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Original research article

Functional outcome following arthroscopic ACL reconstruction using 4 stranded hamstring auto graft and preservation of hamstring graft at tibial insertion

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Abstract

Anterior cruciate ligament (ACL) reconstruction has evolved considerably over the past 30 years. This has largely been due to a better understanding of ACL anatomy and in particular a precise description of the femoral and tibial insertions of its two bundles. In the 1980s, the gold standard was single-bundle antero-medial bundle reconstruction using the middle third of the patellar ligament. All the surgeries are performed by a single orthopedic surgeon. All patients had semitendinosus and gracilis tendon autografts harvested in a similar manner. Single bundle reconstruction technique with quadrupled hamstring autograft is used in every case. In all cases Endo-Button was used for femoral side fixation and preservation of hamstring graft tibial insertion on the tibial side. There is a statistically significant increase in both IKDC and Lysholm score from preoperative/pre-injury to post-operative assessment at minimal 9 month follow up. The mean pre-injury Tegner score was 5.7 ± 1.194 and mean post injury Tegner score was 5.2 ± 1.055. The mean pre-injury Lysholm score was 97.9 ± 2.308 which at minimum 9 month follow-up was 88.3 ± 8.036.

Keywords: Arthroscopic ACL reconstruction, hamstring autograft, functional outcome

Introduction

In pre-arthroscopy era, ACL reconstruction was done by open arthrotomy. However excessive soft tissue dissection led to complications like increased post-operative pain, increased infection rate, post-surgical knee stiffness and prolonged duration of rehabilitation. With the advent of Arthroscopy & refining of arthroscopy assisted ACL reconstruction techniques, the disadvantages of open surgery were overcome. Key-hole incisions, global visualization of the joint, tacking of associated lesions at the same sitting & less intense inflammatory response reduced the post-op morbidity and early recovery to full range of motion with less potential for functional imbalance [1].

Reconstruction of ACL allows the patient to return to a pre-trauma activity level and delays the occurrence of associated meniscal injury and onset of osteoarthritis. The incidence of associated cartilage damage in acute tears is reported at 15-40% whereas it increases to 79% in chronic tears. Reconstruction is also essential to restore the stability of the knee. A stable knee in turn prevents worsening of existing chondral lesions as well as occurrence of newer lesions.

The bone-patellar tendon-bone auto-graft is the most widely used graft source with the largest number of reported outcomes in the literature. However, the use of the quadruple hamstring auto-graft is gaining popularity due to its excellent stiffness and tensile load properties, reduced donor site morbidity, improvements in fixation techniques and implants, less postoperative anterior knee pain, better cosmeses and excellent clinical outcomes [2].

Distinct knowledge of anatomic landmarks of the femoral and tibial insertion sites is essential to ensure anatomic placement of the bone tunnels, since non-anatomic femoral tunnel position has been shown to be the most common cause of graft failure. Especially in chronic cases where the bundle remnants may not be visible, knowledge of these land-marks is crucial to placing the ACL graft within the anatomic footprint [3].

Anterior cruciate ligament (ACL) reconstruction has evolved considerably over the past 30 years. This has largely been due to a better understanding of ACL anatomy and in particular a precise description of the femoral and tibial insertions of its two bundles. In the 1980s, the gold standard was single-bundle antero-medial bundle reconstruction using the middle third of the patellar ligament. Insufficient control of rotational laxity led to the development of double bundle ACL reconstruction. This concept, combined

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with a growing interest in preservation of the ACL remnant, led in turn to selective reconstruction in partial tears, and more recently to biological reconstruction with ACL remnant conservation. Current ACL reconstruction techniques are tailor-made, depending on precise analysis of the type of lesion and the aspect of the ACL remnant in the intercondylar notch [4].

Biomechanical studies have demonstrated that anatomic double-bundle ACL reconstructions can restore knee function significantly more closely to the normal knee as compared with conventional non-anatomic single-bundle procedures. However, the biomechanical evidence has not been backed by clinical studies. As a result, the double-bundle reconstruction has not become a universally adopted practice, and anatomic single-bundle reconstruction is the most widely used technique worldwide [5].

Anatomical single-bundle reconstruction is performed using femoral-tunnel drilling techniques independent of the tibial tunnel. This can be achieved by trans-medial-portal drilling techniques or by retro-drilling techniques, depending upon the surgeon's orientation, philosophy and training.

The technique of arthroscopic anterior cruciate ligament reconstruction (ACLR) has undergone many modifications in the recent times with improved understanding of anatomy, kinematics, and biology of the graft [6].

Methodology

Study design: Retrospective cum prospective observational study.

