74)	0(0)	1(5)	
Good (75-94)	0(0)	3(15)	
Excellent (95-100)	20(100)	16(80)	
Mean± SD (Range)	100±0.00	96.75±5.711 (74-100)	0.020†

† Paired T test, Ψ Wilcoxon Rank Sum test was performed

Table 10 shows that the evaluation of the power of eversion & first ray plantar flexion by MRC grading shows, pre-operatively all the study patients had grade 5 power. While post-operatively after 9 months, majority (n=17, 85%) patients were Grade 5 power of eversion and 15% (n=3) study patients had grade 4 power with the muscle grading by MRC scale.

**Discussion**

In this study, the age composition of study population showed that the age range was 21-39 years and mean age was 27.35 ±4.03, where in maximum patient was belonged in age group 20-25 years (40%). Almost similar finding was observed in the studies of Rhatomy *et al.*, (2019) which was 27.58±8.69 [13]. In this study, Male patients (90%) were more predominant than female (10%). Kerimoglu *et al.*, (2008) shown similar result. In their study 93.1% patients were male and 6.9% were female [15]. Male predominance was also observed in some studies [7, 8, 14]. The reason for male predominance possibly be due to more involvement in manual activities, outdoor sports etc. Although study by Bjordal *et al.*, (1997) compared ACL injury rates in 15- to 18-year-old footballers, and found that females were 5.4 times more likely to sustain injury than male [16]. In regards to occupation, maximum study population was students (35%), due to their

participation in non-professional sports. Athlete (25%), service holder was (20%), businessman (15%) and housewife were (5%). Most commonly affected knee was right knee 12(60%) and left knee was affected in 8 (40%) study patients. A similar result was found in a study [8]. In our study right knee involvement was 60% and left knee involvement was 40%. In this study we found the cause of injury was sporting activity in 60% of cases, 30% was due to road traffic accidents and 10% was due to history of fall. Rhatomy *et al.*, (2019) revealed that the cause of injury of 69.3% patients was sporting activities [14]. Kerimoglu *et al.*, (2008) suggested that 75% of the study patients suffered ACL injury as a result of trauma due to the sports event. ACL reconstruction is ideal after subsidence post traumatic inflammatory response [15]. In our study, Mean duration was  $4.85 \pm 3.569$  months. Duration of from injury to operation was <6 months in 65% patients, 6-12 months in 25% patients and >12 months in 10% patients. Almost similar results were observed from multiple studies of different authors [17, 18].

Graft diameter is one of the most important considerations for ACL reconstruction surgery. Grafts larger than 8mm were found to provide a protective effect in patients aged younger than 20 years [19]. In our study mean of intraoperative doubled peroneus longus graft diameter (mm) was  $8.25 \pm 0.414$  mm. The maximum diameter of the graft was 9 mm & minimum diameter was 7.5 mm. This indicates peroneus longus autograft is the likely choice for ACL reconstruction. Similar study by Rhatomy *et al.*, (2019) revealed that mean of intraoperative peroneus longus graft diameter (mm) was  $8.38 \pm 0.68$  mm [14]. Another study by Rhatomy *et al.*, (2019) showed that peroneus longus graft diameter was  $8.56 \pm 0.82$  mm [20]. The mean thickness of the peroneus longus tendon obtain in the study of Kumar *et al.*, (2020) was 8.74 mm [7]. For ligamentous stability, pre-operative Lachman test was positive in all patients among them 30% had grade 2+ laxity, patient percentage of grade 3+ was 70%. Post-operative Lachman test results improved significantly, Lachman test was negative in 95% cases and grade 1+ was in 5% cases at 9 months in the present study (P value <0.001). Nearly similar result was found in a study where 88% study patients showed negative Lachman test at postoperative final follow up [7]. Our study showed that pre-operative anterior drawer test with the foot in neutral position was positive in all of the study patients, while post-operatively after 9 months, majority (n=19, 95%) patients were negative for anterior drawer test (P value <0.001). Anghong *et al.*, (2015) reported normal anterior drawer test findings in 83.3%, while 16.7% of all examined patients had 1+ anterior laxity [21]. Sharma *et al.*, (2019) reported anterior drawer was negative in 80% cases at final follow-up [8]. Preoperative mean Lysholm knee score was  $56.85 \pm 7.30$  and this score increased up to  $93.35 \pm 6.115$  at 9 months final follow up and this was statistically significant ( $p < 0.001$ ). Which is similar to the findings of (Sharma *et al.*, 2019) [8] found 93.7 & (Rhatomy *et al.*, 2019) [10] which found  $94.9 \pm 5.6$ . Shi *et al.*, (2017) reported  $94 \pm 6.81$  Lysholm score at 24 months after surgery [22]. In our study the pre-operative Lysholm knee score was poor in majority cases (85%), while 9 months post-operative functional outcome of the subjects were good or excellent in most of the cases (95%). Kerimoglu *et al.*, (2008) reported Lysholm knee score were good or excellent in 79.3% cases at post-operative final follow-up [15]. Our study is consistent with all these study findings.

The results of Tegner activity level score reflects that, ACL reconstruction surgery was able to improve the mean Tegner activity level score increased from  $2.95 \pm 0.94$  preoperatively

to  $6.91 \pm 1.21$  at the final visit. The improvement from preoperative to 9 months' postoperative values was statistically significant ( $p < 0.001$ ) and which is consistent with (Shi *et al.*, 2019) [22].

In our study the mean postoperative AOFAS score after 9 months was  $96.75 \pm 5.71$  (range: 74-100). Majority study patients (95%) had good or excellent AOFAS score on final post-operative assessment. Similar result shown in 12 Rhatomy *et al.*, (2019). Rahtomy *et al.*, (2019) revealed the mean AOFAS score was  $98.71 \pm 3.03$  at final follow up [13]. Shrama *et al.*, (2019) revealed the mean postoperative AOFAS score were  $94.5 \pm 1.5$  which shows minimal donor site morbidity and no significant deterioration in ankle function [8]. In our study, the MRC grading of eversion and first ray plantar flexion of donor ankle were grade 5 in majority (85%) of study patients and 15% study patients were grade 4 at final follow up, which was statistically non-significant ( $P = 0.25$ ). Anghong *et al.*, (2015) mentioned the examination of eversion were shown as grade 5 power in 83.3% patients, while 16.7% of all examined patients had grade 4 power with the muscle grading by MRC scale.

Above discussion shows that donor ankle function was excellent after harvesting the peroneus longus tendon. The overall findings of this study were mostly similar to other studies conducted in different population groups all over the globe.

## Conclusion

This prospective interventional study suggests that, the arthroscopic isolated ACL reconstruction by peroneus longus tendon autograft yields satisfactory functional outcome. Peroneus longus tendon is the most favorable autograft for ACL reconstruction and has got advantages over other grafts because of its simpler harvesting technique, larger graft diameter and least complication. It can be a good choice for reconstruction of ACL tear.

## Conflicts of interest

There is no conflict of interest.

## Acknowledgment

The authors thank Dr Sachindra Raj Joshi and Dr.Md. Shahed Morshed for their assistance in this study.

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**How to Cite This Article**

Sheikh Sadi S, Chowdhury AZ, Hossen M, Mahmud CI, Ahmed AMFU, Sanil WM *et al*. Evaluation of the functional outcome of arthroscopic isolated anterior cruciate ligament reconstruction by peroneus longus tendon autograft. *International Journal of Orthopaedics Sciences*. 2023;9(4):43-48.

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