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Arthroscopic Anatomic Single Bundle Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon

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Abstract

Background: Anatomical single bundle arthroscopic Anterior cruciate ligament (ACL) reconstruction has been the standard treatment for ACL injured patients. It is a minimally invasive procedure that allows the surgeon tounderstand the internal derangements of the knee joint. The purpose of Arthroscopic ACL reconstruction is to restore the normal kinematics of knee joint. The aim of the current study was evaluation of the results of anatomic single bundle anterior cruciate ligament reconstruction using hamstring tendon. Patients and methods: prospective clinical study was conducted in Orthopedic Department, Faculty of Medicine, Zagazig University, on 24 patients (18 males and 6 females with mean age 30.16±5.9) with chronic ACL tear treated with the hamstring tendon for reconstruction of the anterior cruciate ligament in all patients during the period from April 2020 to April 2021. Results: Grade of Lysholm score improved significantly postoperatively, where 17 patients were excellent, 5 patients were good, and 2 patients were fair. IKDC SCORE was improved from 45.83±7.46 preoperatively to 78.12±6.04 postoperatively. There were 19 patients without complication, 4 patients had superficial infection and 1 patient had deep infection. Conclusion: The anatomic anterior cruciate ligament reconstitution using hamstring tendon is more effective for reproducing the anatomy of the ACL and obtaining good clinical results, when it is done by accessory medial portal because the technique enables for a better view inside the knee and more obliquity of the reconstructed ACL when compared to the transtibial technique.

Keywords: anterior cruciate ligament, anatomic reconstruction, clinical outcomes

INTRODUCTION

Anterior Cruciate Ligament (ACL) rupture is one of the most frequent orthopedic sport injuries, with a yearly incidence of 30 to 80 in 100,000 according to 21- year population based study[1].

Unlike many tendons and ligaments, a mid-substance (ACL) tear cannot heal and presented with moderate to severe disability with "giving way" episodes in activities of daily living, especially during sport activities. Further, cause rotational

instability which lead to other soft tissues injuries in the knee, particularly the menisci, and lead to early onset knee osteoarthritis[2].

Anterior Cruciate Ligament (ACL) is comprised of two bundles which are named for their relative insertion sites on the tibia: anteromedial and posterolateral bundle[3].

Anatomic ACL reconstruction provide better (vertical) antroposterior stability and (oblique) rotational stability than transtibial technique[4].

Anatomic single-bundle ACL reconstruction using a hamstring autograft is a gold standard technique[5].

Single bundle is common than two bundle ACL reconstruction as it is technically demanding , time consuming and need expert[6].

The aim of the study was to evaluate of the results of anatomic single bundle anterior cruciate ligament reconstruction using hamstring tendon.

PATIENTS AND METHODS

This prospective clinical study was conducted in Orthopedic Department, Faculty of Medicine, Zagazig University, on 24 patients with chronic ACL tear treated with the hamstring tendon for reconstruction of the anterior cruciate ligament in all patients. during the period from April 2020 to April 2021.

Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans

Inclusion criteria: Age range >18years and >45years, Initial ACL tear (not having any previous reconstruction).

Exclusion criteria: Patient with open physeal plate (before skeletal maturity). Patients with degenerative changes evidenced radiologically (joint space narrowing). Patients with combined ligamentous injuries. Patients with clinical evidence of mal-alignment (varus or valgus). Previous operation in the same knee.

All patients were subjected to the:

Present history and clinical examination [Mechanism of injury, side affected (Right / Left), Any management done before.

The clinical evaluation was carried out by an experienced blinded examiner in the outpatient clinic just prior to starting the walking tasks, both before and after ACL reconstruction. Participants were evaluated with the Lysholm Knee Scoring Scale and International knee documentation committee score (IKDC) score.

Radiological evaluation:

X-rays: AP and lateral views of the injured and normal knee before and after reconstruction were done.

Magnetic resonance imaging was performed to confirm the ACL tear and to exclude any other knee injuries and after reconstruction for evaluation of graft location, tunnel location, graft signal intensity, graft quality, and graft ligamentization.

