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Comparative Study between Minimally Invasive Quadriceps VS Hamstring Tendon Autografts in Arthroscopic ACL Reconstruction

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ABSTRACT

Background: The anterior cruciate ligament (ACL) is crucial for knee stability, and its rupture is a common injury among young and active individuals. Autograft selection remains a key factor in optimizing surgical outcomes after ACL reconstruction.

Objective: To compare the clinical and functional outcomes of arthroscopic ACL reconstruction using minimally invasive quadriceps tendon (QT) autografts versus hamstring tendon (HT) autografts.

Patients and Methods: This prospective comparative study enrolled 30 patients with ACL-deficient knees who underwent single-bundle arthroscopic ACL reconstruction and were followed for two years. Patients were randomized into HT (n=15) and QT (n=15) groups. Outcomes were assessed using the Lysholm score (eight subscales and total), International Knee Documentation Committee (IKDC) criteria, Lachman test, pivot shift, functional leg hop test, and radiographic evaluation.

Results: Both groups showed significant postoperative improvements. The median Lysholm total score increased from 66 (IQR: 60–73) to 96 (94–100) in the HT group and from 65 (56–73) to 98 (95–100) in the QT group (both P<0.001), with no significant intergroup difference (P=0.761). IKDC parameters including Lachman and pivot shift tests improved significantly within each group (P<0.001), while effusion and extension remained unchanged (P>0.05). Regression analysis revealed that older age (β=−0.58, P=0.017) and longer time-to-surgery (β=−0.31, P=0.042) were negatively associated with Lysholm score improvement, whereas concomitant medial (β=17.09, P=0.001) and lateral meniscal injuries (β=11.42, P<0.001), as well as higher preoperative activity level III (β=11.59, P=0.002), predicted greater improvement.

Conclusion: Arthroscopic ACL reconstruction using either HT or QT autografts provides comparable functional and clinical outcomes.

Keywords: Anterior cruciate ligament, Quadriceps tendon, Hamstring tendon, Autograft, Arthroscopic reconstruction.

INTRODUCTION

The anterior cruciate ligament (ACL), which prevented the tibia from anteriorly shifting in relation to the femur, stabilized the knee. This ailment is among the most prevalent afflictions for active individuals. An injured ACL can result in joint instability, hasten joint degeneration, and inflict damage on the menisci and cartilage. Consequently, surgical reconstruction is essential for certain patients [1].

An essential factor following ACL restoration is the graft's capacity to withstand the necessary stresses for a patient to effectively resume athletic activities. Postoperatively, the tendon graft initiates its integration phase, experiences histological reorganization due to biomechanical Forces, and evolves into a structure akin to that of the normal ACL [2].

ACL rehabilitation uses a variety of graft types. The two most common types are bone-patellar tendon-bone autograft and hamstring autograft. Because of its favorable propensity for bone-to-bone healing, the bone patellar tendon bone autograft is considered the gold standard for ACL rehabilitation, especially among professional athletes. However, it also has some drawbacks, such as knee pain when kneeling, patellofemoral arthritis, anterior knee pain, and weakness in knee extension. This has resulted in an increased prevalence of hamstring tendon autograft utilization. Harvesting the hamstring tendons diminishes the power of deep knee flexion.

Furthermore, the induced dysfunction impairs athletic performance across numerous sports [3].

With multiple studies comparing the clinical outcomes of quadriceps tendon, bone-patellar tendon-bone, and hamstring tendon autografts, interest in quadriceps tendon autograft in ACL restoration has increased [4].

The quadriceps tendon autograft may serve as a viable alternative for primary anterior cruciate ligament restoration. The quadriceps tendon autograft demonstrated a reduced failure rate in comparison to both patellar tendon and hamstring tendon autografts. A lower incidence of anterior knee soreness has been noted in comparison to the patellar tendon autograft [5].

All varieties of grafts employed in contemporary treatment for the reconstruction of a ruptured ACL hold significance in this intricate surgical domain. There is substantial evidence to substantiate all of them. There is no definitive "optimal" transplant to utilize. Nonetheless, there are distinct advantages concerning the various grafts [6].

Comparing the results of arthroscopic ACL rehabilitation using minimally invasive quadriceps tendon autograft with hamstring tendon autograft was the aim of this study.

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PATIENTS AND METHODS

This prospective study involved thirty patients aged from 18 to 40 years with ACL-deficient knees who had arthroscopic anatomic single-bundle ACL restoration in July 2021 and were monitored for two years until August 2023 at Benha University Hospital and Al Ahrar Teaching Hospital.

Inclusion criteria: Symptomatic ACL injury, which occurred more than three weeks previously, extension and flexion range within 5o degree of full range of motion before surgery, and patients may have a concomitant meniscal tear.

Exclusion criteria: The prior cruciate ligament injury or surgery sustained in the affected knee, associated other ligaments injury, degenerative changes in the joint or abnormal bone morphology evident on standard knee radiograph, quadriceps muscle weakness, and varus or valgus knee deformities.

