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

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### Abstract

**Background:** 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. In this study, we evaluated the functional outcome following arthroscopic single bundle ACLR with tibial attachment preserving quadrupled hamstring autograft without implant on the tibial side.

**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  $5.7 \pm 1.194$  and mean post injury Tegner score was  $5.2 \pm 1.055$ . The mean pre injury lysholm score was  $97.9 \pm 2.308$  which at minimum 9 month follow-up was  $88.3 \pm 8.036$ . 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.

**Conclusion:** Arthroscopic single-bundle ACL reconstruction using 4 stranded hamstring autograft, anatomic femoral tunnel placement and preservation of hamstring graft tibial insertion gives excellent to good functional outcome. Tibial attachment preserving hamstring graft without a tibial implant is a simple, time saving and cost effective technique that provides a consistently satisfactory outcome.

**Keywords:** ACL, hamstring autograft, arthroscopy, tibial insertion

### Introduction

Anterior cruciate ligament injury is the commonest ligament injury of the knee, and reconstructions of the anterior cruciate ligament (ACL) are among the most frequently performed procedures in knee surgery nowadays [1-5]. 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. [6-8]

In our study, we propose to evaluate the functional outcome following arthroscopic single bundle ACLR with tibial attachment preserving quadrupled hamstring autograft without implant on the tibial side. We propose to evaluate the functional outcome measures using two internationally used scoring systems- the Lysholm-Tegner score and the IKDC (International Knee Documentation Committee) rating system

### Methodology

Fifty two patients with complete ACL tears were operated by a single operating surgeon between July 2017 and July 2018 at Sapthagiri hospital, Bangalore. Patients were followed up at 4, 6, 12 weeks, 6 months and 9 months following surgery. All patients had semitendinosus and gracilis tendon autografts harvested in a similar manner. Single bundle reconstruction technique with quadrupled hamstring autograft was 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. The functional outcome was assessed at regular follow ups using IKDC score, Tegner score and lysholm score.

**Inclusion criteria**

1. All the patients who have undergone arthroscopic ACL reconstruction using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion
2. Age between 18 to 55 years
3. Radiologically ACL deficient knee confirmed by MRI
4. Patients with or without associated meniscus injuries.

**Exclusion criteria**

1. Bilateral knee injury
2. ACL tears associated with fractures
3. Revision ACL reconstruction
4. Current or prior Infection
5. Patients with associated PCL tear.
6. Patients with medical contraindication to surgery.

**Surgical technique****Graft harvest and preparation**

After the gracilis & semitendinosus tendons have been positively identified, the semitendinosus tendon is pulled forward with a curved clamp. With the tibial insertions of the tendons left intact, an open ended tendon stripper is used to harvest the graft. The proximal free ends of the tendons are sutured together by wrapping the broader aponeurosis of the semitendinosus around the gracilis tendon using No. 5 Ethibond suture. The tendons are looped around a tight rope with retrobutton, thus creating a quadrupled graft. The graft is sized with a sizer. Standard anterolateral and far-medial arthroscopic portals are made. The femoral point of entry is marked with a bone awl at the junction of the lateral condylar ridge and bifurcate ridge using arthroscopic guidance. A guide pin is introduced into the femur. With the knee in maximal hyperflexion, a 4.5-mm cannulated drill bit is used to create a tunnel in the femur.

The length of the tunnel (length A) is measured with a depth gauge. Reaming of the tunnel is performed with a femoral reamer corresponding to the size of the quadrupled tendon. No. 5 Ethibond suture is passed into the tunnel and the loop parked inside the joint. The tibial tunnel is drilled in a routine manner using an ACL tibial guide. The Ethibond suture loop placed through the femoral tunnel into the joint is retrieved from the tibial tunnel with a grasper. The length of the tibial tunnel and the intra-articular part of the proposed ACL graft (length B) is measured with a depth gauge; this length is added to the already measured length of the femoral tunnel to determine the exact length of both tunnels plus the intra-articular portion of the graft (length A plus length B). A marking suture is placed on the hamstring tendons just opposite the entry of the tibial tunnel. The length of the quadrupled graft and loop of the Retro- Button is adjusted so that it exactly corresponds to length A plus length B. The sutures of the RetroButton are pulled through the tibial and femoral tunnels by loading them onto the Ethibond loop placed in the tunnels. The RetroButton is flipped outside the femoral tunnel onto the cortex. The free end of the graft exiting the tibial tunnel is pulled to maximal stretch and the joint moved through full range of motion at least 10 times to remove any kinks in the graft. The tightness of the ACL graft is checked arthroscopically with a probe. With maximal stretch on the free

end of the graft, it is sutured to the preserved end.

