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Comparative study of functional outcomes of arthroscopic ACL reconstruction by augmented hamstring graft with Fiber tape and hamstring graft alone: A prospective study

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Abstract
Background: Study is carried out to measure the additional effect of using Fiber-tape on functional outcome of anterior cruciate ligament tear managed by augmenting ACL reconstruction with Fiber tape.
Methods: The standardised, Anterior Drawer test Lachman test, Pivot shift test, Lysholm knee score quantified in terms of the side-to-side difference in laxity both preoperatively and postoperatively.
Result: The present study was conducted on patients with anterior cruciate ligament tear admitted in department of orthopaedics, King George's Medical University, Lucknow. The present study had total of 50 subjects among which 25 were assigned in to two groups randomly, viz Group 1 of the treatment procedure – Quadruple hamstring graft alone and Group 2 of patients with augmented hamstring graft with fibertape. On comparing the improvement in grades at 12 weeks and 6 months follow-up, fiber group showed significantly more improvement compared with the non-fiber group. None of the cases in both the groups showed positive pivot shift test at 6 months follow up.
Conclusion: In our study it was found that the improvement in grades of anterior drawer test and Lachman test in fibertape augmented group was significantly more than the non-augmented group at 12 weeks and 6 months. Follow up period of 6 months was a limiting factor in our study. This technique needs further clinical evaluation to assess the long term results and the effect of protection of the graft and also to study the clinical behavior of the resultant collagen fibertape.

Keywords: Anterior drawer test lachman test, pivot shift test, lysholm knee score, ACL

Introduction
Anterior cruciate ligament (ACL) injury is the most common ligament injury in the knee [1]. Greater participation of the general population in sports and recreational activities continues to expose more individuals to the risk of ACL tear. The science and techniques of ACL reconstruction has increased over time. Various methods for reconstructing the ligament exist, including the use of patellar tendon auto graft, quadriceps tendon autograft, hamstring tendons, allograft materials and synthetic ligaments and tapes.
The ACL is the prime static stabilizer of the knee against anterior translation of tibia on femur [2]. The ACL originates from the medial surface of the lateral femoral condyle posteriorly in the intercondylar notch in the form of a segment of a circle [3]. The anterior side of the attachment is almost straight and the posterior side convex. The ligament courses anteriorly, distally, and medially toward the tibia. Over the length of its course the fibers of the ligament undergo slight external rotation. The average length of the ligament is 38 mm, and the average width is 11 mm [4].
The two bundles are defined by their respective tibial insertion with an anteromedial (AM) bundle and a posterolateral (PL) bundle. The AM bundle originates in the proximal part of the femoral origin and inserts in the anteromedialportion of the tibial insertion; in distinction, the PL bundle originates distally in the femoral origin and inserts in the posterolateral aspect of the tibial insertion [4].
The standardised, Anterior Drawer test Lachman test, Pivot shift test, Lysholm knee score

Quantified in terms of the side-to-side difference in laxity both preoperatively and postoperatively.

A rupture of the anterior cruciate ligament (ACL) significantly alters the kinematics and laxity of the knee joint [5, 6, 7]. It is uncertain how ACL reconstruction, the standard medical intervention for active people, is able to restore the kinematics of the involved joint [5, 8]. The literature has demonstrated that the pivot-shift test, used for assessing rotatory and dynamic knee laxity, is associated with ACL deficiency and constitutes the most specific clinical tool for the examination of ACL ruptures [9]. Moreover, the pivot-shift test correlates to subjective instability [10], reduced sport activity [11], and articular and meniscal damage [12]. It should also be high-lighted that full recovery of postoperative laxity is not always achieved when compared with the preinjury level of laxity [13, 14]. However, the functional behavior of the ACL graft at the time of reconstruction is not well understood, and the desired amount of restraint applied by the ACL graft and as compared with the healthy knee has not been fully clarified.

Method

This is aprospective cohort study conducted in dept. of orthopaedic, KGMU, Lucknow in Patients with Anterior Cruciate Ligament tear admitted to the department of Orthopaedics over a period of one year. Full inclusion and exclusion criteria for study eligibility are summarized in Table 1.

Table 1

Inclusion and Exclusion Criteria[a]

Inclusion criteria

- Physically active patients in the age group 18-45 years unwilling to change their life style.
- Clinical / radiological / arthroscopic evidence of anterior cruciate ligament deficiency which remains symptomatic despite conservative therapy.
- Out of acute inflammatory phase of injury with full range of motion and no extensor lag.