All patients underwent clinical evaluation (History [pre-injury sport and level of activity and previous knee problems and surgeries and the cause of injury, history of giving way, locking, hemoarthrosis, and any associated medical problems]. Examination of the patients [Clinical examination, Range of motion], Imaging (Plain films, Magnetic resonance imaging), Operative technique (Harvesting the tendons, Preparation of the graft, Portals, Notch preparation, Femoral tunnel drilling, Tibial tunnel, Graft passage, Graft tensioning and tibial fixation).

Operative technique:

All repair procedures were conducted under spinal anesthetic and utilized a well-padded thigh tourniquet. All patients had examination under anesthesia prior to ACL repair. All patients were administered one gram of ceftriaxone intravenously 30 minutes before to the operation. At first diagnostic arthroscopy was performed to verify the diagnosis and evaluate further pathological conditions. The anterior cruciate ligament remnant underwent debridement.

Hamstring tendons (gracilis and semitendinosus):

On the operating table, the patient was positioned in a supine position. The leg was externally rotated, and the knee was flexed at an angle of 60 degrees. The gracilis and semitendinosus were resected by a 4 cm oblique incision, commenced 2 cm medial to and directly distal to the tibial tuberosity. The subcutaneous tissue and adipose tissue were meticulously separated to reveal the fascia of the sartorius muscle. Upon identification, the aponeurosis was incised along the alignment of its distal fibers. The gracilis and semitendinosus muscles can be discerned through palpation. The gracilis is cylindrical and discernible beneath the sartorius, while the semitendinosus is more flattened and located inferiorly to the gracilis. Upon identification of the tendons, they may be liberated utilizing a curved clamp. A stripper is employed to extract the tendons. The periosteal insertion is distinctly separated from the tibia, resulting in an increased length of 2 cm.

Quadriceps tendon: The quadriceps free tendon's middle portion was utilized. A 3 cm longitudinal incision is made starting at the patella's superior pole and running proximally down the quadriceps tendon to extract the autograft. Or obtained by 1cm transverse incision by quadriceps Harvesting system. The quadriceps tendon is fully visible from medial to lateral. An 8 to 10 mm wide, 7 to 8 mm thick, 90 to 110 mm long strip of tendon is excised.

Preparation of the graft: Hamstring tendon: The tendons were taken to the graft station. The muscle fibers were removed using scalpel or scissor taking care not to cut the tendon itself. The 2 tendons were folded together in a double loop. The free ends of the tendons were individually sutured using Ethibond suture No. 2, employing an ascending and descending technique to securely fasten the loop ends across a distance of 2 cm.

Quadriceps tendon: The graft is subsequently sized and prepared with Ethibond No. 5 at both ends. Initially, the tendon was cleansed of adipose tissue, and each free end of the graft was marked with Ethibond suture No. 2, which was interlaced in an ascending and descending manner to securely fasten the loop ends. The graft was pre-sized utilizing sizing tubes.

Portals: The surgery involves three arthroscopic portals. The auxiliary medial portal is used to drill the femoral tunnel, the anteromedial portal as a viewing gateway, and the anterolateral portal for visualization during diagnostic arthroscopy. Using a No. 11 blade, a high lateral portal was created at the patella's inferior pole as near to the patellar tendon's lateral border as feasible. To generate the AM portal, a spinal needle was introduced into the knee joint, as close to the patella's inferior pole and medial edge. A spinal needle that was placed as low as possible, just above the medial meniscus and away from the medial femoral condyle, was used to generate the AAM portal.

Notch preparation: Notch preparation was conducted concurrently with graft preparation at the back table, following these steps: Excision of the ligamentum mucosum to enhance visibility. employing a motorized 5.5 mm full radius shaver to resect the remaining ACL tissue.

The lateral notch wall's soft tissue is eliminated, but the bony landmarks on the lateral femoral condyle's medial wall remain intact. Notchplasty.

Femoral tunnel drilling: The femoral tunnel was drilled prior to the tibial tunnel. The arthroscope was relocated to the anteromedial portal to inspect the medial portion of the lateral femoral condyle. To mark the position of the femoral tunnel at the middle of the ACL footprint, a microfracture awl was placed into the AAM portal. A 2.7 mm guide pin was introduced via the (AAM) portal to the selected femoral tunnel site while the knee was in 110° of flexion.

A 4.5 mm endobutton drill bit was utilized to penetrate the femoral cortex and form the femoral tunnel. The length of the endobutton loop was estimated by measuring the length of the femoral tunnel using a specific depth gauge. An arthroscopic drill bit was used to form the femoral tunnel, which was customized to the graft's diameter and length, while leaving at least 6-7 mm of the lateral femoral cortex intact. Insert the looped end of a 2 vicryl suture into the slotted end of the 2.7 mm guide pin and run the suture's free ends through the lateral soft tissue to ensure that it remains inside the ACL femoral tunnel.