Standard ACL rehab protocols were followed post operatively.

**Results****Age distribution**

We included patients ranging from 18-55 years, with Mean age 33.2, standard deviation 8.962, range 19-52, majority of the cases were young adults <30 years of age.

**Gender distribution**

Of the 52 cases that were operated 42 (80.8%) were male and 10(19.2%) were female.

**Side of injury**

Out of 52 cases 34(65.4%) were right sided injuries, 18 (34.6%) were left sided injuries.

**Mode of Injury**

Mode of injury was classified according to history given by the patient into slip and fall 14 cases (26.9%), 31 cases (59.6%) of sports related injuries, 7 cases (13.5%) of RTA.

**Table 1:** Mode of injury

Mechanism of Injury	Frequency	Percent
Slip and Fall	14	26.9
RTA	7	13.5
Sports	31	59.6
Total	52	100.0

**Frequency of associated injury diagnosed on arthroscopy**

Diagnostic arthroscopy prior to ACL reconstruction confirmed medial meniscal tear in 25% cases, lateral meniscal tear in 15.4% of cases, and both medial and lateral meniscus injury in 7.7% of cases. The rest of the cases (51.9%) were isolated ACL injuries.

**Complications**

A total of 3 patients out of 52 experienced complications in varying combinations, all patients reporting complications reported more than one complication. Complications reported included persisting instability, pain at operated site, numbness at operated site, occasional swelling, and occasional locking.

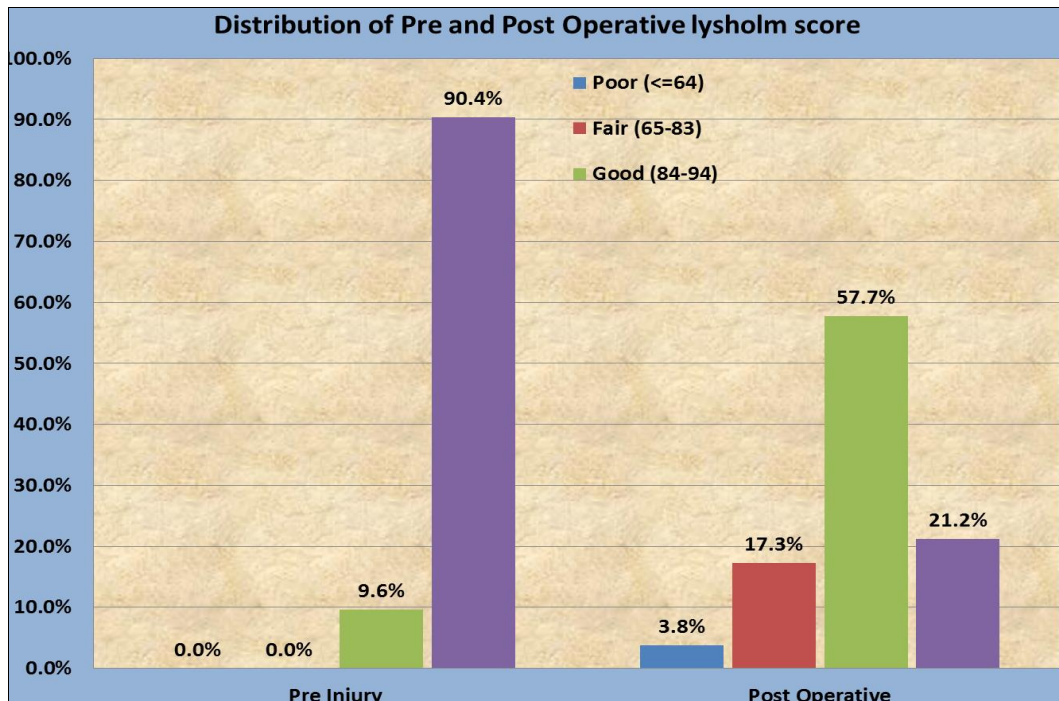
**Functional outcome based on Tegner score, IKDC score and Lysholm knee score**

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  $5.7 \pm 1.194$  and mean post injury Tegner score was  $5.2 \pm 1.055$

The mean pre injury lysholm score was  $97.9 \pm 2.308$  which at minimum 9 month follow-up was  $88.3 \pm 8.036$ .

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



Graph 1: Pre injury and Post-op (minimum 9 month follow-up) lysholm score

### Return to pre injury level based on Tegner score

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 their pre injury level of activity. 7 patients (13.5%) had a drop of 2 level in Tegner activity level from their pre injury level of activity. 2 patients (3.8%) had a drop of 3 level in Tegner activity level from their pre injury level of activity. 1 case reported a 4 level drop from pre injury levels.

