

Functional Outcome of ACL Reconstruction using Hamstring Graft Augmented with Internal Bracing using Fibre Tape

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Abstract:

Introduction: A tear in the anterior cruciate ligament, is a commonly observed outcome of a knee sprain. The present study was conducted to find out the functional outcome of ACL reconstruction using hamstring graft augmented with internal bracing using fibre tape.

Material & Methods: The prospective study was conducted among 50 patients admitted to Department of Orthopaedics for ACL reconstruction for a period of one year. The following test were done : Lysholm knee score, Anterior Drawer test, Lachman test and Pivot shift test both pre and post operatively. The results were analyzed using SPSS version 23.0.

Results: Mean age of patients were found to be 28.34±8.33 years and male patients were more in number (76%) as compared to female patients (24%). The patients showed improvement in grades at 12 weeks and 6 months follow up.

Conclusion: In our study, it was discovered that the patients showed good performance at 12 weeks and 6 months in terms of grade improvement on the anterior drawer test and the Lachman test. The 6-month follow-up time was a constraint on our investigation. Additional clinical testing of this procedure is required to evaluate the long-term outcomes, the impact of graft protection, and the clinical behavior of the resulting collagen fibertape.

Keywords: ACL, Anterior drawer test, graft, lachman test, reconstruction.

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Introduction

An ACL tear, specifically a tear in the anterior cruciate ligament, is a commonly observed outcome of a knee sprain, occurring with a prevalence of approximately 1 in 3000 cases.[1,2] Professional athletes are the individuals who most commonly encounter an anterior cruciate ligament (ACL) tear. Athletes who engage in sports such as skiing, football, and basketball are particularly susceptible to a heightened level of risk.[3] In contemporary society, where there is a prevalent emphasis on physical culture and a noticeable inclination towards regular engagement in physical activities, alongside the rising popularity of extreme sports, there is a consistent increase in the incidence of patients seeking medical attention for ACL injuries.[4]

When left untreated, tears in the anterior cruciate ligament (ACL) cause an imbalance in the biomechanics of the knee joint. This imbalance subsequently leads to instability in the knee, making it

more vulnerable to future injuries. Additionally, the motion dynamics of the affected lower limb are impaired.[5] This phenomenon directly results in a decline in athletic performance or, in specific sports, renders training unfeasible and potentially unattainable.[6] Additional long-term effects may involve causing harm to other internal components of the knee, specifically the menisci and the articular cartilage, which can increase the likelihood of developing arthritis. In light of the prevailing emphasis on leading a healthy lifestyle and the widespread endeavor to uphold physical fitness, the majority of patients express a desire to resume their regular training or engage in their preferred recreational activities. Consequently, they frequently opt to undergo surgical intervention shortly after being informed of their diagnosis.[7]

The efficacy of ACL reconstruction, the prevailing medical intervention for individuals with an active

lifestyle, in fully restoring the kinematics of the affected joint remains uncertain.[8] Previous studies have shown that the pivot-shift test, which is utilized to evaluate rotational and dynamic knee laxity, is closely linked to ACL deficiency and represents the most precise clinical method for assessing ACL ruptures.[9] Additionally, it has been observed that the pivot-shift test is associated with subjective instability,[10] decreased participation in sports activities,[11] and damage to the articular and meniscal structures.[12] It is important to note that complete restoration of postoperative laxity may not always be attained in comparison to the level of laxity prior to the injury[13,14]. Nevertheless, there is currently limited understanding regarding the functional behavior of the anterior cruciate ligament (ACL) graft during reconstruction. Additionally, the extent to which the ACL graft provides the desired level of restraint, in comparison to a healthy knee, remains unclear. Hence the present study was to find out the functional outcome of ACL reconstruction using hamstring graft augmented with internal bracing using fibre tape.

Material & Methods

The prospective study was conducted in Department of Orthopaedics in patients admitted with Anterior Cruciate Ligament tear over a period of one year. Ethical permission was taken from the concerned hospital and college before the commencement of study. Total 50 patients were selected for the study on the basis of following inclusion and exclusion criteria-

Inclusion criteria-

1. Individuals between the ages of 18 and 45 who engage in regular physical activity and exhibit a reluctance to modify their current lifestyle.
2. There is a presence of clinical, radiological, and arthroscopic evidence indicating anterior cruciate ligament deficiency. Despite undergoing

conservative therapy, the symptoms associated with this deficiency persist.

3. The individual has successfully transitioned from the acute inflammatory phase of injury, exhibiting a complete range of motion and the absence of any extensor lag.