Tibial tunnel: In order to bring the arthroscope to the AL portal, the knee was flexed to a 70- to 90-degree angle. At a 55° angle, an AcuFex director ACL tip aimer was inserted into the knee joint via the AM or AAM portal. Approximately 2-3 mm anterior to the posterior margin of the anterior horn of the lateral meniscus and somewhat medial to the midline of the ACL tibial attachment site were the aimer's tips. A precise placement of a guide pin was made using a 2.4 mm drill tip. Following confirmation of the precise position of the guide pin, the tibial tunnel was constructed using a completely fluted cannulated drill bit.

Graft passage:
Using an arthroscopy probe or grasper, the suture loop that remained in the ACL femoral tunnel was extracted, and it was then extracted through the tibial tunnel. When the graft reached the end of the femoral tunnel, the endobutton was flipped after the suture was passed through the loop and pulled into the lateral thigh.

Graft tensioning and tibial fixation: The graft was preloaded with 8 kg and subjected to 30 cycles. While the knee was bent 20 to 30 degrees and the proximal tibia was under back pressure, the tibial side was fixed with an interference bioabsorbable screw. After inserting the arthroscope into the anterolateral portal to evaluate roof impingement and graft tension, a suction drain was inserted.

Postoperative care: The patients were hospitalized for two days following surgery. The limb was raised on a pillow to facilitate passive knee extension. Diclofenac sodium 50 mg pill was administered bi-daily for one week. Ceftriaxone 1 gm IV was administered as a prophylactic antibiotic for 2-3 days. The suction drains were extracted after 48 hours. The patient was discharged on the third day.

Ethical considerations:
This prospective comparative study was approved by the Research Ethics Committee, Faculty of Medicine, Benha University. All patients provided written informed consent prior to participation. The consent form described the study objectives, procedures, potential risks and benefits, the voluntary nature of participation, the right to withdraw at any stage, and permission for the publication of de-identified data and relevant imaging. Confidentiality and privacy were preserved by assigning coded identifiers and restricting data access to the research team. No personal identifiers appear in the study report. The study was carried out in accordance with the ethical principles of the Declaration of Helsinki for research involving human subjects.

Statistical analysis
For statistical analysis, SPSS version 28 (IBM Corporation, Armonk, NY, USA) was utilized. Using the Shapiro-Wilk test, the data distribution's normality was evaluated. The median and interquartile range (IQR) were employed to express quantitative non-parametric data, which were evaluated using the Mann-Whitney test. To analyze the frequency and percentage (%) of categorical data, the Chi-square test or Fisher's exact test, as appropriate, was employed. Using the Wilcoxon signed-rank test, preoperative and postoperative score grades were compared within each group. To assess several factors associated with the postoperative improvement in the Lysholm score, a linear regression analysis was employed. Less than 0.05 was considered statistically significant for a two-tailed P value.

RESULTS
Age, sex distribution, side and mechanism of injury, occupation, meniscal injury, and time interval before surgery did not significantly differ between the HT and QT groups. In both patient groups (HT and QT), the degree of activity was consistent before and after surgery. No significant difference was seen between the two groups, both preoperatively and postoperatively **(Table 1)**.

Table (1): Baseline characteristics, pre and postoperative activity level of the studied groups

Variables		HT group (n=15)	QT group (n=15)	P value
Age (years)		21 (20 - 26)	27 (21 - 29)	0.145
Sex	**Male**	15 (100%)	13 (86.7%)	0.483
	Female	0 (0%)	2 (13.3%)	
Side of injury	**Right**	9 (60%)	9 (60%)	>0.999
	Left	6 (40%)	6 (40%)	
Occupation	**Student**	9 (60%)	5 (33.3%)	0.287
	Manual worker	2 (13.3%)	4 (26.7%)	
	Employer	2 (13.3%)	1 (6.7%)	
	Butcher	1 (6.7%)	0 (0%)	
	Driver	1 (6.7%)	3 (20%)	
	Farmer	0 (0%)	1 (6.7%)	
	Housewife	0 (0%)	1 (6.7%)	
Meniscal injury	**No**	7 (46.7%)	6 (40%)	0.931
	LM	1 (6.7%)	1 (6.7%)	
	MM	7 (46.7%)	8 (53.3%)	
Time interval before surgery (m)		6 (4 - 12)	6 (4 - 9)	0.646
Mechanism of injury	**Daily activity**	2 (13.3%)	2 (13.3%)	0.097
	Sport	11 (73.3%)	6 (40%)	
	Traffic	2 (13.3%)	4 (26.7%)	
	Work	0 (0%)	3 (20%)	
Preoperative	I	10 (66.7%)	6 (40%)	0.526
	II	2 (13.3%)	4 (26.7%)	
	III	2 (13.3%)	3 (20%)	
	IV	1 (6.7%)	2 (13.3%)	
Postoperative	I	9 (60%)	6 (40%)	0.732
	II	3 (20%)	4 (26.7%)	
	III	1 (6.7%)	2 (13.3%)	
	IV	2 (13.3%)	3 (20%)	
P value (pre vs post)		0.157	0.317	

Data is expressed as the Median (IQR) or frequency (%), **HT:** Hamstrings tendon, **QT:** Quadriceps tendon, **MM:** medial meniscus, lateral meniscus, **Activity levels: Level I:** vigorous, **Level II:** moderate, **Level III:** light, and **Level IV:** sedentary.

