

Arthroscopic ACL Reconstruction using Preserved Insertion Hamstring Graft - A Prospective Short - Term Analysis

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Abstract: *Introduction* Graft selection is an important aspect of ACL reconstruction surgery. An ideal graft should be of proper biomechanical strength, sufficient size, reliable fixation, rapid biological healing, no biologically adverse reaction, no donor site morbidity and excellent long term outcome. *Tibial insertion preserving hamstring graft can prevent potential problems of free graft in anterior cruciate ligament (ACL) reconstruction such as pull out before graft-tunnel healing or rupture before ligamentization of the graft. Material and methods* We analysed 60 patients of ACL injury in a prospective trial where all the patients were operated with preserved insertion hamstring graft. The duration of study was 3 years from October 2015 to November 2018 with a minimum follow up of 2 years. *Preoperative clinical and radiological findings were documented along with post op clinical and radiological findings. Functional outcome was assessed with Lysholm's score, Tegner's activity score and Hop test at 1 year and 2 year intervals. Results* Of the 60 patients, the mean age is 26.5±6.0 yrs. The mean height, weight and thigh circumference is 167.5±6.0 cm, 72.7±5.6 kgs and 47.8±4.8 cm respectively. *Pre operative Lysholm score was 42.3±11.5 which rose to 94.4±3.8 at 1st yr follow-up and 95.0±3.8 at 2nd yr followup. 56 out of 60 patients were able to return to their previous activity level with mean duration of return being 8.8±2.3 months. Limb Similarity Index (LSI) as measured by single leg hop, triple hop and crossover hop is 93.5 % at 1 year and 95.1 % at 2 year. Conclusion* In our study, we found that preserved insertion hamstring graft is a good option for arthroscopic ACL reconstruction with good clinical, radiological and functional outcomes.

Keywords: ACL reconstruction, preserved insertion, hamstring graft

1. Introduction

Ruptures of the anterior cruciate ligament (ACL) are among the most common ligamentous injuries. There is scarcely any other ligament in the human body that has been the subject of more professional conferences and publications. The therapeutic approach to ACL ruptures has undergone several changes during the past 30 years. Recent trends use a two-strand semitendinosus and a two-strand gracilis graft which is 238% stronger than native ACL [1, 2].

The advantage of preserving the insertions is more biological and may provide better proprioception. The technique eliminates the need for a tibial-side fixation device, thus reducing the cost of surgery. Furthermore, tibial-side fixation of the free graft is the weakest link in the overall stiffness of the reconstructed ACL, and this technique circumvents this problem. Using the preserved insertion technique, the blood supply of the graft is not hampered and thus results in superior healing and low rates of graft failure [3, 4]. Tibial attachment preserving hamstring graft in animal model has shown good outcomes as the graft viability is preserved and the stage of avascular necrosis and revascularization is by passed [4].

There are a very few studies which have studied the functional outcome of preserved insertion hamstring graft technique [5, 6]. All the studies have reported good functional outcome following the technique.

The primary goal of anterior cruciate ligament reconstruction (ACLR) is to restore stability without sacrificing mobility or strength. The primary purpose of ACLR rehabilitation is to restore mobility and strength without sacrificing stability. Restoration of full extension and almost full flexion should be aggressively pursued

immediately after surgery, but not hyperextension and hyperflexion, which strain the graft.

In our study we have studied the clinical, radiological and functional outcomes following ACL reconstruction using preserved insertion hamstring graft.

2. Material and Methods

We analysed 60 patients of ACL injury in a prospective trial where they were operated with preserved insertion hamstring graft. The duration of study was 3 years from October 2015 to November 2018 with a minimum follow up of 2 years. ACL was reconstructed arthroscopically in all the cases. Tourniquet was used in all cases and tourniquet time was documented. Preoperative clinical and radiological findings were documented along with post op clinical and radiological findings. Functional outcome was assessed with Lysholm's score, Tegner's activity score and Hop test at 1 year and 2 year intervals. MRI was done preoperatively and postoperatively for radiological assessment.

3. Operative Procedure

All the patients were laid supine on OT table with the affected knee flexed on the table such that full range of motion of the knee is possible. A side support is applied on thigh to prevent hip abduction and a bolster is applied on foot end of table to keep the limb stable at 90 degrees flexion. After proper cleaning and draping, arthroscopic ports are made and diagnostic arthroscopy is done to assess the injury along with other associated injuries. Through a 3 cm oblique incision over antero-medial aspect of tibia at level of tibial tuberosity, the gracilis and semitendinosus tendons are identified.

The tendons were identified and harvested with an open ended harvester keeping the origin intact (Figure 1). The free ends were stitched with fibre wire no. 2.

Figure 1. Showing harvesting hamstring graft using open ended tendon harvester.

Graft were quadrupled and diameter and length of graft were measured (Figure 2). ACL remnant was not debrided. Tibial tunnel was created by placing the 55° guide placed at the tibial footprint of ACL and sequential reaming is done. Femur entry point is made at footprint of ACL and sequential reaming is done upto the required graft length. Flexible loop endobutton is used for femur attachment.

