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Original Article

Comparative Study between Anterior Cruciate Ligament Reconstruction by Hamstring Muscle and Peroneus Longus Tendon

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Abstract

Background: Two ligaments—the anterior cruciate & the posterior longitudinal are the primary ligaments that play a crucial role in maintaining knee stability.

The aim of the work: To compare the results of hamstring tendon graft *&* graft for the peroneus tendon in anterior cruciate ligament reconstruction as regarding graft tensile power, length, donor site morbidity and knee ROM in short term follow up period.

Patients and Methods: This Quasi experimental interrupted time series study was performed on Twenty cases with anterior cruciate ligament rupture classified into *2* groups: Group A [ten cases who received arthroscopic single bundle ACLR using hamstring tendon] and Group B [10 cases who received arthroscopic single bundle ACLR using peroneus Longus tendon] at the orthopedic clinics department in Al-Azhar University Hospital in Damietta from August 2022 to January 2023.

Results: There was a statistically significant enhancement in knee range of motion, Lysholm score and International Knee Documentation Committee [IKDC] score in both groups from preoperatively to 6 months postoperatively and no statistically significant variance was found among groups regarding pre & postoperative ROM, preoperative and postoperative Lysholm score between various intervals of follow-up *&* preoperative & postoperative IKDC score between various intervals of follow-up. Also, a statistically significant difference was observed in thigh hypotrophy among hamstring and peroneus groups.

Conclusion: Reconstructive surgery for the ACL with peroneus Longus tendon showed no statistically significant difference regarding ankle function and preoperative & postoperative knee ROM with a benefits of a bigger graft size and less thigh hypotrophy comparable to that of hamstring tendon.

Keywords: Anterior Cruciate Ligament; Reconstruction; Hamstring Muscles; Peroneus Longus Tendon.

INTRODUCTION

The human knee is the body's second-largest joint that bears weight. Cruciate ligaments are a key component of ligamentous stability in the knee. Most importantly, there is the posterior longitudinal ligament & ACL [1].

When it comes to protecting the knee joint from forces that could cause it to rotate or translate, the ACL plays a crucial function. One in three thousand people in the general population will experience an ACL rupture. Potential outcomes include osteoarthritis, meniscus tears, & knee instability [2].

Methods that permit doubling or quadrupling of hamstring grafts enhance the initial tensile strength & raise the graft's cross-sectional diameter to a minimum of 7 mm. Additionally, autografts from hamstring tendons can be used for ACL restoration. In rare cases where the graft-to-tendon ratio is less than 7 mm, which can occur as a result of harvesting mistakes or natural fluctuations in tendon diameters, we will require a different source of graft [3-5].

Several studies have demonstrated that the length and intensity of the Peroneus Longus tendon [PLT] make it an excellent candidate for ACL restoration; nevertheless, the risks associated with this procedure are still little understood. Autologous tendon grafts have been sourced from PLT in the past, but there haven't been enough investigations on the potential negative effects of this procedure [6-8].

The researchers set out to compare the results of hamstring tendon graft & peroneus tendon graft in repair of the anterior cruciate ligament as regarding graft tensile power, length, donor site morbidity and knee ROM in short term follow up period.

PATIENTS AND METHODS

This Quasi experimental interrupted time series study was performed on Twenty [20] cases with ACL rupture classified into two groups: Group A included 10 patients who received arthroscopic single bundle ACLR using hamstring tendon and Group B included 10 patients who received arthroscopic single bundle ACLR using peroneus Longus tendon at the orthopedic clinics department in Al-Azhar University Hospital in Damietta from August 2022 to January 2023.

Inclusion criteria:

Age between [18- 45] years, pivot shift positive on clinical examination and a minimum interval of 8 weeks among surgery & trauma.

Exclusion criteria:

People less than 18 years or more than 45 years, minimum interval between trauma and surgery less than 8weeks, other concomitant ligamentous injuries of the knee, knee osteoarthritis, infection, general disease [hepatic, diabetic, cardiac], associated articular fracture and There is imaging evidence of extensive chondral destruction on the patellar surface as well as on the medial or lateral femoral condyles.

Ethical consideration: Approval of the IRB committee, Damietta faculty of medicine, AL-Azhar University was obtained before initiating this study. Prior to commencing, written informed consent was obtained from all individuals involved, after explaining the objective of the study, the type of operation, the possibility of complications, and the potential benefits.