Lysholm score was assessed based on 8 subjective categories. In each group (patients subjected to reconstruction using HT and those using QT), the scores of limp, locking, instability, pain, swelling and squatting were significantly increased postoperatively than preoperatively (P<0.05), moreover, support and stair climbing scores were comparable between before and after surgery. The overall score greatly improved post-surgery (P<0.001). The comparison between the two groups, both preoperatively and postoperatively, demonstrated no significant differences across all eight categories and the overall score**. Table 2**

Table (2): Pre and postoperative Lysholm score of the studied groups

Variables		HT group (n=15)	QT group (n=15)	P value (HT vs QT)
Limp	Pre	5 (3 - 5)	5 (3 - 5)	0.246
	Post	5 (5 - 5)	5 (5 - 5)	0.15
P value (pre vs post)		0.046*	0.025*	
Support	Pre	5 (5 - 5)	5 (5 - 5)	>0.999
	Post	5 (5 - 5)	5 (5 - 5)	>0.999
P value (pre vs post)		>0.999	>0.999	
Locking	Pre	10 (6 - 15)	10 (6 - 15)	0.76
	Post	15 (15 - 15)	15 (15 - 15)	0.317
P value (pre vs post)		0.004*	0.003*	
Instability	Pre	15 (10 - 15)	15 (15 - 15)	0.697
	Post	25 (25 - 25)	25 (25 - 25)	>0.999
P value (pre vs post)		<0.001*	<0.001*	
Pain	Pre	15 (10 - 15)	15 (10 - 15)	0.464
	Post	25 (20 - 25)	25 (20 - 25)	>0.999
P value (pre vs post)		<0.001*	<0.001*	
Swelling	Pre	6 (6 - 6)	6 (2 - 6)	0.981
	Post	10 (10 - 10)	10 (10 - 10)	0.63
P value (pre vs post)		<0.001*	0.002*	
Stair climbing	Pre	10 (10 - 10)	10 (6 - 10)	0.369
	Post	10 (10 - 10)	10 (10 - 10)	0.55
P value (pre vs post)		>0.999	0.083	
Squatting	Pre	4 (2 - 5)	4 (4 - 4)	0.787
	Post	5 (4 - 5)	5 (5 - 5)	0.073
P value (pre vs post)		0.007*	0.002*	
Total score	Pre	66 (60 - 73)	65 (56 - 73)	0.382
	Post	96 (94 - 100)	98 (95 - 100)	0.761
P value (pre vs post)		<0.001*	<0.001*	

Data are provided as median (interquartile range); *: Statistically significant with a P value < 0.05. HT: Hamstrings tendon, QT: Quadriceps tendon.

Total score grades of all cases in either group were poor and fair before surgery which were significantly improved postoperatively to be good and excellent (P<0.001). Both groups were comparable pre and postoperatively. As regards IKDC Questionnaire in each group (patients subjected to reconstruction using HT and those using QT), Lachman test results, Pivot shift and Functional leg hop test results, therefore the final grades, were significantly improved after surgery than before surgery (P<0.05). On the other hand, effusion and lack of extension grades were comparable pre and postoperatively. Noteworthy, flexion and X-ray results were normal in all patients. There was no significant difference between the two groups for all IKDC values both preoperatively and postoperatively. **Table 3**

Table (3): Pre and postoperative total Lysholm score grades and Pre and postoperative IKDC score of the studied groups