Exclusion criteria

- Bilateral ACL tear.
- Lack of fitness due to associated comorbidity.
- Associated fractures of lower limbs and /or spine/ neurovascular injuries.
- Associated injuries to other ligaments of the knee.
- Significant Arthritis of the knee joint.
- Local skin infection.

ACL, anterior cruciate ligament.

All patients with anterior cruciate ligament tear fulfilling the inclusion criteria, subject to written informed consent and admitted to the department of Orthopaedics were assessed for

1. Age
2. Sex
3. Level of physical activity – Inactive/Light/ Moderate/ Vigorous
4. Duration since injury to intervention
5. Preoperative Lysholm knee score
6. Postoperative Lysholm knee score at 6 weeks, 12 weeks and 6 months
7. Preoperative Anterior Drawer test
8. Postoperative Anterior Drawer test at 6 weeks, 12 weeks and 6 months
9. Preoperative Lachman test
10. Postoperative Lachman test at 6 weeks, 12 weeks and 6 months
11. Preoperative Pivot shift test
12. Postoperative Pivot shift test at 6 weeks, 12 weeks and 6 months.

Patients were divided into two groups namely reconstruction with hamstring graft (Group A) and reconstruction with hamstring graft combined with augmentation using fiber tape (Group B) randomly.

Fig 1: Harvested semitendinosus and gracilis auto graft

Fig 2: Graft placed on graft preparation board

Fig 3: Graft sutured along with fibertape

Fig 4: Prepared graft with fibertape along

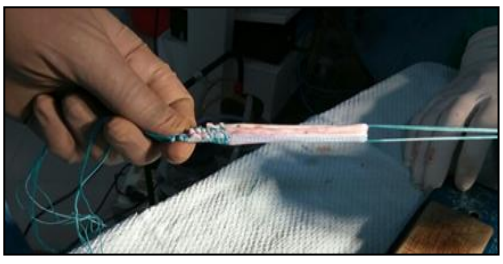

Fig 5: Quadrupled graft with fibertape along

Rehabilitation protocol: Pre-operative rehabilitation

Rehabilitation should commence prior to surgery. After an ACL injury, deficits occur in strength [19], proprioception [20, 21], muscle timing [22] and gait patterns [23]. In fact, strength and proprioceptive alterations occur in both the injured and uninjured knee [24]. The primary impairment with an ACL deficient knee is instability. This is manifested by episodes of 'giving way', which can lead to further joint damage and ultimately, long term degenerative changes [25]. Research has demonstrated that physiotherapy provided pre-operatively is effective in increasing strength and balance which may limit the number the episodes of 'giving way' and decrease the incidence of re-injury in the ACL deficient knee [26, 27]. The main goals of a 'pre-rehabilitative' program prior to surgery include: full range of motion equal to the opposite knee, minimal joint swelling, adequate strength and neuromuscular control, and a positive state of mind [28]. All of these factors facilitate optimal post-operative recovery. It is important to maintain the highest level of strength and function possible in the unaffected leg as it will be used for comparison to assess the progress of the reconstructed knee, in the later stages of rehabilitation [29, 30].

Post-operative rehabilitation

Week 1-2

- Partial weight bearing with support of walker wearing ROM knee brace.
- Range of motion should be 10-90 degrees.
- Quadriceps and hamstring exercises.

Weeks 2-4

- Range of motion should be 0-110 degrees
- Walk wearing ROM knee brace with or without use of stick.

Weeks 4-6

- Range of motion should be 0-115 degrees
- Increase intensity of functional exercises

Weeks 6-12

- Full range of motion. Introduce training as able to demonstrate good mechanics and adequate strength.
- Walking without support with ROM knee brace.

Weeks 12-24

- Patients can begin jogging at 14 weeks assuming they have adequate quadriceps control and no complications. Their first few sessions of running should be monitored.

Weeks > 24 weeks

- squatting allowed
- walking without knee brace

Follow up protocol

- Patient follow up will be done post-operatively at:
- 6 weeks, 12 weeks and 6 months clinically for functional status using Lysholm knee score and extensor lag
- Grading of laxity is to be evaluated by anterior drawer test, Lachman test and pivot shift test.

