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Original Research Article

Anterior cruciate ligament reconstruction using peroneus longus tendon auto-graft: functional results

Ahmed Refaat Khamis, Mohamed Tarek Abdel Aziz*, Magdy Mohamed El Sayed, Mohamed Ahmed Abdel Baky

Department of Orthopedic Surgery, Faculty of Medicine, Benha University, Benha, Qaliobia, Egypt

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***Correspondence:**
Dr. Mohamed Tarek Abdel Aziz,
E-mail: mohamedtarek008@gmail.com

ABSTRACT

Background: The peroneus longus tendon is a promising autograft alternative to the others tendons in ACL reconstruction. It offers the advantages of being expendable, having adequate length and strength, sparing morbidity from other donor sites, and allows early rehabilitation.
Methods: The study was on 30 patients with isolated ACL complete tear treated by arthroscopic reconstruction using the PL tendon in Benha university hospital in the period from July 2022 till June 2023. The patients were assessed pre-operatively and post-operatively with the IKDC score and clinical tests of instability. The ankle was also assessed pre-operatively and post-operatively though AOFAS and clinical tests of instability. Patients were followed up for 12 months.
Results: The age of patients was 18-45 years. The preoperative IKDC score ranged 49-72 with a mean SD of±14.02. The post-operative IKDC score ranged 89-100 with a mean SD of±3.5 showing marked improvement of knee function with 93.3% of patients regained normal knee function. The pre-operative AOFAS score ranged 99-100 with a mean SD of±0.16 and the post-operative score ranged 89-100 with a mean SD of±3.5 denoting minimal affection of ankle functions.
Conclusions: The peroneus longus serves as a suitable autograft for ACL reconstruction as an alternative to the others tendons based on its ability to restore knee function and the minimal morbidity at the donor site.

Keywords: ACL, ACL reconstruction, IKDC score, AOFAS score, Peroneus longus

INTRODUCTION

The anterior cruciate ligament with its anteromedial and posterolateral bundles functions as the primary restraint to anterior tibial translation and as the secondary restraint for tibial anterolateral rotational instability respectively. It is formed mainly of 90% type-1 collagen and 10% type-2 collagen with blood supply from the middle geniculate artery and nerve supply from the posterior articular branch of the tibial nerve.[1]

The ACL injuries are one of the most common knee ligamentous injuries, especially among athletes involved in pivoting sports like football and basketball. Without an intact ACL, the knee is at risk of antero-lateral instability, repetitive injury, and early-onset osteoarthritis. Therefore, treatment of ACL injuries aims to restore knee stability and function.[1] The current gold standard method for ACL reconstruction is to use an autograft. The most common autograft options are bone-patellar tendon-bone (BPTB) graft and hamstring tendons graft. However, the BPTB graft risks anterior knee pain, patella fracture, and patellar tendon weakness, while hamstring grafting can cause hamstring weakness and medial knee instability. This has prompted investigation of an alternative autograft options like the peroneus longus tendon. The maximal load to

failure for native ACL averaged 2200 N, BPTB graft 2600 N, quadrupled hamstring graft 4000 N, quadriceps tendon 2185, and doubled peroneus longus tendon graft 4400 N. The graft choice for ACL reconstruction should be stronger enough more than the native ACL thus the peroneus longus tendon autograft is a suitable option.[2]

The peroneus longus tendon is located on the lateral side of the lower leg behind the lateral malleolus, serving plantar flexion and eversion of the foot. Using the peroneus longus as an ACL autograft was first described by Zhao and Huangfu in 2012.[3] Since the initial description of the technique, several studies have reported favourable clinical and functional outcomes. Rhatomy et al followed 30 patients for 2 years after ACL reconstruction with peroneus longus graft and reported statistically significant improvement in subjective knee scores and stability tests with mean ACL quality of life outcome score of 92.5 and only one patient showed residual anterolateral rotatory instability on pivot shift testing.[4]

The peroneus longus tendon offers the advantages of being expendable, having adequate length and strength, sparing morbidity from other donor sites, and early rehabilitation due to tendon-to-bone healing.[5]

This prospective study aimed at evaluation of the functional and clinical outcome of arthroscopic ACL reconstruction using the peroneus longus tendon as an auto-graft.

METHODS

This prospective interventional study involved 30 randomly selected patients with torn ACL and included 15 amateur football players was conducted in the orthopedic surgery department of Benha faculty of medicine hospitals from July 2022 to June 2023. Patient's age ranged 18-45 years old with isolated anterior cruciate ligament injury and no previous significant ankle injury or instability.