Variables			HT group (n=15)	QT group (n=15)	P value (HT vs QT)
Total score		Pre			
		Poor	5 (33.3%)	7 (46.7%)	0.456
		Fair	10 (66.7%)	8 (53.3%)	
		Post			
		Good	4 (26.7%)	3 (20%)	>0.999
		Excellent	11 (73.3%)	12 (80%)	
P value (pre vs post)			<0.001*	<0.001*	
Effusion	**Pre**	A	14 (93.3%)	14 (93.3%)	>0.999
		B	1 (6.7%)	1 (6.7%)	
	Post	A	14 (93.3%)	15 (100%)	>0.999
		B	1 (6.7%)	0 (0%)	
P value (pre vs post)		>0.999	0.317		
Lack of extension	**Pre**	A	14 (93.3%)	15 (100%)	>0.999
		C	1 (6.7%)	0 (0%)	
	Post	A	15 (100%)	15 (100%)	---
P value (pre vs post)		0.317	---		
Lack of flexion	**Pre**	A	15 (100%)	15 (100%)	---
	Post	A	15 (100%)	15 (100%)	---
Lachman test	**Pre**	B	5 (33.3%)	3 (20%)	0.682
		C	10 (66.7%)	12 (80%)	
	Post	A	13 (86.7%)	14 (93.3%)	>0.999
		B	2 (13.3%)	1 (6.7%)	
P value (pre vs post)		<0.001*	<0.001*		
Pivot shift	**Pre**	A	5 (33.3%)	7 (46.7%)	0.211
		B	8 (53.3%)	8 (53.3%)	
		C	2 (13.3%)	0 (0%)	
	Post	A	14 (93.3%)	15 (100%)	>0.999
		B	1 (6.7%)	0 (0%)	
P value (pre vs post)		0.002*	0.005*		
X-ray	**Pre**	A	15 (100%)	15 (100%)	---
	Post	A	15 (100%)	15 (100%)	---
Functional leg hop test	**Pre**	B	1 (6.7%)	2 (13.3%)	0.697
		C	12 (80%)	10 (66.7%)	
		D	2 (13.3%)	3 (20%)	
	Post	A	13 (86.7%)	14 (93.3%)	>0.999
		B	2 (13.3%)	1 (6.7%)	
P value (pre vs post)		<0.001*	<0.001*		
Final Grade	**Pre**	B	1 (6.7%)	2 (13.3%)	0.697
		C	12 (80%)	10 (66.7%)	
		D	2 (13.3%)	3 (20%)	
	Post	A	12 (80%)	13 (86.7%)	>0.999
		B	3 (20%)	2 (13.3%)	
P value (pre vs post)		<0.001*	<0.001*		
Postoperative graft site pathology		A	14 (93.3%)	14 (93.3%)	>0.999
		B	1 (6.7%)	1 (6.7%)	

Data are provided as frequency (%), *: Statistically significant with a P value < 0.05; HT: Hamstrings tendon. QT: Quadriceps tendon. IKDC: The International Knee Documentation Committee. Grade A: Normal; Grade B: Nearly normal.

Results from simple regression analysis indicated a significant correlation between meniscal injury incidence and Lysholm score outcomes, as patients with MM and LM injuries exhibited greater enhancements in Lysholm scores post-surgery (coefficient=15.15, 95% CI: 6.74 to 23.56, P=0.001) and (coefficient=13.35, 95% CI: 9.16 to 17.55, P<0.001), respectively.

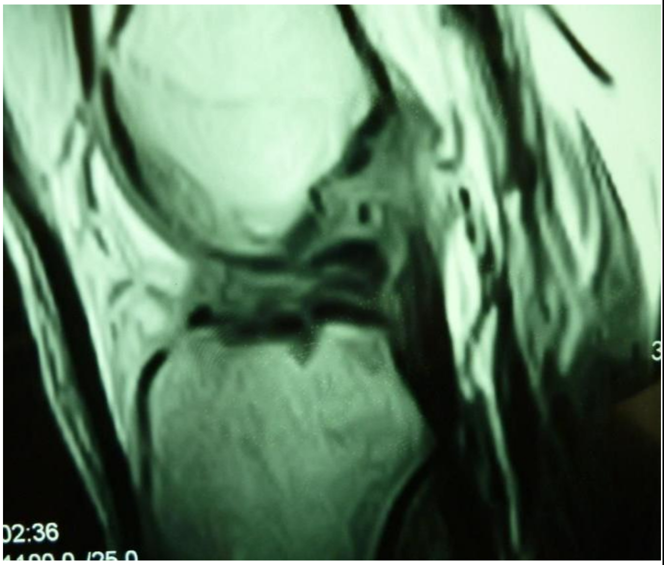
In multiple regression analysis, age and the time interval before to surgery exhibited a significant negative correlation with the enhancement of the Lysholm score post-surgery (coefficient= -0.58, 95%CI: -1.05 to -0.12, P=0.017) and (coefficient= -0.31, 95%CI: -0.6 to -0.01, P=0.042), respectively. Meniscal injury had a substantial correlation with Lysholm score outcomes, as patients with MM and LM injuries exhibited markedly greater enhancements in Lysholm scores compared to others (coefficient=17.09, 95% CI: 8.13 to 26.06, P=0.001) and (coefficient=11.42, 95% CI: 7.34 to 15.5, P<0.001), respectively. Patients with level III activity before to surgery had a substantially greater enhancement in Lysholm score compared to those with level I (coefficient=11.59, 95% CI: 4.77 to 18.42, P=0.002). **Table 4**

Table (4): Linear regression model analyzing variables associated with the enhancement of Lysholm score post-surgery

