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Comparative Analysis of Results of Arthroscopic ACL Reconstruction between Free Hamstring Graft and Preserved Insertion Hamstring Graft: A Short Term Follow Up Study

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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, n2, o 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 80 patients of ACL injury in a prospective trial where 40 patients were operated with free hamstring graft and 40 patients were operated with preserved insertion hamstring graft. The duration of study was 3 years from October 2015 to November 2015 with a minimum follow up of 2 years. The patients were divided in two groups of 40 persons each with the first group operated with free hamstring graft and the second group with preserved insertion hamstring graft. Preoperative clinical and radiological findings were documented along with post op clinical and radiological findings. Functional outcome was assessed with Lysolm`s score, Tegner`s activity score and Hop test at 1 year and 2 year intervals. Results: Results were compared between the two groups. In Group 1 the mean age is 29.0±8.4 yrs. The mean height, weight and thigh circumference is 169.6±5.7 cm, 72.5±6.9 kgs and 50.1±6.6 cm respectively. In Group 2 the mean age is 26.9±6.7 yrs. The mean height, weight and thigh circumference is 167.6±5.8 cm, 72.2±5.7 kgs and 47.5±5.0 cm respectively. In group 1 pre operative Lysolm score was 45.8±10.3 which rose to 93.7±4.8 at 1st year follow up and 94.0±5.0 at 2nd year follow up. 35 out of 40 patients were able to return to their previous activity level with mean duration of return being 10.1±2.7 months. In group 2 pre operative Lysolm score was 42.7±11.7 which rose to 94.7±3.8 at 1st yr follow-up and 95.2±3.9 at 2nd yr follow-up (Table 4). 37 out of 40 patients were able to return to their previous activity level with mean duration of return being 8.7±2.2 months. Conclusion: The preserved insertion hamstring graft group had better clinical, functional and radiological results as compared to free hamstring graft group over a follow up period of 2 years.***

Keywords: ACL, Preserved insertion, hamstring graft

1. Introduction

Anterior cruciate ligament (ACL) injuries most commonly occur during sports activities, and have a high incidence rate in young athletes. Recent development in the techniques of ACL reconstruction have enabled such athletes to return to sports and achieve favourable clinical results[1,2].

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[3].

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. Although many types of grafts have been used in ACL reconstruction over time, it is still a never-ending debate aa to what is the best graft. The popular autograft is hamstring tendon graft (quadrupled), has less donor site morbidity, comparable strength and stiffness to the original ACL. Both the length and diameter of the graft are important factors that determine the adequacy of the graft as the alternate method of fixation may be required for smaller graft dimensions[4,5,6,7].

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[7,8,9,10].
In our study, we have compared preserved hamstring graft with free hamstring graft and have compared the post operative functional and radiological outcomes of both the procedures done.

2. Material and Methods

We analysed 80 patients of ACL injury in a prospective trial where 40 patients were operated with free hamstring graft and 40 patients were operated with preserved insertion hamstring graft. The duration of study was 3 years from October 2015 to November 2015 with a minimum follow up of 2 years. The patients were divided in two groups of 40

persons each with the first group operated with free hamstring graft and the second group with preserved insertion hamstring graft. 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 Lysolm`s score, Tegner`s activity score and Hop test at 1 year and 2 year intervals.

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, arthrocsopic 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. In the free hamstring technique, the tendons were separated from their insertion and their free end was stitched with fibre wire no.2. Tendons were harvested with a closed ended harvester and the other free end were stitched similarly with fibre wire (Fig. 2).

Figure 2: Free hamstring graft harvested and sutured for ACL reconstruction

In preserved insertion technique, the tendons were identified and harvested with an open ended harvester keeping the origin intact (Fig. 2, 3). The free ends were stitched with fibre wire no. 2.

Figure 2: Showing the harvesting of hamstring graft for preserved insertion surgery using open ended harvester

Figure 3: Preserved hamstring insertion quadrupled graft for ACL reconstruction.

Grafts were quadrupled and diameter and length of graft were measured. 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.

Biodegradable screw is used for tibia fixation in free hamstring graft and no fixation device is used in preserved insertion 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 follow up 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.

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). Chi-square test was used for comparison of nominal data, and an unpaired Student's t-test was used for comparisons of continuous data when the data appeared to be approximately normally distributed. The Wilcoxon signed rank test was used for data without normal distribution.

