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Original Research Paper

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QUALITATIVE AND QUANTITATIVE ASSESSMENT OF EFFICACY OF TIGHTROPE FEMORAL FIXATION IN ACL RECONSTRUCTION SURGERY

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KEYWORDS :

INTRODUCTION

Anterior Cruciate Ligament (ACL) is an intraarticular extra-synovial ligament traversing the knee in an antero-inferio-medial direction with its fibres generally twisted along its long axis.[1,2,3]. ACL lends stability to the knee by preventing the anterior translation of the tibia over the femur. Not only does the ligament serve the purpose of stability but also has important proprioceptive function.[4,5,6,7,8]. It is about 35 mm long and 11mm in diameter.

ACL injuries are more commonly seen in the young age group individuals especially those involved in high intensity vigorous activities like athletes, with males more commonly seeking medical attention for this condition. The approach to ACL tear has undergone several changes in last four decades. In 1960s they went untreated, instability being managed by peripheral stabilizing measures. In 1970s and 1980s there was an increasing trend towards operative repair of ACL on an emergency basis to prevent retraction of ligament stumps. By early 1990s, surgeons combined the repair of acute tear with concomitant augmentation of ACL using tendon autografts or synthetic materials (Michael J Strobel)[9]. Central one third Bone patellar tendon bone autograft and quadrupled hamstring autograft are the most popular options for ACL Reconstruction currently.

TightRope (Arthrex, Naples, FL) is a second-generation adjustable loop length suspensory fixation device. The TightRope button is attached to graft through a loop that can be tightened even after insertion into the canal. The adjustable loop allows the surgeon some freedom in terms of the length of the femoral socket, eliminates the need for bothersome intraoperative calculations for selecting loop length, ensures that the socket is completely filled with graft, and provides the possibility of tensioning the graft even after graft fixation and is fast, easy, and secure technique[10].On reviewing the literature we found studies evaluating the outcome of tightrope femoral fixation in arthroscopic ACL reconstruction using quadrupled hamstring autograft. We conducted this study with the aim to assess both the qualitative outcome (Functional assessment) and the quantitative outcome(Objective assessment of ATT by Rolimeter) of the technique . To the best of our knowledge (pubmed search) no previous study has looked at the quantitative assessment of the Tightrope.

METHODS

This was a prospective observational study adhering to the tenets of Declaration of Helsinki. The study was approved by internal Institutional Review Board of the hospital.

Subjects

Records of all patients with Anterior Cruciate ligament tear with or without meniscal injuries from December 2013 to February 2015 at the orthopedics department of Safdarjung hospital New Delhi , was reviewed . The diagnosis was confirmed radiologically on X-ray and magnetic resonance imaging (MRI) scan. Patients aged 19–40 years who had ACL tear with or without meniscus tear within 9-month post injury, without evidence of clinical or radiological degenerative changes in the knee joint, and underwent arthroscopic-guided ACL reconstruction using Semitendinosus and Gracilis were included in the study. Bony avulsions of anterior cruciate ligament, ACL tear with associated other ligament injuries, cartilage lesions ,intra-articular fractures ,ACL tear in osteoarthritic knee, Posterior cruciate ligament tear, ACL tear older than 9 months, bilateral ACL ruptures and revision of ACL reconstruction were excluded .

Out of 100 cases reviewed, 30 patients who fulfilled the inclusion criterion and had minimum follow up of 6 months were enrolled in the study.

The preoperative evaluation of the patients documented the ligament laxity assessed using Lachman's test (0–4+ grades),anterior drawer's test, and pivot shift test. Rolimeter reading of anterior tibial translation was also done preoperatively. All patients underwent pre-anaesthesia check up and were taken as American Society of Anesthesiologists (ASA) grade 1 .

Surgical Technique

Semitendinosus and Gracilis hamstring grafts were harvested and used for the anterior cruciate ligament reconstruction. The graft preparation attachments were placed on the base and ACL tightrope implants were loaded into the attachments. The distance between tightrope loops ends was measured and was kept 10mm less than the final graft length. The graft was loaded through the implant by folding symmetrically over the loops. Both graft ends were stitched together with a single fibre loop after passing the graft through ACL Tight Rope. Alternatively, approximately 2cm of each graft end was stitched with one fibre loop and one tight loop. The tail of each whip 18 stitch was passed over the graft loop ensuring that the tails of the graft were tucked inside the loop during tensioning. This facilitates tapering of ends and maintaining uniform thickness of the graft. Once the graft was folded appropriately and desired length was achieved, the whipstitch sutures were wrapped around the post to hold the construct in place.