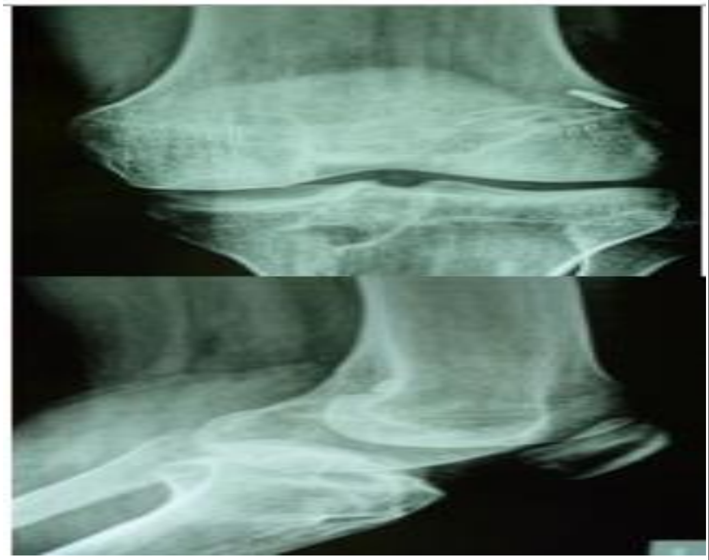
Variables	**Univariate analysis**			**Multivariable analysis**		
	Coefficient	95%CI	P value	Coefficient	95%CI	P value
Technique						
HT	Ref			Ref		
QT	1.47	-5.06 to7.99	0.649	1.57	-2.03 to 5.17	0.369
Age (years)	-0.29	-0.93 to 0.35	0.364	-0.58	-1.05 to -0.12	0.017*
Sex						
Male	Ref			Ref		
Female	5.86	-7.08 to18.79	0.361	-2.69	-11.03 to 5.65	0.504
Side of injury						
Right	Ref			Ref		
Left	0.5	-6.18 to 7.18	0.879	2.26	-1.45 to 5.97	0.215
Meniscal injury						
No	Ref			Ref		
MM	15.15	6.74 to 23.56	0.001*	17.09	8.13 to 26.06	0.001*
LM	13.35	9.16 to 17.55	<0.001*	11.42	7.34 to 15.5	<0.001*
Time interval before surgery (m)	-0.27	-0.74 to 0.2	0.25	-0.31	-0.6 to -0.01	0.042*
Mechanism of injury						
Daily activity	Ref			Ref		
Sport	8.28	-1.38 to17.94	0.09	6.37	-2.33 to 15.08	0.14
Traffic	7.08	-4.13 to 18.3	0.206	4.98	-1.26 to 11.21	0.11
Work	11.75	-1.52 to25.02	0.08	3.68	-4.69 to 12.05	0.365
Level of activity						
I	Ref			Ref		
II	-0.65	-9.23 to 7.94	0.878	1.77	-6.59 to 10.12	0.66
III	5.69	-3.5 to 14.88	0.215	11.59	4.77 to 18.42	0.002*
IV	4.02	-7.26 to 15.3	0.47	5.63	-3.16 to 14.41	0.193

CI: Confidence interval, *: Statistically significant as P value<0.05.

Male student patient 21 years old. With complaint of recurrent giving way of the left knee after twisting injury during playing football 3 months before the operation**. Figure 1**



(A)



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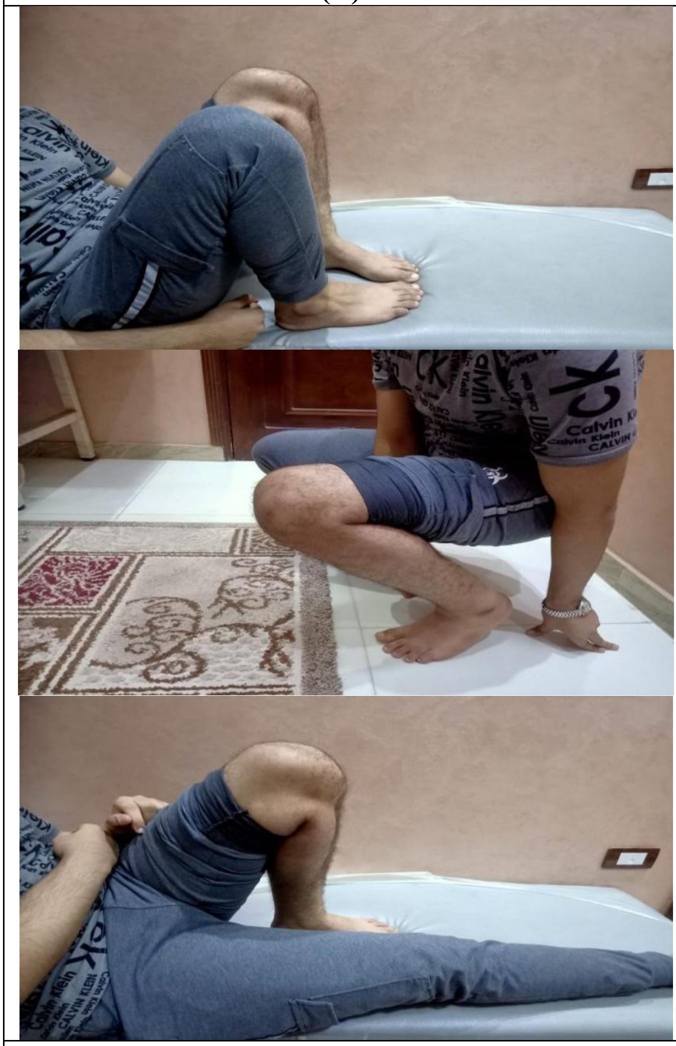