Exclusion Criteria:

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

All the details of patients admitted to Department for ACL repair were noted involving demographic details, pre operative findings and post-operative findings. Patients were asked to sign an informed consent form before commencement of operation. The following test will be done pre, post and follow up period to know the functional outcome of rehabilitation: Lysholm knee score, Anterior Drawer test, Lachman test and Pivot shift test. Patient will be followed at 6 weeks, 12 weeks and 6 months.[15] Case will be labeled as failure as criteria given by Noyes and Barber-Westin[16]

After documenting the all values in Microsoft excel the results will be prepared using SPSS version 23.0 for statistical analysis, keeping the level of significance at $p < 0.05$.

Results

Demographic data of patients showed that mean age of patients were found to be 28.34 ± 8.33 years and male patients were more in number (76%) as compared to female patients (24%) as shown in table 1.

Table 1: Demographic details of patients

Variable	Mean / N(%)
Age (in years)	28.34±8.33
Male	38 (76)
Female	12 (24)

Pre operatively anterior drawer test grade 3 was seen in 45% cases remaining cases (55%) had grade 2. Pre operatively no significant difference was found in various grades proportion ($p=0.078$) Post operatively after 6 weeks Anterior drawer test grade 3 was eliminated. Grade 2 was seen in 9% of cases. Majority had grade 1 with proportion 91%. However no significant difference was found ($p=0.631$). Post operatively after 12 weeks anterior drawer test grade 3 was eliminated. Grade 2 was seen 14% cases.

Majority had grade 1 with 86%. However no significant difference was found ($p=0.764$). Post operatively after 6 months anterior drawer test grade 3 was eliminated. Grade 2 was again seen in 3% cases of fiber group. Grade 1 was seen in 97% of cases. However no significant difference was found ($p=0.314$) as seen in table 2.

Table 2: Anterior drawer test result at pre-operative, 6 weeks, 12 weeks and 6 months

Variable		Percentage	P value
Preoperatively	Grade 2	55	0.078
	Grade 3	45	
6 weeks	Grade 1	91	0.631
	Grade 2	9	
12 weeks	Grade 1	86	0.764
	Grade 2	14	
6 months	Grade 1	97	0.314
	Grade 2	3	

Pre operatively Lachman test grade 3 was seen in 75% cases. Remaining 35% cases had grade 2. Pre operatively a significant difference was found ($p=0.010$). Post operatively after 6 weeks Grade 2 was seen in 9% cases. Majority had grade 1 with 91%. However no significant difference was found ($p=0.573$). Post operatively after 12 weeks. Grade 2

was seen 8% cases. Majority 92% had grade 1. However, no significant difference was found ($p=0.721$). Post operatively after 6 months Lachman test grade 3 was eliminated. Grade 2 was seen in 7% of cases. Majority had grade 1 in 93% respectively. However no significant difference was found ($p=0.263$) as shown in table 3.

Table 3: Lachman test result at pre-operative, 6 weeks, 12 weeks and 6 months

Variable		Percentage	P value
Preoperatively	Grade 2	75	0.010
	Grade 3	35	
6 weeks	Grade 1	91	0.573
	Grade 2	9	
12 weeks	Grade 1	92	0.721
	Grade 2	8	
6 months	Grade 1	97	0.263
	Grade 2	3	

Pre operatively Knee extension lag was present in 9% cases. Pre operatively no significant difference was found in knee extension lag ($p=0.284$). Post operatively after 6 weeks Knee extension lag was present in 5% cases. Post operatively no significant difference was found in knee extension lag ($p=0.563$). Post operatively after 12 weeks and onwards Knee extension lag was absent in all the cases as shown in table 4.

Table 4: Knee extension lag status pre-operative, 6 weeks, 12 weeks and 6 months

Variable		Percentage	P value
Pre operatively	Absent	91	0.284
	Present	9	
6 weeks	Absent	95	0.563
	Present	5	
12 weeks	Absent	100	-
	Present	0	
6 months	Absent	100	-
	Present	0	

Pre operatively mean Lysholm knee score for the case was 64.86 ± 9.28 . Post operatively after 6 weeks mean Lysholm knee score was 76.81 ± 4.76 . Post operatively after 12 weeks mean Lysholm knee score was 82.06 ± 4.05 . Post operatively after 6 months mean Lysholm knee score was 85.86 ± 4.98 . The results were non-significant with p value = 0.781 as shown in table 4.

Variable	Mean score	P value
Pre operatively	64.86 ± 9.28	0.781
6 weeks	76.81 ± 4.76	
12 weeks	82.06 ± 4.05	
6 months	85.86 ± 4.98	

Discussion

The present study was conducted among 50 patients with anterior cruciate ligament tear admitted in department of orthopaedics. The study was conducted with an aim to find out the functional outcome of ACL reconstruction using hamstring graft augmented with internal bracing using fibre tape.