At first the meniscal pathology was dealt with, balancing any unstable tears or whittling any meniscal segments impinging during knee movement.

The torn stump of the ACL was identified and a note was made of the level of tear. Minimal debridement of the ACL stump on both the femoral and tibial sides was done as a rule, to

preserve the healing capacity of the sheath remnant.

The femoral footprint was cleared for better visualization to ascertain the intra-articular reference point for the femoral tunnel. A true notch plasty was not performed unless needed on the medial surface of the lateral femoral condyle. Femoral and Tibial Tunnels were made and the graft was passed.

TightRope fixation was used on femoral side. On tibial side graft was fixed with interference screw after cycling for 20 times. Re-tensioning was done at femoral side. After thorough lavage of joint, wound is closed in layers. Dressing is done and knee is immobilized in full extension with a knee brace. Postoperatively routine analgesics and antibiotics were given for 7 days.Suture removal was done at 2 weeks post-operatively. Follow up was done at 2 and 6 weeks , 3 and 6 months postoperatively.

All patients underwent vigorous ACL rehabilitation starting from post-operative day 3 as per the protocol and continued through the follow up period of 3-6 months depending upon the function and stability of the joint .

Outcome Measures

The primary outcome measure was to evaluate the functional improvement postoperatively by the standard protocol of Lysholm knee scoring system during follow-up.

Secondary outcome measure was the subjective (Lachmann test, Anterior Drawer test, pivot shift test) and objective (Rolimeter reading) assessment of the knee laxity postoperatively.

Statistical Analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test was used. Qualitative variables were correlated using Chi-Square test. Spearman rank correlation coefficient was used to assess the association of various parameters with each other. A p value of <0.05 was considered statistically significant. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

Demographic Details

Table 1 describes the demographic details of the patients enrolled in the study. Mean age was calculated to be 28.33 ± 7.25 years. Out of the 30 patients enrolled in the study, right knee was affected in 16 patients (53.3%) and left in 14 (46.6%). There was a male preponderance. Table 2 describes modes of injury and the other associated injuries with the ACL tear. The most common mode of injury was RTA accounting for 14 cases (46.7%) and in this group fall from bike was the most common mode. No associated injuries were identified in 18 patients (60%). Most common associated injury with ACL tear was found to be medial meniscus injury, seen in 7 patients (23.33%). Mean time lapse from injury to surgery was 6.46 ± 5.55 months .16 patients sought operative intervention before 5 months and about 22 patients within a year. Only one patient underwent operative intervention after 2 years of trauma. (Table 2)

The mean quadrupled hamstring graft length was found to be 127.73 ± 8.21 mm.

The mean graft diameter was measured was 7.5 ± 0.78 mm. The femoral tunnel diameter was chosen the same as the graft diameter. The mean femoral tunnel length was 39.5 ± 2.74 mm. Most cases had femoral tunnel length between 35 to 45 mm. The mean tibial length was 50.93 ± 3.65mm. The mean tibial tunnel diameter was chosen same as graft diameter.

Most of the patients had tourniquet time less than 1 hour with range being from 34 minutes to 110 minutes. The mean tourniquet time was found to be approximately 53.77 ± 14.93 minutes.

Postoperative improvement in Anterior drawer test and Lachman test at 2 weeks , 3 months and 6 months has been shown in Table 3 and 4.

Pivot shift test was present in 86% cases pre-operatively and was found negative in all the operated knees tested at 2weeks, 3 and 6 months post- operatively.

The mean preoperative Lysholms knee score was found to be 47.53 ± 7.43 (Range 30-59). Comparison of the Lysholms scores preoperatively and postoperatively at 3 and 6 months has been shown in Table 5. The change in mean Lysholms score pre-op compared to post-op at 3 and 6 months was found to be statistically significant after applying paired student t-test ($p<.01$).

The subjects preoperative Anterior Tibial Translation (ATT) as measured by RolimeterTM (AIRCAST) with knee in 90 degrees flexion was greater than 10mm.Table 6 depicts the Rolimeter reading of ATT pre and postoperatively at 2 weeks, 3 and 6 months. The change in pre-operative mean ATT compared to post-op at 3 and 6 months was statistically significant after applying paired student t-test ($p<0.0005$). Three readings were taken by standard methodology and the average of these three reading was noted. No subjective instability was elicited at any post op visits. Post-operatively most of the cases showed anterior tibial translation of ≤5mm. The mean ATT of operated knee at 6months compared to the opposite normal knee was statistically not significant after applying Mann Whitney test with p value of 0.755 (Table 6). One case was excluded for final evaluation at 6 months due to tear of graft at postop 5month due to retrauma.