Routine Operative Labs: (Complete blood picture, PT, PTT and INR, Random blood sugar, Liver and Kidney function tests.

Lysholm knee score was used for evaluation of subjective criteria. The IKDC knee examination form was used for evaluation of the objective criteria.

Surgical Technique:

Examination under anesthesia was performed for all patients before anterior cruciate ligament reconstruction to ensure anterior cruciate ligament deficiency by positive Lachman and Pivot shift tests. A standard anterolateral portal was created and diagnostic arthroscopy was done to confirm the diagnosis and evaluation of other pathological conditions. Probing of the ACL ligament to determine laxity while performing lachman's maneuver, and management of any meniscal tears was performed before reconstruction of ACL. Then the stump of the ACL was debrided without removal of the fibers that does not form obstacles for proprioception , vascular and cellular ingrowth. The tendons of gracilis and semitendinosus were obtained as an auto graft. The two anteromedial portals were done. A standard anteromedial portal was established close to the patellar tendon, and the far anteromedial portal was created far away from the former portal (-2 cm from the standard anteromedial portel), Appling a needle at a site which permits for using the reamer without affecting the medial femoral condyle. The standard anteromedial portal permits to visualize the medial wall of the lateral femoral condyle by the arthroscope with the knee in110° of flexion; hence, the femoral insertion site of the anterior cruciate ligament and the posterior cortical bone can be found readily. The far anteromedial portal was used for placement of the guide pin at the center of the insertion site of the anterior cruciate ligament on the femur and establishment of the femoral tunnel using an endoscopic drill bit. Placement of a guide pin at the center of the insertion site of the anterior cruciate ligament on the tibia and a drill bit was used to establish the tibial tunnel, preserving the remaining anterior cruciate ligament tissue. Then, passage of the graft through the femoral tunnel was performed. Endobutton was used for fixation of the femoral side ,and bioabsorbable interference screw for fixation of the tibial after cycling of the graft.

Postoperative care:

The patients stayed in the hospital for 2 days postoperatively. The limb was elevated on a pillow to achieve passive knee extension. Diclofenac sodium 50 mg tablet was given twice daily for one week. Prophylactic antibiotic, ceftriaxone 1 gm IV for 2-3 days was given. Suction drains were removed after 48 hours. The patient was discharged in the 3rd day.

Rehabilitation: Postoperatively, all patients followed the accelerated rehabilitation program of Shelbourne and Nitz but without using a CPM machine, , described before.

Follow up: All patients were followed up for 2 years using Lysholm knee score and the IKDC 2000. Also, X-ray (AP) and lateral views for the knee was done for assessment of tunnel position and the degenerative changes.

RESULTS

The mean age of the studied patients was 30.16 ± 5.9 years with minimum 19 years and maximum 40 years (table 1). There were 16 cases had right ACL tear (58.3%), while 8 cases had left ACL tear (33.3%). According to the mechanism of injury 14 cases were sport injury (58.3%), 7 cases were RTA (29.2%), and 3 cases were fall down stairs (12.5%) (Table 2). The time tell intervention was distributed as 29.79±8.14 with minimum 12 and maximum 48 months (Table, 3). IKDC SCORE was improved significantly from 45.83±7.46 to 78.12±6.04 (Table 4). All scores sub-items significantly improved as limb score improved from 2.76±1.36 to 4.50±0.88 and support score from 4.58±0.82 to 5.0±0.0 and regard locking score it changed from 5.91±2.47 to 14.37±1.68 and instability score from 10.83±3.45 and 22.70±3.29 and pain score improved from 14.37±4.73 to 23.95±2.94, swelling improved from 4.58±1.89 to 9.33±1.52 and stair score changed from 8.66±1.92 to 9.83±0.81 and finally squatting score improved from 3.0±0.99 to 4.87±0.33 (Table 5). The total LYSHOLM score improved significantly from 54.33±14.04 to 94.37±8.14 (Table 6). The grade of Lysholm score improved significantly from pre to post as poor score was majority at pre with 75.0% but at post excellent was majority with 70.8% (Table 7). The mean time for return to activity duration was 9.91±2.79 with minimum 6 and maximum 18 weeks (Table 8). There were 5 cases (20.8%) were complicated (4 cases had superficial infection and 1 case had deep infection) (Table 9).