Study formula

Based on the published literature, the proportion of patient return to pre-injury activity is 84 % using regular arthroscopic technique, assuming similar proportion of returning to pre-injury activity level in our present technique.

Assuming 5% level of significance, 90% power and 10% absolute precision required sample size is 52. The formula used to arrive the above-mentioned sample size is

$$n = \frac{Z^2_{(1-\alpha/2)} P(1-P)}{d^2}$$

p = proportion, d = absolute precision,

$z_{1-\alpha/2=}$ standard normal value a 5% level of significance

Sample size: 52.

Study population

Our study population will include all patients on whom anterior cruciate ligament reconstruction surgery has been performed using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion operated. The estimated number would be 52 patients. Case notes would be used to establish all demographic details including mechanism of injury, time to surgery, post-operative immobilization and intra-operative details. Complications are also will be recorded and confirmed with the patients. The functional questionnaire will be both e-mail based and in-person format methods. Patients will be followed up at least 9 months post-operatively. IKDC subjective functional scoring system & The Lysholm score and Tegner pre-operative and post-operative scoring system will be utilized to assess the functional outcome.

All the surgeries are performed by a single orthopedic surgeon. All patients had semitendinosus and gracilis tendon autografts harvested in a similar manner. Single bundle reconstruction technique with quadrupled hamstring autograft is used in every case. In all cases Endo-Button was used for femoral side fixation and preservation of hamstring graft tibial insertion on the tibial side. Indications for surgery were clinically and radiologically confirmed cases of anterior cruciate ligament deficient knees.

Results

There is a statistically significant increase in both IKDC and Lysholm score from preoperative/pre injury to post-operative assessment at minimal 9 month follow up.

The mean pre-injury Tegner score was 5.7 ± 1.194 and mean post injury Tegner score was 5.2 ± 1.055 The mean pre-injury Lysholm score was 97.9 ± 2.308 which at minimum 9 month follow-up was 88.3 ± 8.036.

The mean pre-operative IKDC was 35.8 ± 9.651 which improved to 81.6 ± 12.952 post-operatively which is statistically significant (p-0.001; <0.05).

Table 1: Comparison of Pre and Post Op Tegner score, Lysholm and IKDC score

	N	Mean	SD	Median	Min.	Max.
Pre-injury Tegner Score	52	5.7	1.194	6	4	8
Post-Op Tegner Score	52	5.2	1.055	5	2	7
Pre-injury Lysholm Score	52	97.9	2.308	99	94	100
Post-Operative Lysholm Score	52	88.3	8.036	90	55	100

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Pre-Injury IKDC Score	52	93.3	7.365	96.8	70.1	100
Pre-Operative IKDC Score	52	35.8	9.651	34.3	17.9	66
Post-Op IKDC Score	52	81.6	12.952	86.8	35	99.9

Table 2: Comparison of Pre-injury Vs Post Op Tegner score, Mean Standard Deviation Range

	N	Mean	SD	Mean Diff	SD of Diff	't' value	'p' value
Post-Op	52	5.15	1.055	-0.56	0.998	-4.028	<0.001
Pre-Injury	52	5.71	1.194				

Table 3: Comparison of Pre-injury Vs Post Op Lysholm score, Mean Standard Deviation Range

	N	Mean	SD	Mean Diff	SD of Diff	't' value	'p' value
Post-Op	52	88.25	8.036	-9.67	8.498	-8.208	<0.001
Pre-Injury	52	97.92	2.308				

Table 4: Comparison of Pre-injury, Pre-Op Vs Post Op IKDC score, Mean Standard Deviation Range

	N	Mean	SD	Mean Diff	SD of Diff	't' value	'p' value
Pre-Injury	52	93.3	7.365	57.6	11.841	35.062	<0.001
Pre-Operative	52	35.8	9.651				
Post Op	52	81.6	12.952	-11.7	11.841	-7.152	<0.001
Pre-Injury	52	93.3	7.365				
Post Op	52	81.6	12.952	45.8	15.182	21.768	<0.001
Pre-Operative	52	35.8	9.651				

A comparison of pre-injury and post op Lysholm.
A comparison of pre-injury and post op Lysholm score showed that 78.9% of patients reported good-excellent outcomes.