Figure 2. Graft preparation and measurement. No implant was used at tibia site for fixation of the graft.

Knee in now put in full range of motion and graft is examined arthroscopically for impingement. The graft conditioning was done by cycling the knee through full ROM (20 cycles) while maintaining a constant pull on the graft.

Patients were encouraged to bear as much weight as possible walking from the next day. Active straight leg raises, isometric quadriceps exercise, active knee curls against the resistance of Theraband and active knee bending with end-range assistance was initiated. ROM knee brace was given for ambulation only till patients regained quadriceps control. Routine followup was done at 2, 6, and 12 weeks and every 6 months. Lysolm and Tegner's score were used for scoring the functional outcome pre and post operatively. Lachman and Pivot shift tests were used to assess knee stability pre and post operatively. Post operatively, MRI was done at 1 and 2 year interval to assess ligamentization and integration of the graft. (Figure 3, 4)

Figure 3, 4: Saggital and coronal T2 weighted MRI of Knee at 2 year follow up showing good tunnel placement with good ligamentization and no tunnel enlargement.

Statistical analysis was done using EpiInfo TM version 7 software. Continuous data with normal distribution were expressed as means (± standard deviation) and non-normal distribution as median (range).

4. Results

Of the 60 patients, the mean age is 26.5±6.0 yrs. The mean height, weight and thigh circumference is 167.5±6.0 cm, 72.7±5.6 kgs and 47.8±4.8 cm respectively. The mean time difference from injury to surgery is 8.4 months (Table 1). There were 48 male and 12 female patients in this group. There are 24 patients with sports injury in this group. 35 patients were operated within 3 months of injury, 16 patients were operated in 3 to 12 months duration and 9 patients were operated after 1 year from date of injury (Table 2). 17 patients had associated medial meniscus injury and 13 patients had associated lateral meniscus tear. Mean graft diameter is 7.5±0.5 mm and mean duration of surgery is 59.6±8.6 minutes (Table 3).

Pre operative Lysolm score was 42.3±11.5 which rose to 94.4±3.8 at 1st yr follow up and 95.0±3.8 at 2nd yr followup (Table 4). 56 out of 60 patients were able to return to their previous activity level with mean duration of return being 8.8±2.3 months (Table 5). Anterior drawer test, Lachmann test and Pivot shift tests were done pre operatively and at 1 and 2 year followup and were compared as in Table 6. Limb Similarity Index (LSI) as measured by single leg hop, triple hop and crossover hop is 93.5% at 1 year and 95.1% at 2 year (Table 7, 8). After 2 year follow up, 5 patients had tibial tunnel enlargement. 4 patients with age >40 years had increase in KL grade from grade 1 to grade 2. One patient had increase in KL grade from grade 2 to grade 3. Thigh wasting was seen in 2 patients.

Table 1

	Age (in yrs)	Weight (in kg)	Height (in cms)	Thigh circumference (in cms)	Duration since injury (in mths)
Mean value	26.5±6.0	72.7±5.6	167.5±6.0	47.8±4.8	8.4

Table 2

Gender			
Male		Female	
48		12	
Time Since Injury			
< 3 mths	3 – 12 mths		>1 yr
26	22		12
Mode of injury			
Sports Injury	RTA	Fall	Others
24	24	8	4

Table 3

Medial meniscus injury pattern(Intraop findings)				
Normal	Stable Tear(not repaired)	Tear Repaired (horizontal/bucket handle)	Partial menisectomy complex tear	Root injury-repair
43	3	8	4	2
Lateral meniscus injury pattern(Intraop findings)				
Normal	Stable Tear(not repaired)	Tear Repaired (horizontal/bucket handle)	Partial menisectomy complex tear	Root injury-repair
47	4	6	2	1
Graft Diameter (in mm)		Duration of Surgery (in min)		
7.5±0.5		59.6±8.6		

Table 4

Lysolm Score		
Pre op	1 yr post op	2 yr post op
42.3±11.5	94.4±3.8	95.0±3.8

Table 5

Return to work	
No. of Patients	Duration of return
56	8.8±2.3

Table 6

Anterior Drawer Test (Grade)							
Pre operative Grade (no.)			1 Year post op Grade (no.)			2 Year post op Grade (no.)	
Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2
16	24	20	57	3	0	57	3
Lachmann Test (End point finding)							
Pre operative		1 Year post op			2 Year post op		
Firm	Soft	Firm	Soft	Firm	Soft	Firm	Soft
8	52	51	9	56	4		
Pivot Shift Test (Grade)							
Pre operative grade			1 Year post op Grade			2 Year Post op Grade	
Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2
36	17	7	60	0	0	60	0