Case will be labeled as failure as per following criteria given by Noyes and Barber-Westin [31]

1. A complete graft tear with > 6 mm of anterior tibial displacement as compared to healthy knee or
2. A positive pivot shift test graded +2 or +3 compared to the healthy knee, with or without knee pain or inflammation, or subjective sensation of instability or functional limitations for daily life and/or sports activities.

Table 1: Lysholm knee score

Parameters	Finding	Points
1. Limp (5 points)	None	5
	Slight or periodic	3
	Severe and constant	0
2. Support (5 points)	No support	5
	Stick or crutch	2
	Weight bearing impossible	0
3. Stairs climbing (10 points)	No problem	10
	Slightly impaired	6
	One step at a time	2
	Impossible	0
4. Squatting (5 points)	No problem	5
	Slightly impaired	4
	Not past 90 degrees	2
	Impossible	0
5. Instability (25 points)	Never giving way	25
	Rarely gives way except for athletic or other severe exertion	20
	Gives way frequently during athletic events or severe exertion 20	15
	Occasionally in daily activities	10
	Often gives way during daily activities	5
	Gives way on every step	0
6. Swelling (10 points)	None	10
	On severe exertion	6
	On ordinary exertion	2
	Constant	0
7. Pain (25 points)	None	25
	Inconstant and slight during severe exertion	20
	Marked pain during vigorous activities	15
	Marked on or walking more than 1 mile / 2 km	10
	Marked on or walking less than 1 mile / 2 km	5

	Constant	0
8. Locking sensation in the knee --(15 points)	No locking no catching sensation	15
	Catching sensation but no locking sensation	10
	Knee locks occasionally	6
	Knee locks frequently	2
	Locked joint on examination	0

The results are interpreted as follows if scores are

< 65	= Poor
65- 83	= Fair
84- 90	= Good
> 91	= Excellent

Grading of anterior drawer and lachman tests

- Anterior translation of tibia on femur
  - +3 - >10 mm
  - +2 - 5-10 mm
  - +1 - <5 mm

Grading of pivot shift tests

1. Gentle twisting slide with tibia twisting internally maximally;
2. Clunk with tibia neutral, negative when tibia externally rotated;
3. Painless glide for examiner and patient;
4. Jamming and Plowing, impingement;

Knee extension lag

Present - $\geq 5^0$

Absent - $<5^0$

Observation and Results

Table 2: Age distribution of subjects

Age				
Type	**Mean**	**SD**	**Min.**	**Max.**
Non Fiber	32.16	9.22	17	56
Fiber	27.84	9.44	16	53
t-value	1.604			
p-value	0.115			

The mean age of patients in Non Fiber groups was 32.16±9.22 years (Table-2) which was slightly more than the Fiber group where the mean age of patients was 27.84±9.44years. However the difference in mean ages between the two groups was not found to be significant (p=0.115) (Table-2).

Table 3: Sex distribution of subjects

Sex	**Type**				**Total**	
	Non Fiber		**Fiber**			
	No.	**%**	**No.**	**%**	**No.**	**%**
Female	5	20.00%	4	16.00%	9	18.00%
Male	20	80.00%	21	84.00%	41	82.00%
Total	25	100.00%	25	100.00%	50	100.00%
chi sq	0.136					
p-value	0.713					

In the non-fiber group there were 20.0% females and 80.0% males while the fiber group contained 16.0% females and 84.0% males (Table-3). Overall the study included 18.0% females and 82.0% males. The difference in female – male ratio between the two groups was not found to be significant (p=0.713) (Table-3).

Table 4: Anterior drawer test results – intergroup comparison between non-fiber and fiber group

Anterior Drawer test		**Type**				**Total**	
		Non Fiber		**Fiber**			
		No.	**%**	**No.**	**%**	**No.**	**%**
Pre-operative	Grade 2	14	56.00%	8	32.00%	22	44.00%
	Grade 3	11	44.00%	17	68.00%	28	56.00%
	Chi sq	2.922					
	p-value	0.087					
6 week Post-operative	Grade 1	24	96.00%	23	92.00%	47	86.00%
	Grade 2	1	4.00%	2	8.00%	3	14.00%
	Chi sq	0.355					
	p-value	0.552					
12 week Post-operative	Grade 1	22	88.00%	21	84.00%	43	86.00%
	Grade 2	3	12.00%	4	16.00%	7	14.00%
	Chi sq	0.166					
	p-value	0.684					
6 month Post-operative	Grade 1	22	88.00%	24	96.00%	46	92.00%
	Grade 2	3	12.00%	1	4.00%	4	8.00%
	Chi sq	1.087					
	p-value	0.297					