Table (1): Distribution of the studied patients according to age

	Age
Mean± SD	30.16±5.9
Median (Range)	30.0 (19-40)

Table (2): Distribution of the studied patients according to affected side and Mechanism of injury

		N	**%**
Side	Left	8	33.3
	Right	16	66.7
MOI	Sport	14	58.3
	RTA	7	29.2
	Fall	3	12.5
	Total	24	100.0

Table (3): Time interval between injury and intervention distribution among studied group

	Time of intervention/ m
Mean± SD	29.79±8.14
Median (Range)	29.50 (12-48)

Table (4): IKDC total score distribution between pre and postoperative

	Pre	Post	Paired t	P
IKDC SCORE	45.83±7.46	78.12±6.04	24.628	0.00**

Table (5): LYSHOLM score items distribution among studied group pre and post intervention

	Pre	Post	Paired t	P
Limb	2.76±1.36	4.50±0.88	6.133	0.00**
Support	4.58±0.82	5.0±0.0	2.460	0.022*
Locking	5.91±2.47	14.37±1.68	10.563	0.00**
Instability	10.83±3.45	22.70±3.29	16.366	0.00**
Pain	14.37±4.73	23.95±2.94	13.091	0.00**
Swelling	4.58±1.89	9.33±1.52	11.023	0.00**
Stair	8.66±1.92	9.83±0.81	3.077	0.005*
Squatting	3.0±0.99	4.87±0.33	8.537	0.00**

Table (6): Total LYSHOLM score distribution among studied group

	Pre	Post	Paired t	P
Total score	**54.33±14.04**	**94.37±8.14**	**19.477**	**0.00****

Table (7): LYSHOLM score Grade distribution among studied group

		Pre		Post	
		N	%	N	%
Grade	**Poor**	18	75.0	0	0.0
	Fair	5	20.8	2	8.3
	Good	1	4.2	5	20.8
	Excellent	0	0.0	17	70.8

Table (8): Return to activity distribution among studied group

	Return to activity/ W
Mean± SD	9.91±2.79
Median (Range)	9.0 (6-18)

Table (9): Complication distribution among studied group

		N	%
Complication	**Non complicated**	19	79.2
	Complicated	5	20.8
	Total	24	100.0

DISCUSSION

The anterior cruciate ligament (ACL) is one of the most common ligaments injured in the knee which requires surgical intervention. ACL injuries frequently occur in athletes involved in multidirectional sports activities such as basketball and soccer

because ACL is the main anterior stabiliser of the knee and prevents rotational valgus forces [7].

A previous study, published at national level, assessed the use of hamstring autograft technique for ACL reconstruction by open technique with short-term follow up of six months. The study mainly focused on clinical parameters such as stability and range of motion. However, the minimum time required to regain normal function and clinical stability after ACL reconstruction is one year. In addition, the advantages of arthroscopic ACL reconstruction are manifold [8].

Therefore, the purpose of this study was to evaluate the results of arthroscopic anatomic reconstruction of chronic ACL injury using the hamstrings as a free autogenous graft in terms of clinical stability and functional outcome.

The current study showed that the age was distributed as **30.16±5.9** with minimum 19 and maximum 40 years, regard sex distribution male were majority with 75.0%, which in close to the study of **Riad and Ali**[9], who reported that the average age of the patients' was 27.5 years (range, 19 to 42).Twenty patients (83.3%) were males and four (16.7%) were females.

Hussein et al., [10] reported that the mean age of Anatomic Single-Bundle group (n = 78) was 34.2 (16-63) and 46 (59%) patients were males and 32 (41%) were females.