Preoperative Assessment: Diagnosis of ACL tears was done by: History, Clinical Examination and Investigations.

Arthroscopic procedure

The patient lies on his or her back on the operating table, the anesthesia team administered spinal anesthetic. A thigh tourniquet was placed on the patient. The usual anteromedial & anterolateral entrances were utilized.

The transplant was harvested after a diagnostic knee arthroscopy. In the hamstrings & peroneus longus groups. The ACL repair procedure involved the use of a bio-absorbable screw in the tibial tunnel & a loop endobutton in the femur tunnel.

Reconstructing the anterior cruciate ligament with Hamstring Tendon autograft: 2-3cm oblique incision midway amongst tibial tubercle & posteromedial border of the tibia along the pes anserinus. Dissection up to the sartorial fascia which was opened in line with the direction of the hamstring tendons.

Gracilis and Semitendinosus tendons were identified and freed from their connections with the sartorial fascia and gastrocnemius. The tendons were then released from their proximal attachments by a tendon stripper then detached from their tibial insertion.

Method for repairing anterior cruciate ligaments using tendon autograft from the peroneus Longus: ACL repair was carried out by the researcher using ipsilateral PL autograft. The full-thickness PL graft was obtained through a two cm-long incision that was made behind the lateral malleolus, somewhat over the superior peroneal retinaculum. With caution to avoid damaging the sural nerve, the peroneus brevis tendon [PB] & PL were exposed. The skin window was used to remove PL to PB.

We performed a tenodesis from PL to PB. The PL was stitched with heavy, non-absorbable Krackow stitches and then cut.

After that, the surrounding soft tissues were removed from PL. In order to avoid injuring the peroneal nerve, the tendon was harvested proximally, approximately four to five centimeters from the fibular head, utilizing an open long tendon stripper under controlled tension.

During the graft harvesting process, the tendon stripper was abruptly halted when resistance was encountered, while simultaneously applying force to the distal end of the stump & moving the tendon stripper forward.

The point of loss of resistance was observed on the skin to be around four to five cm from the head of the fibula in the patients. Wound closure was multi-layered.

Muscle fibers were separated from the tendon in order to prepare the graft. Non-absorbable sutures were used to secure the Krackow-type whipstitches to both ends of each tendon.

Depending on the length of the graft obtained, it can be doubled, tripled, or quadrupled until it reaches a thickness of seven millimeters to eight millimeters.

The method of intra-articular surgery was the same: Using the outside-in approach, the single femoral tunnel was defined in close proximity to the anteromedial footprint. A cannulated reamer was used to bore it to a diameter that matched the breadth of the harvested graft.

A cannulated reamer was used to drill the tibial tunnel, which was constructed using a tibial jig set at 50°. While preparing to drill a tunnel at the site of the native ACL's footprint, every effort was made to preserve the tibial vestiges of the ACL stump. Both techniques involved inserting the graft into the femoral tunnel via the tibial tunnel, then crossing the joint and fastening it with a suspensory system [Endo button]. The tibial tunnel was then secured with an interference bio-absorbable screw.

Postoperative Assessment:

A thorough assessment of the patient's health, including taking their pulse & monitoring the pulsation in their extremities. Five days following surgery, following two check dressings, patients were released. Physical therapy was administered according to the same conventional regimen to both groups.

During the first two weeks, patient was permitted to begin exercises to strengthen quadriceps & hamstrings, as well as ankles. In addition, the patient work on active straight leg raising while wearing a knee brace in full extension, & the patient can support his/her weight on toes while wearing a brace in extension while walking.

During the next three to six weeks, the patient instructed to make sure that he/she fully bend knees, ride a stationary bike, and bear weight as feel comfortable.

Quadriceps strength was used to determine when Walker was weaned off. Those in the peroneus Longus group were instructed to strengthen their ankles by performing activities that allow them to turn their foot inward. The knee brace was removed, & partial squatting was initiated around the 6- to 12-week mark. Patients were allowed to resume sporting activities after 6 months. Wearing a knee brace for at least a year is recommended for contact sports, as well as for activities involving jumping & landing. Assessing the knee's stability & function following surgery using the Lysholm Score & the International Knee Documentation Committee "IKDC" Scores. At the most recent follow-up, a pivot-shift test Was employed to assess the stability of the knee.