3. Results

A total of 80 patients were analysed and were divided in two groups of 40 patients each. The first group consisted of patients who had free hamstring graft and the second group had preserved insertion graft. All parameters were analysed for both groups and were compared.

Group 1

The mean age is 29.0±8.4 yrs. The mean height, weight and thigh circumference is 169.6±5.7 cm, 72.5±6.9 kgs and 50.1±6.6 cm respectively. The mean time difference from injury to surgery is 18.8 months (Table 1). There were 37 male and 3 female patients in this group. There are 20 patients with sports injury in this group. 17 patients were operated within 3 months of injury, 15 patients were operated within 3 to 12 months of injury and 8 patients after 1 year of injury (Table 2). 8 patients had associated medial meniscus injury and 11 patients had associated lateral meniscus tear. Mean graft diameter is 7.7±0.6 mm and mean duration of surgery is 56.8±11.5 minutes (Table 3).

Pre operative Lysolm score was 45.8±10.3 which rose to 93.7±4.8 at 1st year followup and 94.0±5.0 at 2nd year followup (Table 4). 35 out of 40 patients were able to return to their previous activity level with mean duration of return being 10.1±2.7 months (Table 5). Limb Similarity Index (LSI) as measured by single leg hop, triple hop and crossover hop is 92.2% at 1 year and 93.1% at 2 year (Table 9, 10). After 2 year followup 5 patients had tibial tunnel enlargement and 2 patients had non visualisation of graft on MRI. 2 patients developed fixed flexion deformity of 10 degrees at 2 year follow up. 3 patients with age >40 yrs had increase in KL grade from grade 1 to grade 2. Thigh wasting was seen in 2 patients.

Group 2

The mean age is 26.9±6.7 yrs. The mean height, weight and thigh circumference is 167.6±5.8 cm, 72.2±5.7 kgs and 47.5±5.0 cm respectively. The mean time difference from injury to surgery is 9.1 months (Table 1). There were 34 male and 6 female patients in this group. There are 17 patients with sports injury in this group. 22 patients were operated within 3 months of injury, 9 patients were operated in 3 to 12 months duration and 9 patients were operated after 1 year from date of injury (Table 2). 11 patients had associated medial meniscus injury and 8 patients had associated lateral meniscus tear. Mean graft diameter is 7.5±0.5 mm and mean duration of surgery is 59.1±8.7 minutes (Table 3).

Pre operative Lysolm score was 42.7±11.7 which rose to 94.7±3.8 at 1st yr followup and 95.2±3.9 at 2nd yr followup (Table 4). 37 out of 40 patients were able to return to their previous activity level with mean duration of return being 8.7±2.2 months (Table 5). 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 9, 10). After 2 year followup, 3 patients had tibial tunnel enlargement. 2 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 1 patient.

Table 1

	Age (in yrs)	Weight (in kg)	Height (in cms)	Thigh circumference (in cms)	Duration since injury (in mths)
Free Graft	29.0±8.4	72.5±6.9	169.6±5.7	50.1±6.6	18.8
Preserved insertion	26.9±6.7	72.2±5.7	167.6±5.8	47.5±5.0	9.1

Table 2

Gender				
	Male		Female	
Free Graft	37		3	
Preserved Insertion	34		6	
Time Since Injury				
	< 3 mths	3 – 12 mths	>1 yr	
Free Graft	17	15	8	
Preserved Insertion	22	9	9	
Mode of injury				
	Sports Injury	RTA	Fall	Others
Free Graft	20	17	2	1
Preserved Insertion	17	16	5	2

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
Free Graft	32	1	3	4	0
Preserved insertion	29	0	6	1	4
Lateral meniscus injury pattern(Intraop findings)					
	Normal	Stable Tear (not repaired)	Tear Repaired (horizontal/bucket handle)	Partial menisectomy complex tear	Root injury-repair
Free Graft	29	4	6	1	0
Preserved insertion	31	3	2	4	0
Graft Diameter (in mm)			Duration of Surgery (in min)		
Free Graft	7.7±0.6		56.8±11.5		
Preserved insertion	7.5±0.5		59.1±8.7		

Table 4

Lysolm Score				
	Pre op	6 mth post op	1 yr post op	2 yr post op
Free Graft	45.8±10.3	90.2±4.8	93.7±4.8	94.0±5.0
Preserved insertion	42.7±11.7	92.1±3.8	94.7±3.8	95.2±3.9

Table 5

Return to work		
	No. of Patients	Duration of return
Free Graft	35	10.1±2.7
Preserved insertion	37	8.7±2.2
P value		0.01

Pre and post operative clinical examination were done (anterior drawer test, Lachman test, pivot shift test) and were compared between the two groups as shown in table (Table 6, 7, 8).