Pre operatively anterior drawer test grade 3 was seen in 44.0% cases of non-fiber group and 68.0% cases of fiber group. Remaining cases had grade 2 in both the groups. Pre operatively no significant difference was found in various grades proportion between the two groups (p=0.087) Post operatively after 6 weeks Anterior drawer test grade 3 was eliminated from both groups. Therefore improvement was found in both the groups. Grade 2 was seen in 4.0% cases of non-fiber group and 8.0% cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 96% and 92% respectively. However no significant difference was found between the two groups (p=0.552) (Table-4).

Post operatively after 12 weeks anterior drawer test grade 3 was eliminated from both groups. Grade 2 was seen in 12.0% cases of non-fiber group and 16.0% cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 88% and 84% respectively. However no significant difference was found between the two groups (p=0.684) (Table-4).

Post operatively after 6 months anterior drawer test grade 3 was eliminated from both groups. Grade 2 was again seen in 12.0% cases of non fiber and 4.0% cases of fiber group. Grade 1 was seen in 88% of non-fiber groups and 96.0% of fiber group. However no significant difference was found between the two groups (p=0.297) (Table-4).

Considering Grade 3 to Grade 1 shifting as improvement of level 2 and Grade 2 to Grade 1 or grade 3 to Grade2 shifting as improvement of level 1. Following table was made to compare improvements between the groups.

Table 5: Intergroup comparison of improvements in grades of anterior drawer test

Time	Improvement level	Non Fiber		Fiber		chi sq	p-value
		No.	%	No.	%		
6 week	Level - 1	14	56.00%	9	36.00%	2.013	0.156
	Level - 2	11	44.00%	14	56.00%		
12 week	Level - 1	16	64.00%	8	32.00%	5.128	0.024
	Level - 2	9	36.00%	17	68.00%		
6 month	Unchange	2	8.00%	0	0.00%	6.29	0.043
	Level - 1	16	64.00%	10	40.00%		
	Level - 2	7	28.00%	15	60.00%		

On comparing the improvement in grades of ADT, after 6 weeks the fiber group showed 56.0% improvement of level – 2 and 44.0% improvement of level – 1 while non-fiber group showed 44.0% improvement of level – 2 and 56.0% improvement of level – 1. However no significant difference in various improvement levels was found between the two groups. (p=0.156) (Table-5).

After 12 weeks the fiber group showed 68.0% improvement of level – 2 and 32.0% improvement of level – 1 while non-fiber group showed only 36.0% improvement of level – 2 and remaining 64.0% improvement of level – 1. Fiber group showed significantly more improvement than the non fiber group. (p=0.024) (Table-5).

After 6 month the fiber group showed 60.0% improvement of level – 2 and 40.0% improvement of level – 1 while non-fiber group showed only 28.0% improvement of level – 2 and 64.0% improvement of level – 1. Fiber group showed significantly more improvement than the non fiber group. (p=0.043) (Table-5).

Pre operatively Lachman test grade 3 was seen in 36.0% cases of non-fiber group and 72.0% cases of fiber group. Remaining cases had grade 2 in both the groups (Table-6). Pre operatively a significant difference was found in grades between the two groups (p=0.011) (Table-6).

Post operatively after 6 weeks Lachman test grade 3 was eliminated from both groups. Grade 2 was seen in 4.0% cases of non-fiber group and 8.0% cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 96% and 92% respectively (Table-6). However no significant difference was found between the two groups (p=0.552) (Table-6).

Post operatively after 12 weeks Lachman test grade 3 was eliminated from both groups. Grade 2 was seen in 12.0% cases of non-fiber group and 8.0% cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 88% and 92% respectively (table-6). However no significant difference was found between the two groups (p=0.637) (Table-6).

Post operatively after 6months Lachman test grade 3 was eliminated from both groups. Grade 2 was seen in 16.0% cases of non-fiber group and 8.0% cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 84% and 92% respectively (Table-6). However no significant difference was found between the two groups (p=0.384) (Table-6).