RESULTS

Table [1]: demonstrated that there wasn't statistically significant variance among the two studied group as regard age, gender, sports activity, ASA Physical State, mechanism of Injury, side of injury, dominance of injured side, time since injury [weeks] and follow-up [months]. Table [2]: demonstrated that there was a statistically significant variation among the 2 studied groups regarding graft strength [p=0.044], length [p=0.004] and diameter [p=0.010].

Table [3]: demonstrated that there wasn't statistically significant distinction amongst the two studied group regarding Lachman test preoperatively or postoperatively and Pivot Shift Test preoperatively or postoperatively [P > 0.05]. Table [4]: demonstrated a statistically significant enhancement in knee ROM, Lysholm score and IKDC score in both groups from presurgical to 6 months postsurgical and no statistically significant variance was found among groups regarding preoperative & postoperative ROM, preoperative and postoperative Lysholm score at different follow-up intervals, preoperative & postoperative IKDC score at different follow-up intervals [*P* > 0.05].

Figure [1] showed statistically significant difference was observed in thigh hypotrophy among hamstring & peroneus groups [*P* < 0.001]. Figure [2] showed no statistically significant distinction regarding ankle function of the peroneus group among the donor side & contralateral side [P > 0.05].

Table [1]: Baseline Demographic Data [N = 20]

Variables		Group A [N=10]	Group B[N=10]	P value
Age, years	Mean ±SD	30.5 ± 6.3	31.1 ± 7.7	
	Min. – Max.	23-38	20-43	0.896
Gender [n,%]	Male	9 [90%]	8 [80%]	0.531
	Female	1 [10%]	2 [20%]	
Sports Activity	Recreational	5[50%]	6[60%]	0.653
	Professional	5[50%]	4[40%]	
ASA Physical State	Grade I	9[90%0	7[70%]	0.264
	Grade II	1[10%]	3[30%]	
Mechanism of Injury	Noncontact Trauma	6[60%]	7[70%]	0.639
	Contact Trauma	4[40%]	3[30%]	
Side of Injury	Right	6[60%]	8[80%]	0.329
	Left	4[40%]	2[20%]	
Dominance of Injured Side	No	3[30%]	2[20%]	
	Yes	7[70%]	8[80%]	0.606
Time Since Injury, weeks	Mean±SD	12.9 ± 2.6	12.8 ± 2.9	0.119
	Min. Max.	8-16	8-16	
Follow-up, months	Mean±SD	7.8 ± 0.9	7.1 ± 0.9	0.936
	Min. Max.	6-9	6-9	

Table [2]*:* Graft Characteristics [N =20]

	Group A [N =10]	Group B [N = 10]	*P* value*
Strength, N/mm²			0.044
Mean ± SD	303 ± 104	406 ± 109	
Range	200 – 457	260 – 542	
Length, cm			0.004
Mean ± SD	24 ± 3	29 ± 3	
Range	18 – 28	25 – 35	
Diameter, mm			0.010
Mean ± SD	7.3 ± 0.9	8.7 ± 1.2	
Range	6 – 9	7 – 11	
* **Chi-square test.**			

Table [3]: Comparing Stability Tests Results [N = 60]

	Group A [N = 30]		Group B [N = 30]		*P* value*
	No.	**%**	**No.**	**%**	
Lachman Test					
Preoperative					0.264
Grade I	2	20	0	0	
Grade II	6	60	6	60	
Grade III	2	20	4	40	
Postoperative					0.606
Grade 0	8	80	7	70	
Grade I	2	20	3	30	
Pivot Shift Test					
Preoperative					0.653
Grade II	5	50	4	40	
Grade III	5	50	6	60	
Postoperative					0.363
Grade 0	8	80	5	50	
Grade I	1	10	3	30	
Grade II	1	10	2	20	
* **Chi-square test.**					

Table [4]: Comparing Functional Outcomes [N = 60]

		Group A [N = 30]		Group B [N = 30]		*P* value*
		Mean	**SD**	**Mean**	**SD**	
ROM, degrees	**Preoperative**	131	6.2	132	4.5	0.896
	Postoperative	136	4.3	134	4.7	0.314
	P* value*	< 0.001		< 0.001		
Lysholm Score	**Preoperative**	57.2	4.4	57.5	3.8	0.875
	Postoperative	93.2	5.3	89.3	4.0	0.081
	P* value*	< 0.001		< 0.001		
IKDC Score	**Preoperative**	49.7	4.8	50.4	4.2	0.735
	Postoperative	87.6	5.1	84.7	7.3	0.317
	P* value*	< 0.001		< 0.001		
* Independent Sample t test. ** Paired sample t test.						