The average patient age was 28.34 ± 8.33 years. The mean age group of patients using a ligament augmentation device in a study by Mark d. Santi et al.[17] was 27.3 ± 7.0 years, and the mean age group of patients using a nonalignment augmentation device was 24.3 ± 7.3 years. There were no statistically significant variations in the age distribution of the two groups. In their study, Riel KA et al.[18] included 50 cases of a quadriceps patellarperiosteum-patellar tendon autograft (MarshallMacIntosh) and 31 examples of patellar tendon grafts, both of which were enhanced with the Kennedy Ligament Augmentation Device (LAD).

In our study male patients were more in number (76%) as compared to female patients (24%). In a study by, Mark D. Santi et al.[17] found that the male to female ratio in the LAD group was 75:25, compared to 71.87:28.13% in the non-LAD group. Due to the fact that men tend to be more active, spend more time outside, and sustain injuries more frequently than women in our Indian healthcare system, men made up the majority of patients .

Grade 3 of the anterior drawer test was removed from both groups 12 weeks following surgery. Pre operatively anterior drawer test grade 3 was seen in 45% cases remaining cases (55%) had grade 2. Pre operatively no significant difference was found in various grades proportion ($p=0.078$) Post operatively after 6 weeks Anterior drawer test grade 3 was eliminated. Grade 2 was seen in 9% of cases. Majority had grade 1 with proportion 91%. However no significant difference was found ($p=0.631$). Post operatively after 12 weeks anterior drawer test grade 3 was eliminated. Grade 2 was seen 14% cases. Majority had grade 1 with 86%. However no significant difference was found ($p=0.764$). Post operatively after 6 months anterior drawer test grade 3 was eliminated. Grade 2 was again seen in 3% cases of fiber group. Grade 1 was seen in 97% of cases. However no significant difference was found ($p=0.314$). This shows the improvement of patients undergone ACL reconstruction.

Lachman test evaluation during various postoperative follow-up visits. At six weeks following surgery, grade 3 patients from both groups were excluded from the Lachman test. Pre operatively Lachman test grade 3 was seen in 75% cases. Remaining 35% cases had grade 2. Pre operatively a significant difference was found ($p=0.010$). Post operatively after 6 weeks Grade 2 was seen in 9% cases. Majority had grade 1 with 91%. However no significant difference was found

($p=0.573$). Post operatively after 12 weeks. Grade 2 was seen 8% cases. Majority 92% had grade 1. However no significant difference was found ($p=0.721$). After 6 months grade 2 was seen in 7% of cases. Majority had grade 1 in 93% respectively. However no significant difference was found ($p=0.263$). In their investigation, Mark D. Santi et al.[17] found no statistically significant difference between the ligament augmentation device group and the nonligament augmentation device group. At the 6-month follow-up, none of the cases in either group displayed grade 3-positive results for the Lachman and anterior drawer tests. At the 6-month follow-up, none of the cases in either group displayed a positive pivot shift test. Deficits in flexion and internal rotation strength are prevented when the semitendinosus tendon is harvested separately from the gracilis[19,20]. Fiber tape can be applied to the semitendinosus graft to prevent gracilis harvesting and the problems that come with it, such as diminished flexion and internal rotation strengths. Theoretically, there are benefits to using a synthetic fibertape in addition to hamstring autograft for ACL restoration, however there are still many unsolved issues.

Lysholm knee score evaluation of patients' functional recovery at various follow-up visits following surgery At 6 weeks, 12 weeks, and 6 months after the follow-up, the mean score was was 76.81, 82.06, and 85.86, respectively; this improvement was statistically non-significant.. In their study, Mark D. Santi et al.[17] found that the mean Lysholm knee score was 89.8 in the group using ligament augmentation devices and 92.0 in the group using non-ligament augmentation devices. However, there was no statistically significant difference between the mean postoperative Lysholm score for the group using ligament augmentation devices and the group not using such devices.

According to Mark D. Santi et al.'s study[17], recurrent symptomatic effusions occurred in 4 out of 28 patients (14%) who received a ligament augmentation device. In all patients, removing the synthetic substance proved beneficial. No one in our study's patients experienced this problem.

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

Conclusion

In our study, it was discovered that the fiber tape augmented cases showed good results at 12 weeks and 6 months in terms of grade improvement on the anterior drawer test and the Lachman test. After surgery, none of the patients in the group who had their knees reconstructed failed the pivot shift test, enhancing the rotational stability of the knee. At the 6-month follow-up, every patient had complete extension. In our investigation, there were no postoperative effusions or allergic responses

associated with the addition of fibertape to hamstring grafts. The fibertape may function as a second knee stabilizer, reducing damage or long-term graft elongation. Additionally, it might increase the thickness of 8 mm or smaller diameter grafts. The 6-month follow-up time was a constraint on our investigation. Additional clinical testing of this procedure is required to evaluate the long-term outcomes, the impact of graft protection, and the clinical behavior of the resulting collagen fibertape.

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