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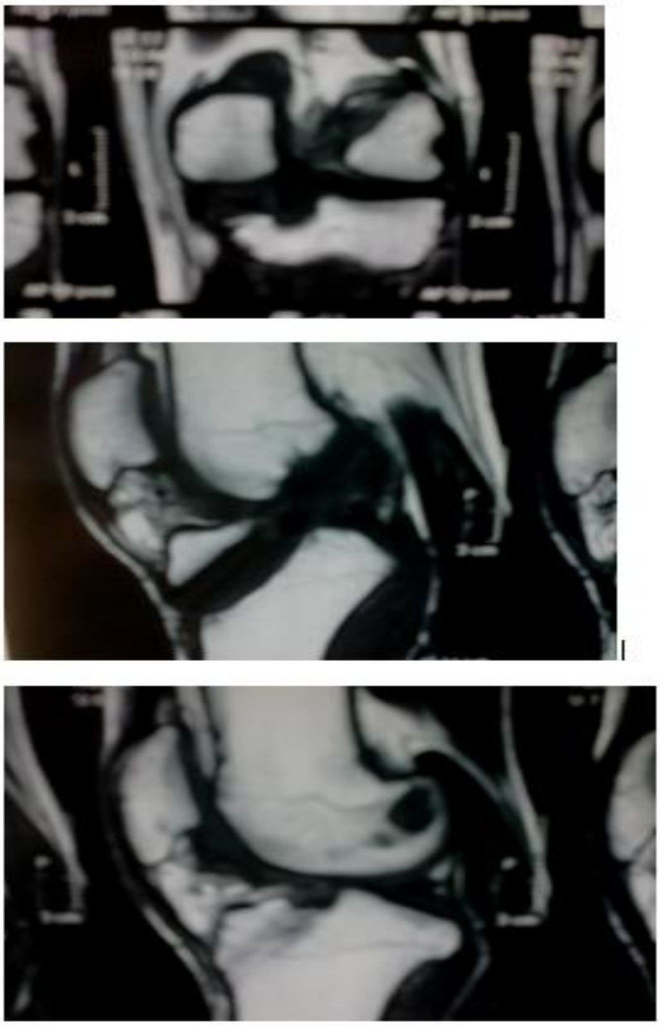

(D)

Figure (1): (A) Pre-operative MRI showing ACL tear, (B) postoperative X-ray showing position of the femoral and tibial tunnels (C) at the end of follow up Full range of motion and (D) 4 months Postoperative MRI showing graft position and tunnel position

DISCUSSION

Injuries to the ACL are common and often lead to serious problems. They can happen to people of all ages, especially those who play sports or do physical work. The ACL is a key ligament that helps support the knee joint. When it gets damaged, it can cause major issues with knee function and increase the chance of developing osteoarthritis. Because of this, ACL reconstruction surgery has become a widely accepted treatment to help restore knee stability and function [7].

There were no notable changes between the HT and QT groups in terms of patient demographics, according to the current study. About meniscal damage, age, gender distribution, injury mechanism and side effects, occupation, and time before surgery.

In a comparison study, **Schagemann *et al.*** [8] looked at whether taking a hamstring graft affects the knee's ability to stabilize and the strength during movement, especially in terms of valgus motion, compared to using a quadriceps graft or the non-operated leg. They found no noticeable differences between the groups that received hamstring and quadriceps grafts when it came to body mass index, weight, height, or age.

Even though the current study shows both groups had similar activity levels, it's still important to note that how well someone recovers function after surgery can be affected by other factors besides the type of graft used. Things like having other injuries, damage to the meniscus, and how much the knee is unstable can all play a role in how much someone improves after the operation.

Previous studies by Westermann and others showed how important it is to look for and fix meniscal injuries at the same time as ACL reconstruction. They stressed that handling meniscal tears during the surgery helps lead to better overall results [9].

In this study, the Lysholm score was evaluated based on 8 subjective categories. In each group (patients who underwent reconstruction using HT and those who used QT), the scores for limps, locking, instability, pain, swelling, and squatting were significantly higher after surgery compared to before the procedure ($P<0.05$), moreover, support and stair climbing scores were comparable between before and after surgery. The overall, total score was significantly improved post-surgery ($P<0.001$). The comparison between both groups pre and postoperatively revealed no statistically significant difference in terms of all 8 categories and total score.

Interestingly, **Schagemann *et al.*** [8] reported that for both groups the functional scores were exceptional in the follow-up evaluation. The differences in overall functional scores and subcategory scores were not statistically significant (overall Lysholm score $p = 0.18$; overall Knee Injury and Osteoarthritis Outcome Score (KOOS) score $p = 0.82$), except for a small but significant benefit for the HS group in the Lysholm score related to climbing stairs ($p = 0.04$).