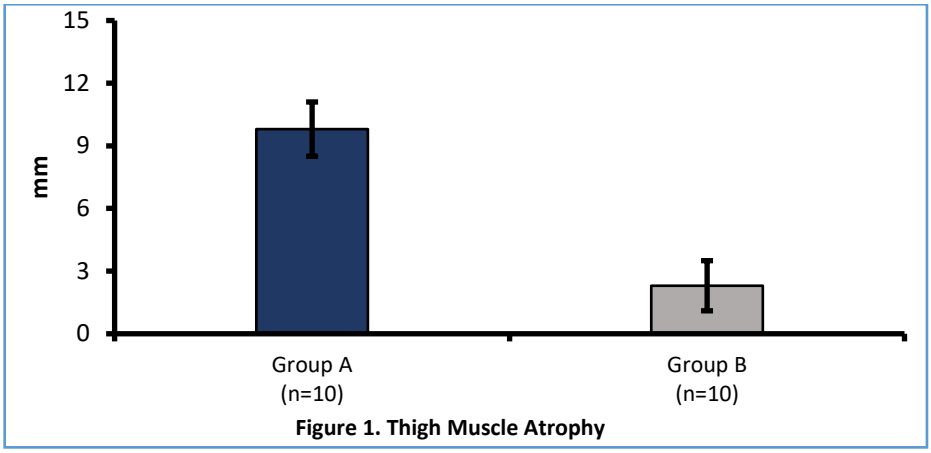

Figure 1. Thigh Muscle Atrophy

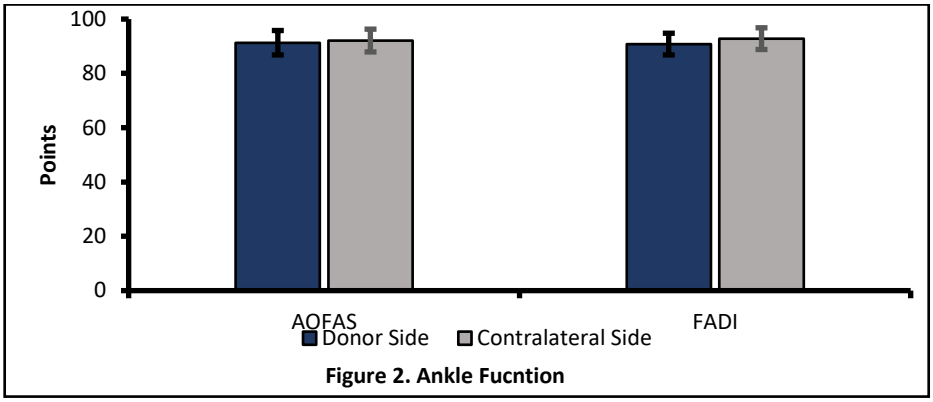

Figure 2. Ankle Fucntion

DISCUSSION

There wasn't statistically significant variance among the 2 studied group as regard age, gender, sports activity, ASA Physical State, mechanism of Injury, side of injury, dominance of injured side, time since injury [weeks] and follow-up [months]

The average age of the people who took part in the research was 27.58 ±8.69 years, which agrees with the results reported by **Rhatomy *et al.*** [9], who sought to evaluate ankle eversion and first ray plantar flexion strength among the donor site and its contralateral site following anterior cruciate ligament repair. Also, our result supported with **Rhatomy *et al.*** [10]**.** They reported that in the hamstring group 24 were men & 4 were women, in the peroneus longus group 20 were men & 4 were women, there wasn't statistically significant variance was discovered among groups as regard gender. The same authors added that, 61 cases suffered single-bundle anterior cruciate ligament reconstruction from 2015 - 2017. Among October 2015 & June 2016 cases were allocated to anterior cruciate ligament reconstruction with a hamstring tendon [9 months from injury to surgery] while, amongst July 2016 & February 2017 the peroneus longus tendon was used [8 months from injury to operation].