In a prospective study by **Kim et al**. [11], patients who had complete ACL tear were treated by anatomic single bundle ACL reconstruction, the mean age was 29.8 (17-58 years), sex distribution was 25 males (75.7%) and 8 females (24.3%).

The current study showed that the Majority were right sided and the major cause of injury was sport followed by road traffic accident (RTA) then fall, there were 54.2% of studied group had associated injuries.

Fahmy et al., [12] reported that according the site of injury; Nineteen patients had their ACL injury in the left knee (63.3%), while eleven patients had their ACL injury in the right knee (36.7%) and according to the **Mechanism of injury;** Fifteen patients (50%) in this study were injured while participating in sports, five patients (16.7%) were injured due to traffic accident, five patients (16.7%) were injured at work and five patients (16.7%) were injured during daily activity**.**

Kassem et al., [13] reported that in arthroscopic anatomic single-bundle group (n = 76), Right injuries recorded in 59 cases (77.6%) and left injuries recorded in 17cases (22.4%), regarding **Mechanism of injury,** pivoting noncontact sport was recorded in 50 cases (65.8%), Contact sport was recorded in 9 (11.8%), Traffic accident in 5 cases (6.6%), work injuries in 7 (9.2) and Activity of daily living injuries in 5 cases (6.6) which is far from the current results.

Chen et al., [5] reported that sports injury was reported in 222 cases (71%), Traffic accident in 59 cases (19%) and fall in 31 cases (10%).

The current study showed that the time tell intervention was distributed as 29.79±8.14 with minimum 12 and maximum 48 months.

Kassem et al., [13] reported that in arthroscopic anatomic single-bundle group (n = 76), the time interval between injury and operation (months) was (7.65 ± 2.68) which is far from the current results.

Fahmy et al., [12] reported that the time interval before surgery in this study was between 1.5 and 72 months with a mean of 17.9 ± 20.2 months.

The current study showed that all scores sub-items significantly improved as limb score improved from 2.76±1.36 to 4.50±0.88 and support score from 4.58±0.82 to 5.0±0.0 and regard locking score it changed from 5.91±2.47 to 14.37±1.68 and instability score from 10.83±3.45 and 22.70±3.29 and pain score improved from 14.37±4.73 to 23.95±2.94, swelling improved from 4.58±1.89 to 9.33±1.52 and stair score changed from 8.66±1.92 to 9.83±0.81 and finally squatting score improved from 3.0±0.99 to 4.87±0.33.

Fahmy et al., [12] reported that the results for the Lysholm score have shown significant improvement of the **Limp** as it was found that the mean for preoperative was **3.5 (SD±0.9)** show improvement postoperative mean **4.7**(SD**±0.7);** also for **Locking Sensation** In The Knee from preoperative mean **7.8** (SD **±4.3)** to postoperative mean **14.8** (SD **±0.9);** also for **swelling** from preoperative mean **3.9** (SD **±2.7)** to postoperative mean **9.5**(SD **±1.4);** also for **Giving Way Sensation From The Knee (Instability)** from preoperative mean **9** (SD**±3.7)** to postoperative mean **24.2** (SD**±2.3);** also for **Climbing Stairs** from preoperative mean **8.8** (SD**±1.9)** to postoperative mean **9.6** (SD **±1.2);** also for **Squatting** from preoperative mean **2.9** (SD**±1.1)** to postoperative mean **4.8** (SD**±0.4),** and for comparison between **pre and post total mean for lysholm score** show improvement from preoperative **53(SD±13)** to postoperative **93.4 (SD±16.8).**

The current study showed that Total LYSHOLM score improved significantly from 54.33±14.04 to 94.37±8.14 which agreement with the study of **Fahmy et al.,** [12] **reported** that the pre and post total mean for lysholm score showed high significant improvement from preoperative (53±13) to postoperative (93.4±16.8).

Also, **Shaikh et al.** [14] reported that the Mean preoperative Lysholm score was 34.5 ± 10.8) which improved to 90.7 ± 9.1 (p-value <0.005) after surgery at the last follow up which similar to our results.