Inclusion criteria

Patients with age 18-45 years, no previous significant ankle injury or instability, patients with no history of previous knee ligament surgery and patients with anterior cruciate ligament injury were included.

Exclusion criteria

Patients with multi-ligamentous injuries, individuals with pre-existing ankle deformities, neuromuscular disorders, or a history of significant ankle injuries, patients whit previous failed ACL reconstruction surgery, individuals aged under 18 or over 45 years old, patients with knee deformities (varus malalignment-osteoarthritis) and patients have ACL injury with associated fractures or neurovascular injuries were excluded.

Preoperative assessment of knee was done through the clinical tests of instability including Lachman test, anterior drawer test and pivot shift test. Functional scores according to the International Knee Documentation Committee (IKDC) were recorded before and after the surgery. The graft side ankle joint was clinically assessed preoperatively and postoperatively through anterior drawer test of ankle, varus talar tilt, eversion test and planter flexion, and ankle stability assessment was done by the American orthopedic foot and ankle score (AOFAS).

Preoperative radiographic assessment for all patients was done by plain radiographs for deep lateral sulcus sign, anterior tibial translocation sign, Segond fracture, arcuate fracture and joint effusion. Magnetic resonance imaging (MRI) as the gold standard investigation for diagnosis was done for all patients for discontinuity of the ACL fibres, avulsion of femoral or tibial attachments, bone marrow contusion or associated injuries of menisci, other ligaments or fractures.

At the final follow up period after one year, all cases were assessed for knee and ankle functional state according to the IKDC score and the AOFAS. Statistical analysis of data was done by the social science software program version 26 (SPSS) and summarized as mean, standard deviation, median and interquartile range for quantitative variables and number and percent for qualitative variable. Comparison between qualitative variables was done using chi square test and paired-T-test for normally distributed quantitative variables. Mann-Whitney test for non-parametric quantitative variables. $P<0.05$ was considered significant.

Surgical technique

Through standard arthroscopic portals in supine position with tourniquet applied on upper thigh, a diagnostic arthroscopy was performed to confirm the diagnosis of ACL complete tear and to identify any associated meniscal or articular cartilage pathology. Graft harvesting was done through a small 3 cm incision located 2-3 cm proximal and 1 cm posterior to the lateral malleolus. Identifying of the peroneus longus tendon was done with blunt dissection and released by stripping from surrounding soft tissue proximally with care not to advance the stripper more than one hand breadth distal to the head of the fibula to avoid injury of the common peroneal nerve. The distal part of the peroneus longus tendon was tagged then sutured to the peroneus brevis tendon distally with end-to-side sutures. Each end of the peroneus longus tendon was stitched with stay sutures (Figure 1). Then whipstitch the doubled tendon with fibres loop to reinforce it. The graft size was measured to define the size of the bony tunnels. Lastly, the flip mark was measured and drawn on the graft. The femoral tunnel was drilled in the anatomical attachment of the ligament on the medial wall of the lateral femoral condyle with the knee flexed 90°, leaving approximately 1-2 mm of the bone between the tunnel and the back wall of femur. The tibial tunnel was drilled with a 55° angled

ACL guide inserted into the joint through the anteromedial portal and positioned about 7 mm anterior to the PCL tibial attachment, posterior to the anterior horn of the lateral meniscus and on the lateral wall of the medial tibial spine in order to locate the native ACL footprint. The graft was passed from the tibial tunnel to the femoral tunnel with the help of 2 leading sutures. At the femoral side, with the knee flexed 120°, the graft was secured with an Endobutton. Then the knee was cycled several times while applying traction on the graft to avoid any slacking of the graft and to ensure that no anterior impingement is present. At the tibial side the graft was fixed with a bioabsorbable interference screw. After thorough cleaning of the surgical area, closure was done.

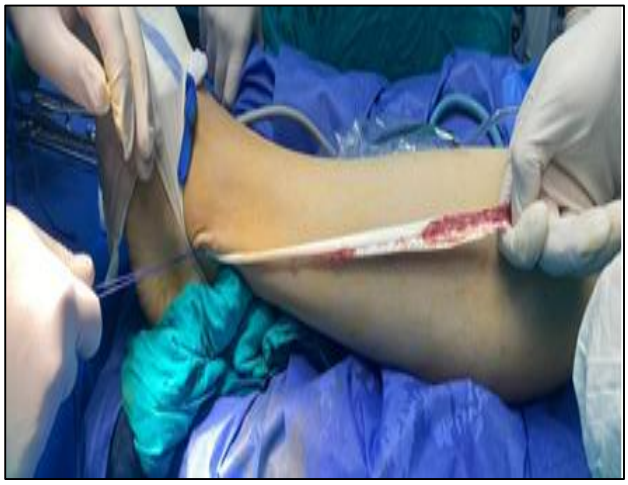

Figure 1: Graft harvesting.