Table 2: 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

### Discussion

Anatomic ACL reconstruction is a concept rather than a technique and can best be described based according to the following four principles. The first principle is to restore both functional bundles of the ACL, the AM and PL bundle. The second principle is that the graft needs to be placed anatomically, with the tibial and femoral tunnel apertures placed within the native ACL insertion sites. To ensure similar functional properties as the native bundles have, the third principle is to tension each bundle in accordance with the native tensioning 70 patterns from full knee extension through flexion. The fourth and final principle is to customize the surgery for each individual patient by considering the variation in anatomic characteristics, activity level, lifestyle and personal preferences [9].

We evaluated the functional outcome measures using two internationally used scoring systems- the Lysholm-Tegner score and the IKDC (International Knee Documentation Committee) rating system. These scores have been selected since there is a

growing movement towards patient-reported outcomes in clinical evaluation of surgical technique results.

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.<sup>[10]</sup>

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  $56 \pm 13$  in their study and  $35.8 \pm 9.651$  in our study which was comparatively less, whereas post-operative IKDC was  $90 \pm 10$  in Dehler et al study and  $81.6 \pm 12.952$  in our study. Pre injury lysholm was not recorded in their study, we had a score of 97.92; postoperative lysholm score was  $93 \pm 6$  in their study  $88.25$  in our study<sup>[11]</sup>.

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  $81.6 \pm 12.952$ .



The mean postoperative 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<sup>[12]</sup>.

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 ( $81.6 \pm 12.952$ ) when compared to pre-operative IKDC scores ( $35.8 \pm 9.651$ ).

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 Lysholm score showed that 78.9% of patients reported good-excellent outcomes.

A total of 3 patients (5.8%) out of 52 experienced complications in varying combinations, all patients reporting complications reported more than one complication. Complications reported included persisting instability, pain at operated site, numbness at operated site, occasional swelling, and occasional locking

### Limitations

Our study has a few limitations. Being an observational study, there is no randomization or blinding. There is a possibility of recall bias.

The scoring done including IKDC, Lysholm may not be significant at an individual level. Objective analysis is necessary to get the complete picture. However the subjective analysis gives a unique advantage of being free from physician bias.

The sample size may be inadequate and larger sample size may be necessary for more appropriate results.

The duration since surgery was not standardized which may have influenced the outcome of this study

There were no bilateral ACL reconstruction done simultaneously using the above mentioned technique in the study sample and hence the outcome score of both knees in the same patient was not compared.

### Conclusion

1. Our findings confirm with the current consensus from the literature that arthroscopic single-bundle ACL reconstruction using 4 stranded hamstring autograft, anatomic femoral tunnel placement and preservation of hamstring graft tibial insertion gives excellent to good functional outcome.
2. An accessory anteromedial portal technique of the femoral tunnel drilling facilitates anatomical femoral tunnel placement.
3. Majority of the patients return to their pre-injury level of activity.
4. The main finding of this preliminary study is that tibial attachment preserving hamstring graft without a tibial implant is a simple, time saving and cost effective technique that provides a consistently satisfactory outcome
5. There was no complications like bio-screw reaction, graft loosening and laxity, although 3 patients developed other complications

6. There exists no one ideal test/outcome measure that accurately and comprehensively provides all necessary information, and each outcome measure has its own advantages and disadvantages and provides scope of immense improvement for the development of new scoring systems in the future

### Recommendations

- There exists no one ideal test/outcome measure that accurately and comprehensively provides all necessary information, and each outcome measure has its own advantages and disadvantages and provides scope of immense improvement for the development of new scoring systems in the future
- A scoring system needs to be evolved that best reflects the local cultural and sporting practices and routine activities as these scores we used are patient administered in the form of a questionnaire and results are expected to be much more accurate if the patients are able to relate to the questions better.
- A universally acceptable scoring system needs to be evolved that stratifies results based on presence or absence of Meniscal injury, associated Chondral damage, associated other ligament injuries or combinations of these to be able to predict outcomes in advance based upon findings at the time of surgery.
- Further comparative studies may be required to compare the medium term and long term functional outcome results of ACL reconstruction using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion with those techniques of ACL reconstruction that use other methods of femoral tunnel drilling including trans tibial and retrodrilling techniques.
- There is a requirement for more studies of functional outcome results of ACL reconstruction using 4 stranded hamstring autograft and preservation of hamstring graft tibial insertion as it is a newer technique

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