Table 6

Anterior Drawer Test										
	Pre operative			6 mth post op		1 yr post op		2 yr post op		
	1	2	3	1	2	1	2	1	2	3
Free Graft	9	17	14	29	11	32	8	35	3	2
Preserved insertion	11	16	13	34	6	38	2	38	2	0

Table 7

Lachman Test (end point finding)								
	Pre op		6 mth post op		1 yr post op		2 yr post op	
	Firm	Soft	Firm	Soft	Firm	Soft	Firm	Soft
Free Graft	5	35	25	15	26	14	35	5
Preserved insertion	5	35	33	7	34	6	37	3

Table 8

Pivot Shift Test (Grade)										
	Pre operative				6 mth post op		1 yr post op		2 yr post op	
	0	1	2	3	0	1	0	1	0	1
Free Graft	11	12	10	7	17	23	39	1	39	1
Preserved Insertion	6	10	19	11	28	12	40	0	40	0

Table 9

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	160.2±4.9	467.2±14.1	431.8±14.8	148.2±5.3	151.6±8.6	432.6±12.8	436.9±19.6	395.8±14.8	397.5±19.9
Preserved insertion	158.8±5.0	461.6±15.0	425.8±15.8	149.4±4.9	154.8±5.3	431.5±14.1	436.7±13.9	398.0±15.0	403.8±15.3

Table 10

	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	92.5	94.6	92.6	93.5	91.6	92.1	92.2	93.1
Preserved insertion	94.0	97.4	93.4	94.6	93.4	94.8	93.5	95.1
P value	<.01	<.01	0.02	0.1	<.01	<.01	<.01	<.01

Table 11

	Limb Similarity Index (in percentage)							
Return to previous activity level	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
Yes	93.7	96.9	93.4	94.7	93.0	94.1	93.3	94.8
No	89.0	88.4	89.5	88.2	88.4	87.1	89.0	87.8
P value	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01

The above results were compared between the two groups. There was no statistically significant difference between the age, gender, height, weight and thigh circumference parameters. Data regarding mechanism of injury, site of ACL tear and associated meniscus tear were also comparable in both groups with no statistical difference.

Patients operated with preserved insertion technique had a better Lysolm score, had early return to previous activity level, better knee stability and proprioception (better hop test results). Lower complications were also seen in the preserved insertion group.

4. Discussion

In our study we have done a prospective analysis of patients operated for arthroscopic ACL reconstruction and compared the functional and radiological outcomes between free hamstring and preserved insertion technique. The free hamstring graft revascularizes and is incorporated with the bone in 8 to 12 weeks duration[11]. There are concerns of graft pull-out before healing of the graft resulting in failure of the procedure[12, 13]. With the preserved insertion technique, the origin of the tendon is preserved hence the blood supply to the tendons in 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[14]. 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[15]. In our study however no statistically significant difference was seen in cases having tibia tunnel widening in the two groups. We observed tunnel widening in 5 cases of free hamstring graft and in 3 cases of preserved insertion hamstring graft. 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[16]. A good range of motion was achieved in all cases in preserved insertion group. The patients in the preserved insertion group had an early return to previous activity (8.7±2.2 months in preserved insertion group) as compared to the free hamstring graft group where the time period was 10.1±2.7 months and the result was statistically significant.

A good functional outcome was achieved in the preserved insertion group as compared to the free hamstring group. The mean Lysolm score was better in the preserved insertion group then the free hamstring group both at 1 year and 2 year followup. Post operative knee stability was assessed clinically with anterior drawer test, Lachmann test and Pivot shift test. In our study, 5 patients had positive Lachmann test in free graft technique and 3 patients had positive Lachmann in preserved insertion. Of the 5 patients in the free graft group, 2 patients had Grade 3 anterior drawer test while no patient had positive anterior drawer test in the preserved insertion group. 1 patient in the free hamstring graft group had positive pivot shift test along with positive anterior drawer and positive Lachmann test. This indicates a better knee stability and lower failure rate of graft in the preserved hamstring insertion group as compared to the free hamstring group.