Postoperative rehabilitation

It was done in 6 stages. The immediate stage (1-10 days) aimed at pain and swelling control, maintenance of full extension, continuous passive muscle strengthening exercises and increasing flexion as quickly as tolerated. The early stage (1-3 weeks) aimed to increase flexion, more muscles strengthening and starting partial weight bearing. The intermediate stage (3-5 weeks) aimed at continued building the quadriceps and hamstring strength, starting passive knee extension exercises and active knee flexion exercises with electrical muscle stimulation if the patient is unable to contract the quadriceps or hamstring muscles. The late stage (5-8 weeks) goals were to continue quadriceps and hamstring strengthening, continue proprioceptive training, near full flexion and full extension, patella mobilization, gait training and closed kinetic chain exercises. The final or transitional stage (8-12weeks) goals were to continue muscles strengthening, proprioceptive training, full flexion and extension and to start open chain exercises such as simple running program to be ready to the sport phase. The sport specific rehabilitation stage (12 weeks -9 or 12 months) goals were to continue the running program, start gradually advanced training until return to sport.

Ethical considerations

Before participation, patients were required to provide informed written consent. Approval from the research ethics committee of the faculty of medicine, Benha university was obtained. Additionally, administrative permission will be obtained before commencing the study.

RESULTS

This study was conducted on thirty patients who had completed follow up for 12 months. All studied cases were males with a mean age 30.28±12.3 years (ranged 18-45 years) (Table 1).

Preoperative assessment of the knee showed that all cases had positive Lachman test, pivot shift test and anterior drawer test and all of them had negative posterior drawer test, varus stress test and valgus stress test. The IKDC score ranged 49-72 with a mean of 64.66±14.02.

Postoperative assessment of the knee showed that 93.3% of the studied patients had negative Lachman test, pivot shift test and anterior drawer test. The IKDC score ranged 89-100 with a mean of 96.2±3.5.

Postoperative assessment of the ankle showed that all cases had normal anterior drawer test, 90% had normal varus talar test, 80% had grade-V of eversion test, 100% had grade- IV power of planter flexion test and 93.3% had no ankle stiffness. Postoperative AOFAS ranged 96-100 with a mean of 99.38±1.2.

There was a statistically significant difference between the preoperative and the postoperative IKDC score ($p<0.001$). The preoperative and postoperative mean of the AOFAS showed a negligible difference (99.9±0.16 and 99.38±1.2 respectively) (Table 2).

Regarding the complications encountered in our study, there were 3 patients with superficial infection, only one patient had deep venous thrombosis (DVT), and one patient had hemarthrosis and 2 patients with residual mild knee instability. Regarding the graft donor site, there were 2 patients with superficial infection, 2 patients with temporary ankle stuffiness and 3 patients with mild hyperesthesia around lateral malleolus.

Regarding the time to return to sports, 6 patients (20%) returned to sport after 5 months, 15 patients (50%) returned to sports after 6-9 months, 7 patients (23.3%) returned to sports after 9-12 months and 2 patients (6.6%) returned to sports after 12 months.

At final follow up, the functional results according to the IKDC score was normal (class-A) in 28 patients (93.3%), near normal (class-B) in 2 patients (6.7%), and no patients had abnormal or severely abnormal knee function (classes-C or D) (Table 3).

Table 1: Sociodemographic characteristics of the studied cases.

Age (in years)	Mean±SD	30.28±12.3
	Min-Max	18-45
Gender	Male	30 (100%)

Table 2: Comparison between IKDC and AOFAS before and after the surgery.

Variables		Pre-op	Post op	P value
IKDC score	Mean±SD	64.66± 14.02	96.2± 3.5	<0.001
	Min-Max	49-72	89-100	
AOFAS score	Mean±SD	99.9± 0.16	99.38± 1.2	0.003
	Min-Max	99-100	96-100	

Table 3: Post-operative assessment using the IKDC score.