Table 6: Lachman Test Results

Lachman's test		Type				Total	
		Non Fiber		Fiber			
		No.	%	No.	%	No.	%
Pre-operative	Grade 2	16	64.0%	7	28.0%	23	46.0%
	Grade 3	9	36.0%	18	72.0%	27	54.0%
	chi sq	6.522					
	p-value	0.011					
6 week Post-operative	Grade 1	24	96.0%	23	92.0%	47	94.0%
	Grade 2	1	4.0%	2	8.0%	3	6.0%
	chi sq	0.355					
	p-value	0.552					
12 week Post-operative	Grade 1	22	88.0%	23	92.0%	45	90.0%
	Grade 2	3	12.0%	2	8.0%	5	10.0%
	chi sq	0.222					
	p-value	0.637					
6 month Post-operative	Grade 1	21	84.0%	23	92.0%	44	88.0%
	Grade 2	4	16.0%	2	8.0%	6	12.0%
	chi sq	.758					
	p-value	0.384					

On comparing the improvement in grades of Lachman test, after 6 weeks the fiber group showed 60.0% improvement of level – 2 and 40.0% improvement of level – 1 while non-fiber group showed 44.0% improvement of level – 2 and 56.0% improvement of level – 1 (Table-7). However no significant difference in various improvement levels was found between the two groups. (p=0.258) (Table-7).

Table 7: Intergroup comparison of improvements in grades of lachman test

Time	Improvement level	Non Fiber		Fiber		chi sq	p-value
		No.	%	No.	%		
6 week	Level - 1	14	56.0%	10	40.0%	1.282	0.258
	Level - 2	11	44.0%	15	60.0%		
12 week	Level - 1	16	64.0%	8	32.0%	5.13	0.024
	Level - 2	9	36.0%	17	68.0%		
6 month	Unchange	2	8.0%	1	4.0%	6.48*	0.039
	Level - 1	15	60.0%	7	28.0%		
	Level - 2	8	32.0%	17	68.0%		

After 12 weeks the fiber group showed 68.0% improvement of level – 2 and 32.0% improvement of level – 1 while non-fiber group showed only 36.0% improvement of level – 2 and remaining 64.0% improvement of level – 1 (Table-7). Fiber groups showed significantly more improvement than the non fiber group. (p=0.024) (Table-7).

After 6 months the fiber group showed 68.0% improvement of level – 2 and 28.0% improvement of level – 1 while non-fiber group showed only 32.0% improvement of level – 2 and remaining 60.0% improvement of level – 1(Table-7). Fiber groups showed significantly more improvement than the non fiber group. (p=0.039) (Table-7).

Table 8: Knee extension lag status

knee extension lag		Type				Total	
		Non Fiber		Fiber			
		No.	%	No.	%	No.	%
Pre-operative	Present	4	16.0%	2	8.0%	6	12.0%
	Absent	21	84.0%	23	92.0%	44	88.0%
	chi sq	0.758					
	p-value	0.384					
6 week	Present	2	8.0%	1	4.0%	3	6.0%
	Absent	23	92.0%	24	96.0%	47	94.0%
	chi sq	0.355					
	p-value	0.552					
12 week	Absent	25	100.0%	25	100.0%	50	100.0%
	chi sq	NA					
	p-value	NA					
6 month Post-operative	Absent	25	100.0%	25	100.0%	50	100.0%
	chi sq	NA					
	p-value	NA					

Pre operatively Knee extension lag was present in 16.0% cases of non-fiber group and 8.0% cases of fiber group (Table-8). Pre operatively no significant difference was found in knee extension lag between the two groups (p=0.384) (Table-8)

Post operatively after 6 weeks Knee extension lag was present in 8.0% cases of non-fiber and 4.0% cases of fiber groups (Table-8). Post operatively no significant difference was found in knee extension lag between the two groups (p=0.552) (Table-8)

Post operatively after 12 weeks and onwards Knee extension lag was absent in all the cases (Table-8).

Table 9: Lysholm knee score comparison between the fiber & non – fibre

Lysholm Knee Score	Non Fiber		Fiber		t-value	p-value
	Mean	SD	Mean	SD		
Pre-operative	64.5	8.88	63.78	9.19	0.392	.784
6 week	74.92	5.66	75.82	5.77	0.121	0.904
12 week	81.14	5.06	80.02	5.04	0.192	.848
6 month	87.02	4.77	86.96	4.98	0.313	.756

Pre operatively mean Lysholm knee score for the non-fiber group was 64.5±8.88 while for the fiber group it was 63.78±9.19 (Table-9). The difference was insignificant (p=0.784) (Table-9).