The mean duration of surgery is 56.8±11.5 minutes in the free hamstring group and is 59.1±8.7 in the preserved insertion group. No significant difference in the duration of surgery has been noted in our study, though some studies have noted an increase in duration of surgery in the preserved insertion group as the graft preparation and arthroscopy had to be done sequentially and not side by side.

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. The data of both limbs were collected and limb similarity index (LSI) was calculated. The LSI was better in the preserved insertion group as compared to the free hamstring group in the three groups (single leg hop, triple hop and crossover hop) and the results were statistically significant. 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[17]. 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.

5. Conclusions

In our study we have compared ACL reconstruction technique with free hamstring graft versus preserved insertion graft. Study group where we performed preserved insertion hamstring graft had better clinical, functional and radiological results as compared to free hamstring graft group. The less 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 between the two techniques.

References

[1] Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. Br J Sports Med 2005;39: 324–329.
[2] Boden BP, Dean GS, Feagin JA, et al. Mechanisms of anterior cruciate ligament injury. Ortho 2000;23:573–578.
[3] Freeman JW, Kwansa AL. Recent advancements in ligament tissue engineering: The use of various techniques and materials for ACL repair. Recent Pat Biomed Eng 2008;1:18-23.
[4] Prodromos CC, Han YS, Keller BL, et al. Stability of hamstring anterior cruciate ligament reconstruction at two- to eight-year follow-up. Arthroscopy 2005;21:138–146.
[5] Harter RA, Osternig LR, Singer KM. Long term evaluation of knee stability and function following surgical reconstruction for anterior cruciate ligament insufficiency. Am J Sports Med 1988;16:434-443.
[6] Kondo E, Merican AM, Yasuda K, Amis AA (2010) Biomechanical comparisons of knee stability after anterior cruciate ligament reconstruction between two clinically available transtibial procedures: anatomic double bundle versus single bundle. Am J Sports Med 38:1349–1358.
[7] Kim SJ, Kim HK, Lee YT. Arthroscopic anterior cruciate ligament reconstruction using autogenous hamstring tendon graft without detachment of the tibial insertion. Arthroscopy 1997;13:656-660.
[8] Novak PJ, Bach BR Jr, Bush-Joseph CA, et al. Cost containment: a change comparison of anterior cruciate ligament reconstruction. Arthroscopy 1996;12:160–164.
[9] Papachristou G, Nikolaou V, Efstathopoulos N, Sourlas J, Lazarettos J, Frangia K, et al. ACL reconstruction with semitendinosus tendon autograft without detachment of its tibial insertion: A histologic study in a rabbit model. Knee Surg Sports Traumatol Arthrosc. 2007;15:1175–80.
[10] Lipscomb AB, Johnston RK, Snyder RB, et al. Evaluation of hamstring strength following use of semitendinosus and gracilis tendons to reconstruct the anterior cruciate ligament. Am J Sports Med 1982;10:340–342.
[11] Hamner DL, Brown CH, Steiner ME, et al. Hamstring tendon grafts for reconstruction of the anterior cruciate ligament: biomechanical evaluation of the use of multiple strands and tensioning techniques. J Bone Joint Surg 1999;81A:549–557.
[12] Brand JC, Weiler A, Caborn DNM, et al. Graft fixation in cruciate ligament reconstruction. Am J Sports Med 2000;28:761–774.
[13] Deehan DJ, Cawston TE. The biology of integration of the anterior cruciate ligament. J Bone Joint Surg Br. 2005;87:889–95
[14] Ruffilli A, Pagliazzi G, Ferranti E, Busacca M, Capannelli D, Buda R, et al. Hamstring graft tibial insertion preservation versus detachment in anterior cruciate ligament reconstruction: A prospective randomized comparative study. Eur J Orthop Surg Traumatol. 2016;26:657–64.
[15] Zijl JAC, Kleipool AEB, Willems WJ. Comparison of tibial tunnel enlargement after anterior cruciate ligament reconstruction using patellar tendon autograft or allograft. Am J Sport Med 2000;28:547–551.
[16] Buda R, Ruffilli A, Vannini F, Parma A, Giannini S. Anatomic anterior cruciate ligament reconstruction using distally inserted doubled hamstrings tendons. Orthopedics. 2013;36:449–53.
[17] Fitzgerald GK, Axe MJ, Snyder-Mackler L (2000) A decisionmaking scheme for returning patients to high-level activity with nonoperative treatment after cruciate ligament rupture. Knee Surg Sports Traumatol Arthrosc 8:76–82