IKDC score	N	Percentage (%)
Normal (A)	28	93.3
Nearly normal (B)	2	6.7
Abnormal (C)	0	0
Severely abnormal (D)	0	0

DISCUSSION

Our study, which included only male patients, may limit the generalizability of the findings to female ACL reconstruction patients. On the contrary, Montalvo et al found that ACL injuries requiring reconstruction are much more prevalent among young females, especially athletes.[6]

The mean age of our sample was 28 years, aligning with the typical ACL injury demographic distribution. Our narrow age range between 18-45 years allows for a more homogeneous population. Edwards et al noted that younger age is associated with better outcomes after ACL reconstruction, likely due to increased healing capacity.[7]

In our study all cases were followed-up for 12 months. Ramkumar et al indicated that loss to follow-up in ACL reconstruction studies can exceed 20%, even among prospective designs.[8]

Our mean preoperative IKDC score of 64.66 highlights significant impairments, but the range extending up to 99 indicates some patients had less severe initial symptoms. This variability, with a standard deviation of ±3.3 could influence postoperative outcomes. Moses et al described that the IKDC scores below 90 are considered indicative of abnormal knee function.[9]

Our postoperative IKDC score improvement from 64.66 to 96.2 matches the findings of Rhatomy et al who reported a significant increase in the mean IKDC score from 64 preoperatively to 92.5 at the final follow-up after ACL reconstruction with a peroneus longus graft. Our higher scores may be attributable to the younger patient population (mean age of 30.28±12.3 years) compared to Rhatomy's study mean age of 34 years.[10]

The current study found no cases of anterior drawer laxity of the ankle postoperatively, indicating that the peroneus longus tendon harvest did not compromise ankle stability. Only 10% of our patients had abnormal varus talar tilt, and their mean AOFAS score was near perfect at 99.4, a slight decrease from the preoperative score of 99.9 (p=0.003), likely was not clinically significant. In line with us Zhao and Huangfu who first described using the peroneus longus tendon as an ACL autograft option, reported no cases of postoperative ankle instability.[3] Our findings of maintained ankle function and near perfect AOFAS scores are supported also by Saeed et al study which showed low donor site morbidity with peroneus longus harvest.[11]

In our study, according to IKDC scale there were 28 (93.3%) patients who regain normal (A) knee function, 2 (6.7%) patients regain nearly normal (B) knee function, and no patients had abnormal (C) or severely abnormal (D) knee function. These results were better than Karimoglu et al study who reported 17 (58.6%) patients had been rated normal or nearly normal and 12 (41.4%) patients were rated as abnormal or severely abnormal.[12]

The reported complications in our study were 3 (10%) patients with superficial infection due to improper daily dressing of the wound and they were treated by proper antibiotics and proper dressing, one (3.3%) patient with DVT due to tight bandage on the leg after surgery that was medically managed, 2 (6.6%) patients with residual mild knee instability (translation grade-1 Lachman test) due to generalized ligamentous laxity, and one (3.3%) patient with hemarthrosis that required aspiration of the joint twice before completely resolved. As a comparison with our study, Andres Cano et al reported (3.2%) of their patients had infection, (0.6%) had deep venous thrombosis and (6.7%) had hemarthrosis. [13] The higher rate of infection in our study could be attributed to the smaller number of our study group.

As regarding the time to return to sports in the current study, there were 6 patients (20%) who were young, motivated and cooperative with the accelerated rehabilitation returned to sport and full daily activities before 6 months. Their result was excellent on the IKDC score. On the other hand, 15 patients (50%) returned to sports after 6-9 months and were rated as good result, 7 patients (23.3%) returned to sports after 9-12 months and reported as a fair result, and 2 patients (6.6%) returned to sports after 12 months due to high BMI and inconsistent postoperative rehabilitation. Walron et al reported that there is no universally accepted timeline for returning to sport after arthroscopic ACL reconstruction but evidence shows reported benefits of both accelerated and conservative approaches.[14]

Limitations of this study include the lack of a control group for comparison. Future randomized controlled trials comparing peroneus longus grafts to traditional BPTB and hamstring grafts are warranted. Patient-reported outcome scores beyond just the IKDC and AOFAS could also be considered. Additionally, longer-term follow-up is needed to assess graft survival and failure rates over time.

CONCLUSION

The peroneus longus tendon autograft for arthroscopic reconstruction of anterior cruciate ligament injury offers favourable functional outcome of the knee. It showed negligible morbidity at the donor site which allows immediate postoperative enhanced rehabilitation protocol and early return to pre-injury knee function. In addition, the harvesting technique is much easier than the other graft types. We recommend considering it the graft of choice in ACL reconstruction. Further research with larger number of patients is favoured in the future.

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