Post operatively after 6 weeks mean Lysholm knee score for the non-fiber group was 74.92±5.66 while for the fiber group it was 75.82±5.77 (Table-9). Again the difference between the two groups was insignificant (p=.904) (Table-9).

Post operatively after 12 weeks mean Lysholm knee score for the non-fiber group was 81.14±5.06 while for the fiber group it was 80.02±5.04 (Table-9). Was increased but insignificant (p=0.848) (Table-9).

Post operatively after 6 months mean Lysholm knee score for the non-fiber group was 87.02±4.77 while for the fiber group it was 86.96±4. 98 (Table-9). Was insignificant (p=0.756) (Table-9).

Discussion

The present study was conducted on patients with anterior cruciate ligament tear admitted in department of orthopaedics, King george's medical university, Lucknow. The study was conducted with an aim to measure the additional effect of using Fiber-tape along with hamstring graft on functional outcome of anterior cruciate ligament reconstruction.

The present study had total of 50 subjects among which 25 were assigned in to two groups randomly, viz Group 1 of the treatment procedure – Quadruple hamstring graft alone and Group 2 of patients with augmented hamstring graft with fibertape. Mark D. Santi *et al* [15]**,** in their study compared 28 patients of ligament augmentation device in the semitendinosus and gracilis tendons with 32 patients who had reconstruction with semitendinosus and gracilis tendons alone.

Our observations of the present study has been discussed under the following headings.

1. Age distribution of the patients
2. Gender distribution of patients
3. Assessment in functional recovery of the patients using lysholm knee score at different follow-ups in the postoperative period
4. Assessment of anterior drawer test at different follow-ups in the postoperative period
5. Assessment of lachmann test at different follow-ups in the postoperative period
6. Age distribution of the patients

The mean age of patients in Non Fiber group was 32.16±9.22 years which was slightly more than the Fiber group where the mean age of patients was 27.84±9.44 years. However the difference in mean ages between the two groups was not found to be significant (p=0.115). In study of Mark d santi *et al.* [15], the mean age group of patients with ligament augmentation device were 27.3±7.0, and those in non-ligament augmentation device were 24.3±7.3 and there was no significant differences between the two groups in terms of

age distribution. Riel KA *et al.* [16] in their study had 31 cases with patellar tendon graft and 50 cases with a quadriceps-patellar periosteum-patellar tendon auto graft (Marshall-MacIntosh) augmented with the Kennedy Ligament augmentation device (LAD).