The significant improvement in specific categories of the Lysholm score, such as limps, locking, instability, pain, swelling, and squatting, indicates the successful reduction of these symptoms following ACL reconstruction. These results align with other research indicating that ACL reconstruction surgery effectively reduces pain, enhances knee stability, and improves functional outcomes. **Kotsifaki *et al.*** [10] conducted research that demonstrated significant improvements in pain, edema, and instability ratings after ACL restoration with various graft types.

Interestingly, the present study found comparable support and stair climbing scores before and after surgery within each group. Similar findings were reported in a study by **Ajrawat *et al.*** [11] did a study comparing HT and QT autografts and found that there were no big differences in the support or stair climbing scores between the two types of grafts.

The research revealed no statistically significant differences between the HT and QT groups in any of the eight Lysholm score categories or the total score, both preoperatively and postoperatively. This aligns with a meta-analysis by **Runer *et al.*** [12] which evaluated the results of several graft types and found no significant changes in Lysholm ratings between the HT and QT groups. The lack of significant differences between the two graft types suggests that both HT and QT autografts can yield comparable improvements in subjective knee function following ACL reconstruction.

In the current work, the total score grades of all cases in either group were poor and fair before surgery which were significantly improved postoperatively to be good and excellent ($P<0.001$). Both groups were comparable pre and postoperatively.

Several studies have reported significant improvements in functional outcomes, as assessed by various scoring systems, following ACL reconstruction surgery [13, 14].

As regards IKDC Questionnaire in each group (patients subjected to reconstruction using HT and those using QT), Lachman test results, Pivot shift and Functional leg hop test results, therefore the final grades, were significantly improved after surgery than before surgery ($P<0.05$). On the other hand, effusion and lack of extension grades were comparable pre and postoperatively. Significantly, flexion and X-ray findings were normal in all cases. There wasn't a significant difference in the IKDC scores between the two groups, whether before or after the surgery.

Consistent with the present study, **Makhni *et al.*** [15] investigated the results of ACL restoration utilizing hamstring autografts and observed substantial enhancements in IKDC scores, alongside reduced laxity in Lachman and Pivot shift assessments. Similarly, **Schagemann *et al.*** [8] conducted a systematic study to compare the outcomes of HT and QT grafts and concluded that both graft types resulted in significant increases in functional outcomes as measured by various clinical measures.

Regarding effusion and lack of extension grades, the current investigation disclosed no significant differences between the preoperative and postoperative assessments. This discovery aligns with prior studies that has reported limited improvements in effusion and full range of motion following ACL reconstruction. **Han *et al.*** [(16)], investigated the outcomes of ACL reconstruction and found that while most patients experienced enhancements in knee stability and functional scores, there were minimal changes in effusion and extension deficits.

Based on the results of simple regression analysis in our study, the incidence of meniscal injury was significantly associated with Lysholm score results as patients with MM and LM injury had better improvement in Lysholm score than others after surgery (coefficient=15.15, 95% CI: 6.74 to 23.56, P=0.001) and (coefficient=13.35, 95% CI: 9.16 to 17.55, P<0.001) respectively.

Frobell *et al.* [(17)], investigated the impact of meniscal tears on patient-reported outcomes indicated that the existence of meniscal tears correlated with worse knee function and an elevated likelihood of functional deterioration.

Another study by **Wright *et al.*** [(18)] assessed the impact of concomitant meniscal injuries on patient-reported outcomes and reported that patients with meniscal injuries had lower postoperative functional scores compared to those without meniscal injuries.

In multiple regression analysis, age and time interval before surgery were significantly negatively associated with the improvement in Lysholm score after surgery (coefficient= -0.58, 95% CI: -1.05 to -0.12, P=0.017) and (coefficient= -0.31, 95% CI: -0.6 to -0.01, P=0.042), respectively. Meniscal injury was significantly associated with Lysholm score results as patients with MM and LM injury had significantly better improvement in Lysholm score than others (coefficient=17.09, 95% CI: 8.13 to 26.06, P=0.001) and (coefficient=11.42, 95% CI: 7.34 to 15.5, P<0.001) respectively. Also, patients with level III of activity before surgery had significantly better improvement in Lysholm score than those with level I (coefficient=11.59, 95% CI: 4.77 to 18.42, P=0.002) [(19)].

Limitations of the study:

This research used a small group of 30 cases, which made it hard to apply the findings to a larger population and affected the strength and accuracy of the results. The study was based on past data, which can introduce biases and have limitations in how information is gathered and understood. The follow-up period was short, which made it difficult to assess long-term outcomes and how well the HT and QT autografts last over time.

CONCLUSIONS

The selection of HT versus QT autografts in ACL repair procedures yielded no significant disparities in clinical outcomes or functional recovery. Both the HT and QT groups exhibited comparable enhancements in activity level, Lysholm score, and IKDC characteristics post-surgery. Patients with meniscal injuries, specifically MM and LM injuries, demonstrated significant enhancement in the Lysholm score post-surgery. Age, the duration prior to surgery, and preoperative activity level were recognized as determinants affecting postoperative results. The data indicate that both HT and QT autografts are feasible alternatives for ACL restoration, demonstrating similar efficacy in facilitating recovery and function.

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