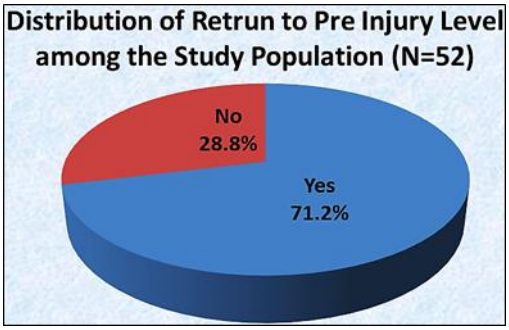
Table 5: Pre-injury and Post-op (minimum 9 months follow-up) Lysholm score

	Pre-Injury		Post-Operative	
	n	%	n	%
Poor (<=64)	-	-	2	3.8
Fair (65-83)	-	-	9	17.3
Good (84-94)	5	9.6	30	57.7
Excellent (>94)	47	90.4	11	21.2

Out of 52 patients 37 of the patients (71.2%) were able to return to their pre-injury activity including to recreational and to competitive sports. 5 patients (9.6%) had a drop of 1 level in Tegner activity level from there pre-injury level of activity. 7 patients (13.5%) had a drop of 2 level in Tegner activity level from there pre-injury level of activity. 2 patients (3.8%) had a drop of 3 level in Tegner activity level from there pre-injury level of activity. 1 case reported a 4 level drop from pre injury levels.

Table 6: Return to pre-injury level based on Tegner score

Change in Tegner Score (Post-Pre)	Frequency	Percent
-4	1	1.9
-3	2	3.8
-2	7	13.5
-1	5	9.6
0	37	71.2
Total	52	100.0



Graph 1: Return to pre-injury level based on tenger score

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Discussion

During the study period 59 patients underwent arthroscopic single-bundle ACL reconstruction, 3 were excluded due to various factors including associated injuries such as PCL injury, bilateral injury etc., 4 patients were lost to follow-up. In our study, we evaluated 52 patients for the functional outcome following arthroscopic single-bundle ACL reconstruction using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion. All patients underwent graft fixation using endobutton in the femoral tunnel and tibial attachment preserving quadrupled hamstring autograft without implant on the tibial side.

Out of 52 patients 42 (80.8%) males and 10(19.2%) were females patients, all aged between 18 and 55 years of age. In 34 cases (65.4%) right side was involved and in 18 cases (34.6%) left side was involved.

Tan SH, *et al*. noted in their study there were comparable or inferior results for females compared with males in all outcomes analyzed. No statistically significant sex difference was identified in most of the objective parameters. However, subjective and functional outcomes, including Lysholm score, Tegner activity scale, and ability to return to sports, have been shown to be poorer in females in their study but the same results in our study were comparable in both sexes [7].

Dehler C, *et al*. in their study of Prospective randomized comparison of double-bundle versus single-bundle anterior cruciate ligament reconstruction, noted Preoperative IKDC was 56 ± 13 in their study and 35.8 ± 9.651 in our study which was comparatively less, where as post-operative IKDC was 90 ±10 in Dehler *et al*. study and 81.6 ± 12.952 in our study. Pre-injury Lysholm was not recorded in their study, we had a score of 97.92; postoperative Lysholm score was 93 ±6 in their study 88.25 in our study [8].

S Shervegar, *et al*. in their study on Functional Outcome Following Arthroscopic ACL Reconstruction with Rigid Fix: A Retrospective Observational Study found a Mean IKDC subjective score post reconstruction was 75.6 with a standard deviation of 17.36 whereas in our study it was 81.6 ± 12.952. The mean post-operative Lysholm score was 84.42 with standard deviation of 13.24 whereas in our study it was found to be 88.25. The pre-injury and post reconstruction Tegner score was 5.44 and 4.26 respectively whereas in our study it was 5.71 and 5.15 respectively [9].

From the above data it emerges clearly that results of our study statistically validate the improved functional outcome post-surgery in arthroscopic single-bundle ACL reconstruction using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion by showing a demonstrable, statistically significant increase in post-operative IKDC scores (81.6 ± 12.952) when compared to pre-operative IKDC scores (35.8 ± 9.651).

Also, to be noted is that Out of 52 patients in our study, 37 of the patients (71.2%) were able to return to their pre-injury activity including to recreational and to competitive sports. 5 patients (9.6%) had a drop of just 1 level in Tegner activity level from there pre-injury level of activity, 7 patients (13.5%) had a drop of 2 level in Tegner activity level from there pre injury level of activity, thus most patients were able to recover to attain pre injury activity level. A comparison of pre and post injury Lyshom score showed that 78.9% of patients reported good-excellent outcomes [10].

Conclusion

Out of 52 patients 37 of the patients (71.2%) were able to return to their pre-injury activity including to recreational and to competitive sports. 5 patients (9.6%) had a drop of 1 level in Tegner activity level from there pre-injury level of activity. 7 patients (13.5%) had a drop of 2 level in Tegner activity level from there pre-injury level of activity. 2 patients (3.8%) had a drop of 3 level in Tegner activity level from there pre-injury level of activity. 1 case reported a 4 level drop from pre injury levels.

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