1. Gender distribution of patients the male-female ratio in non fiber group was 80.0%: 20.0% %, while in fiber group was 84.0%: 16.0% %. Mark d santi *et al* [15] in their study had a male female ratio in LAD group as 75: 25 %, while in non - LAD group it was 71.87: 28.13 %. Most of the patients in both the groups were males probably because males are more active, spend more time outwards and exposed to injuries as compared to females in our Indian set up. Since the patients in both the groups were similar with regards to age and sex distribution, we can infer that patients in both the groups were similar and therefore comparable.
2. Assessment in functional recovery of the patients using Lysholm knee score at different follow-ups in the postoperative period Mean Lysholm knee score in non-fiber group was 74.92, 81.14 and 87.02 at 6 weeks, 12 weeks and 6 months follow-up respectively, the intragroup improvement being statistically significant. While in fiber group it was 75.82, 80.02, and 86.96 at 6 weeks, 12 weeks and 6 months follow-up respectively, the intragroup improvement being statistically significant. However the difference in Lysholm knee score between the two groups during the follow up weeks was insignificant. Mark d santi *et al* [15] in their study had a mean Lysholm knee score of 89.8 in ligament augmentation device group and 92.0 in the non-ligament augmentation device group. However the mean postoperative Lysholm score for the ligament augmentation device group was not statistically different from that of the non- ligament augmentation device group.
3. Assessment of anterior drawer test at different follow-ups in the postoperative period. Post operatively after 6 weeks anterior drawer test grade 3 was eliminated from both groups. Therefore improvement was found in both the groups. Grade 2 was seen in 1 cases of non-fiber group and 2 cases of fiber group. However no significant difference was found between the two groups (p=0.552). Post operatively after 12 weeks anterior drawer test grade 3 was eliminated from both groups. Grade 2 was seen in 3 cases of non-fiber group and 4 cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups. However no significant difference was found between the two groups (p=0.684). Post operatively after 6 months anterior drawer test grade 2 was seen in 3 cases of non fiber and 1 cases of fiber group. The rest had grade 1 anterior drawer test. However no significant difference was found between the two groups (p=0.297) Among the 25 patients in non-fiber group who underwent ACL reconstruction, three patients had grade 2 anterior drawer test, rest all patients had grade 1 anterior drawer test at 6 months follow-up. But among the 25 patients in the fiber group, one patient had grade 2 anterior drawer test, rest all patients had grade 1 anterior drawer test at 6 months follow-up. On comparing the improvement in grades at 12 weeks and 6 months follow-up, fiber group showed significantly more improvement compared with the non-fiber group.
4. Assessment of Lachman test at different follow-ups in the postoperative period Post operatively at 6 weeks Lachman test grade 3 was eliminated from both groups. Grade 2 was seen in 1 case of non-fiber group and 2 cases of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 96% and 92% respectively. However no significant difference was found between the two groups (p=0.552) Post operatively after 12 weeks Lachman test Grade 2 was seen in 3 cases of non-fiber group and 2 case of fiber group. Majority had grade 1 in both non-fiber and fiber groups with proportion 92% and 96% respectively. However no significant difference was found between the two groups (p=0.637) four patients in non-fiber group had grade 2 Lachman test, rest all patients had grade 1 Lachman test at 6 months follow-up. But among the 25 patients in the fiber group, two patient had grade 2 Lachman test, rest all patients had grade 1 Lachman test at 6 months follow-up. However no significant difference was found between the two groups (p=0.384). On comparing the improvement in grades at each follow-up, fiber group showed significantly more improvement at 12 weeks and 6 months compared with the non-fiber group. Mark d santi *et al* [15] in their study had no difference statistically between the ligament augmentation device and non-ligament augmentation device group. None of the cases in both the groups showed grade 3 positive for Lachman and anterior drawer test at 6 months follow up. None of the cases in both the groups showed positive pivot shift test at 6 months follow up. Harvesting the semitendinosus tendon alone without the gracilis avoids flexion and internal rotation strength deficits [17, 18]. Adding fiber tape to the semitendinosus graft can avoid gracilis harvesting and the complications relating to it such as reduction in flexion and internal rotation strengths. Adding a synthetic fibertape to augment hamstring autograft in ACL reconstruction offers theoretical advantages but many questions remain unanswered. Stress shielding of the autograft may be beneficial in the early revascularization phase, but the continued effect of long-term stress shielding on the ultimate tensile properties of the graft is still unknown. Mark D. Santi *et al* [15], found no difference in the objective criteria (KT-1000 arthrometer testing, presence of pivot shift, or Lachman knee score) to suggest that the ligament augmentation device improved graft performance. Examining subjective data (Lysholm knee score, return to Tegner activity levels, and overall subjective rating) likewise revealed no significant difference in the two groups. Mark D. Santi *et al* [15] in their study, 4 of 28 patients (14%) with ligament augmentation device had recurrent symptomatic effusions. Removal of the synthetic material was helpful in all patients. None of the patients in our study developed such a complication.

One of the limitations of our study is a short follow-up period as long term effect of the fibertape on graft could not be evaluated.

Conclusion

In our study it was found that the improvement in grades of anterior drawer test and Lachman test in fibertape augmented group was significantly more than the non-augmented group at 12 weeks and 6 months.

Improvement in the subjective Lysholm knee score was found to be equal in both the groups with no significant difference between the two.

Pivot shift test was absent in all the patients of reconstructed group postoperatively thus improving the rotational stability of the knee. All patients had full extension at 6 months follow up.

Addition of fibertape with hamstring graft did not develop any postoperative effusions or allergic reactions in our study.

The fibertape may act as a secondary stabilizer of the knee thus preventing injury or graft elongation over time. It may also add to the thickness of small diameter grafts of < 8 mm.

Follow up period of 6 months was a limiting factor in our study. This technique needs further clinical evaluation to assess the long term results and the effect of protection of the graft and also to study the clinical behavior of the resultant collagen fibertape.

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