Table 7

Hop Test (distance in cms)									
	Single hop normal	Triple hop normal	Crossover hop normal	Single hop 1 yr	Single hop 2 yr	Triple hop 1 yr	Triple hop 2 yr	Crossover hop 1 yr	Crossover hop 2 yr
Free Graft	158.6±5.2	460.8±15.2	425.0±16.1	149.1±4.5	154.6±5.3	431.1±14.5	436.3±14.3	397.3±15.4	403.1±15.6

Table 8

Limb Similarity Index (in percentage)								
	Single hop 1 yr	Single Hop 2 yr	Triple hop 1 yr	Triple hop 2 yr	Crossover hop 1 yr	Crossover hop 2 yr	Mean LSI 1 yr	Mean LSI 2 yr
Free Graft	94.0	97.5	93.5	94.6	93.4	94.8	93.6	95.1

5. Discussion

In our study we have performed a prospective analysis of ACL injury in 60 patients. All the patients were operated arthroscopically and preserved insertion hamstring graft was used in all cases.

Interference screws can migrate inside the joint damaging articular cartilage and bioabsorbable materials can generate foreign-body inflammatory reaction. The production of inflammatory cytokine and the creation of a granuloma inside the bone around the screw or even in the surrounding soft-tissues, could possibly compromise the trabecular architecture weakening the bone [7].

There are many reasons why tibial fixation is more challenging than femoral fixation. Bone mineral density

(BMD) is higher in the distal femur than it is in the metaphyseal region of the tibia [8].

With the preserved insertion technique, the origin of the hamstrings is preserved thus blood supply to the tendons is intact due to which the biological strength of the insertion is maintained and this prevents the failure of graft from tibial insertion. It also helps in better healing of the graft and early incorporation [9]. However, because of using suspensory fixation at both the femoral and tibial ends, the theoretical risk of the windshield-wiper effect exists in the preserved insertion group, though there are limited studies on this and more studies are required to prove it [10]. In our study there were 5 patients which had tunnel enlargement in followup and was statistically not significant. Buda et al observed a 27% reduction in tibial tunnel diameter using preserved insertion hamstring graft could be in direct evidence of

intact attachment being helpful in graft tunnel healing. The secure tibial fixation warrants early and accelerated physiotherapy resulting in good functional outcome [11]. A good functional outcome is projected by early return to work activity. In our study, the mean duration of return to previous activity is 8.4 months, which is comparable to other studies.

Post operative knee stability is assessed by Anterior drawer test, Lachmann test and Pivot shift test. At 2 year follow up, 4 out of 60 patients had positive Lachmann test. None of the patients had a positive pivot shift at final follow up. An absence of these tests in followup indicates a stable knee with lower incidence of graft failure in follow up. A good tibial fixation results in a stable knee with low graft failure incidence.

The maturation and ligamentization of the graft was assessed in our study by MRI done at 1 and 2 year interval. Figueroa's score was used to estimate the ligamentization and graft integration process. (Table 9)

Table 9

Item	Points
Integration: synovial fluid at tunnel graft interface	
Positive	1
Negative	2
Ligamentization: Graft signal pattern (>50%)	
Hypointense	3
Isointense	2
Hyperintense	1
Characterisation of graft	
Poor	2
Adequate	3-5

The Figueroa score is based on the sum of the points achieved in the 2 items (integration and ligamentization): 2-points represents an insufficiently mature graft, while a score between 3 and 5 points represents a good ligamentization process and graft integration[12].

Table 10

	Grade 3	Grade 4	Grade 5
Figueroa score at 1 yr	0	22	38
Figueroa score at 2 yr	0	4	56

Adequate graft integration and ligamentization was seen in all of our patients and better results were seen at 2 year followup as compared to 1 year follow up.

Hop tests were used for the functional evaluation of the limb after ACL reconstruction and was compared with the normal limb at 1 year and 2 year follow up. We performed single leg hop, triple hop and crossover hop in all patients at 1 and 2 year follow up and result was compared with the normal limb. Fitzgerald et al described a decision making scheme for returning patients with an ACL injury to a high level of physical activity. Patients successfully returning to pre-injury levels of activity had a mean hop test score of 95%, compared with the mean of 85% in the patients who failed rehabilitation. On the basis of this, an LSI of 90% was chosen as the cut-off score in this study[13]. In our study, patients with a mean LSI of >90% were able to return to their previous activity level and was statistically significant.

The main shortcoming of preserved insertion technique is that can be done by use of an open ended tendon harvester. Also the tendon length should be sufficient to perform this procedure.

Comparing the mechanical stability, functional and radiological outcome of patients undergoing ACL reconstruction using hamstring tendon autograft with preserved insertions with those in patients undergoing ACL reconstruction using free hamstring autograft is a very interesting and promising subject and should be explored further. A long term comparative study is required to determine the benefits and complications related to the procedure.

6. Conclusions

In our study we have studied ACL reconstruction technique with preserved insertion graft. In our study we had better clinical, functional and radiological results as compared to free hamstring graft technique. The fewer number of cases and short followup were the main limitations of our study. We recommend further studies with a longer followup to assess the results and for a better comparison of the technique.

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