In their study, **Cao *et al.*** [11] sought to identify the best course of treatment for anterior cruciate ligament injuries using the peroneus longus tendon. They found that all cases were monitored for an average of fifteen months, with a range of 12 to 24 months. However, our findings contradict their findings.

The peroneus longus tendon has a noticeably greater tensile strength than the hamstring tendon, according to our findings [P = 0.044]. In contrast to our findings, **Mustamsir *et al.*** [12] sought to examine the tensile strength of the peroneus longus & the hamstring tendons & found no statistically significant variance among the two groups [p > 0.05] in terms of average tensile strength values.

The peroneus longus tendon was found to be noticeably longer than the hamstring tendon, according to our results [P = 0.004]. Our findings agreed with those of **Joshi *et al.*** [13], who demonstrated that autograft lengths ranged from 26.2 to 34.8 centimeters, with an average of 29.4 centimeter.

According to our findings, the peroneus longus tendon had a noticeably bigger diameter compared to the hamstring tendon [P = 0.010]. **Rhatomy *et al.*** [10] discovered that the peroneus longus graft had a substantially greater mean diameter [8.8 ± 0.7-millimeter, range eight to ten millimeter] than the hamstring tendon, which is validated by our results.

Neither the pre- nor the post-operative Lachman test revealed a statistically significant distinction among the groups [P > 0.05]. The results are in line with those of **Rhatomy *et al.*** [9], who proven that no patient exhibited translation on the Lachman test six months following surgery.

Both before & after surgery, there wasn't statistically significant distinction in the groups' performance on the pivot shift test [P > 0.05]. We found the same thing as **Liu CT *et al.*** [14], who demonstrated that the pivot shift test came out negative in every single subject. When comparing normal & abnormal knees, KT-1000 didn't detect any statistically significant variations.

Both the pre- & post-operative ranges of motion were not significantly variance across the groups [P > 0.05]. The results are in line with those of **Bi M *et al.*** [15]**,** who proven that complete range of motion was achieved in four to six weeks.

When comparing the Lysholm scores of the groups before & after surgery at various intervals of time, no statistically significant change was seen [P > 0.05]. We found no statistically significant distinction amongst the groups regarding preoperative and postoperative Lysholm scores at different follow-up intervals, which is consistent with the finding of **Rhatomy *et al.*** [10], which demonstrated that the average preoperative Lysholm score in the hamstring group was 69.8 ± 15.9 & in the peroneus group was 70.8 ± 10.2. The Lysholm mean variations in the hamstring group was 23.2 ± 14.3, and in the peroneus, group was 24.1 ± 10.4.

When comparing the groups' International Knee Documentation Committee scores before & after surgery at various follow-up intervals, no statistically significant change was seen [P > 0.05]. According to **Liu CT *et al.*** [14]**,** the average IKDC score was 86.0, with a range of 83 to 89.

The hamstring & peroneus groups showed significantly different levels of thigh hypotrophy [P < 0.001]. **Rhatomy *et al.*** [10] corroborated our findings; they demonstrated that no patients in the peroneus longus tendon group experienced thigh hypotrophy of twenty millimeters, & four patients experienced thigh hypotrophy of ten millimeters. The hamstring tendon group showed considerably more thigh hypotrophy one year following surgery [p = 0.002]. When comparing the hamstring group to the peroneus longus group, the average reduction in donor thigh circumference was 11.4 ± 3.6 millimeters, whereas the difference was 2.5 ± 0.5 mm.

When comparing the peroneus group's ankle function on the donor side to the contralateral side, no statistically significant change was seen [P > 0.05]. There wasn't statistically significant variance in the peroneus group's ankle function among the donor side & the contralateral side, according to our results & those of **Rhatomy S *et al.*** [10]**.** For the donor ankle, the average AOFAS score was 97.3 ± 4.2, with a range of eighty-eight to one hundred. Similarly, the FADI score was 98 ± 3.4, with a range of 85.6 to one hundred.

Conclusion: Surgical procedure involving the replacement of the anterior cruciate ligament using the peroneus longus tendon. showed no statistically significant variance regarding ankle function and pre- and post-operative knee ROM with Benefits of using a bigger graft diameter and less thigh hypotrophy comparable to that of hamstring tendon.

Disclosure:

None to be disclosed.

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