Also, in accordance with the current study, **Chen et al.,** [5] reported that the Mean preoperative Lysholm score was (56.4±10.2) which improved to 94.5±8.4 (p-value <0.01).

Hussein et al., [10] reported that in the group of Anatomic single-bundle reconstruction (n=78) the mean preoperative Lysholm score was (73.6± 12.8) which improved to (91.8± 4.3) (p-value <0.01).

Morey et al., [15], found that the mean preoperative Lysholm score was (66.2 ± 12.45) and the mean Lysholm scores was (83.5± 3.3) with a statistical significant improvement between the preoperative and postoperative scores in both the groups (p<0.05).

The current study showed that Grade of Lysholm score improved significantly from pre to post as poor score was majority at pre with 75.0% but at post excellent was majority with 70.8%.

Senthillkumar and Rajmohan [16] reported that Grade of Lysholm score improved significantly postoperatively where, good to excellent results was observed in 80 % of the cases as Excellent reported in 8 patients (53.4%), Good in 4 patients (26.6%), Fair in 2 patients (13.3%) and Poor in one patients (6.7%).

In a prospective study by **Kim et al** [11], patients who had complete ACL tear were treated by anatomic single bundle ACL reconstruction, the Lysholm final score postoperatively, 19 patients (57.6%) had excellent score, 12 patients (36.4%) had good results, one patient (3%) had fair results and one patient (3%) had poor results.

Shaikh et al. [14] reported that found excellent results (lysholm score >91) were reported in 36 patients (66.67%), good in 12 patients (22.22%) (lysholm score 84-90) and fair or poor results in six patients (11.11%) (lysholm score <83) using single bundle anatomic anterior cruciate ligament reconstruction.

The current study showed that return to activity duration was distributed as **9.91±2.79** with minimum 6 and maximum 18 weeks, which in agreement with the study of **Khatri and Bansal** [16] found in a Single-Bundle Anterior Cruciate Ligament Reconstruction patients found that the mean time to return to activity was 10.3 ± 3.1weeks.

The current study showed that IKDC SCORE was improved significantly from 45.83±7.46 to 78.12±6.04. **Hussein et al.,** [10] reported in anatomic single bundle group that the IKDC SCORE was improved significantly from (67.7 ± 14.0) to (90.6± 6.4) (P< 0.001).

Mayr et al., [17] concluded that the IKDC subjective improvement was highly significant compared with preoperative findings (52.4 ±7.2 versus 92.8 ± 6.2) (P < .001).

Also, **Aga et al.,** [18] reported that IKDC SCORE was improved significantly from 51.6±5.36 to 68.12±4.24 (P< 0.05).

The current study showed that 5 cases (20.8%) were complicated (4 cases had superficial infection and 1 case had deep infection).

Stucken et al., [19], found that postoperative infection following ACLR ranged from 0.14%–1.7%.

Fahmy et al., [12] reported that complications was reported in 5 patients (16.5%); Intraoperative lateral femoral cortex blow out was happened in one case (3.3%). Postoperative superficial wound infection at graft site was happened in one case (3.3%). Also, tourniquet neuropraxia was happened in one case (3.3%). Finally, postoperative neuropraxia of the saphenous nerve was happened in two cases (6.6%).

Gundavarapu et al., [20] No major complications were seen in their series except superficial infection in 3 cases (7.5%). 3 cases (7.5%) had difficulty in regaining the motion.

Limitation:

The first limitation of our study is the small sample size and short period follow-up. The sample size small to draw any definite conclusions, where a larger sample size with a long period follow up might have made it a stronger study and confirm the clinical role of anterolateral ligament.

Conclusion: The anatomic anterior cruciate ligament reconstitution using hamstring tendon is more effective for reproducing the anatomy of the ACL and obtaining good clinical results, when it is done by accessory medial portal because the technique enables for a better view inside the knee and more obliquity of the reconstructed ACL when compared to the transtibial technique.

No Conflict of Interest

No financial disclosure

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