DISCUSSION

With increase in sports injury in addition to ever increasing burden of road traffic accidents and domestic injuries, various surgical techniques for torn ACL have gained steady popularity. In this study we report the outcome of tightrope femoral fixation in arthroscopic ACL reconstruction using quadrupled hamstring autograft. Postoperatively there was documented improvement in the Lysholm's score with change in the mean score pre-operatively compared to post-operatively at 3 and 6 months as statistically significant. There was also improvement in ATT measured with Rolimeter. Post-operatively most of the cases showed anterior tibial translation of ≤5mm.

In our study, RTA was the most common cause for ACL tear was RTA accounting for 50% of the cases. Amongst this group, motor bike accident was the most common mode of injury followed by sports related injuries which accounted for 23.33 of the cases. This is in contrast to study by Sgaglione et al[11] where 90% of patients with ACL tear had sports related injuries. This can be explained by relatively less sports activities in our region and a very high RTA rate.

ACL tear is well corroborated in literature to be more common in young physically active individuals.[12] In our study too, mean age group was calculated to be 28.33 ± 7.25 years (Range 18-46 years) and majority of the cases (56.6%) were below the age group of 30 years.

Other studies[12,13] have also mentioned associated meniscal injuries with lateral meniscal being more commonly involved.

Similar to our study medial meniscus injury was most commonly associated with ACL tear in study by Rai et al.[14]

The mean time lapse between injury and surgery in our study is 6.46 ± 5.55 month which is in contrast to study by Rai et al.[14] This could be as our hospital is the main referral tertiary care centre of North India with a long emergency and elective theatre list .

We used Lysholm score to assess the functional outcome of ACL reconstruction using Tightrope. We documented an increase in mean Lysholm score of 47.53 ± 7.43 preoperatively to 93.13±2.8 and 97.45 ± 2.41 at 3 months and 6 months indicating significant improvement postoperatively. Similar observation has been made by other studies too.[14,15] These values are comparable to those mentioned in the literature for other standard anterior cruciate ligament reconstruction techniques.[16,17]

In our study, all patients had a positive pivot test preoperatively and maximum patients had a grade 3 laxity on Anterior drawer and Lachmann test. Post-operatively all patients were negative for pivot shift test. At final follow-up 6 months postoperatively, 11 out of 29 cases has grade-I laxity on Anterior drawer Test and Lachmann test. One case was excluded from the study due to repeat injury and rupture of the graft at 5 months after ACL reconstruction following significant trauma. No patient complained of instability post-surgery.

Several studies[18,19,20] have documented the reliability and importance of objective measurement of anterior knee laxity in ACL tear by rolimeter. In our study, objective measurement of anterior tibial translation (ATT) by rolimeter also showed substantial improvement.

The mean preoperative rolimeter reading of 10.8 (± 2.02) mm improved to 2.9 ± 1.24 and 3.63±1.27mm at 3 and 6 months postoperatively. The rolimeter reading of the uninjured opposite knee was 2.67mm±0.94mm.

All our patients were under supervised physiotherapy postoperatively and achieved full range of motion 3 months after the surgery. We documented the average time period for achievement of good Quadriceps control by the sustained unassisted active straight leg raising and found it to be 3.3(±2.81 S.D) days.

Our patients were advised continued physiotherapy resulting in good achievement of strength in hamstrings at the end of 3 months.

Anterior knee pain (4, 13.7%) was the most frequently observed complication in our study. Infection at the incision site was seen in one patient. Heijne et al[21] and Rai et al[14] in their study concluded that mild anterior knee pain is associated with good clinical outcome. The pain was managed conservatively with nonsteroidal anti-inflammatory drugs and physiotherapy.

Similar to our result, good clinical outcome of ACL reconstruction with Tightrope has been documented by Nag et al [22], Wise et al[23] (who concluded variable loop is better than fixed loop) and Rai et al.[14]

CONCLUSION

ACL tightrope is a very good option for femoral side graft fixation device, as it provides an option for further tightening the graft if needed even after the tibial end fixation is done. We can conclude that autologous ipsilateral quadrupled hamstring tendon graft is a good choice of graft in arthroscopic ACL reconstruction and graft fixation using ACL tightrope for the femoral end fixation and interference screw fixation at the tibial end give an very good results with very few complications. The implant has adjustable length loops that can be tightened intraoperatively when required. This makes ACL tightrope a good and a reliable fixation device. ACL rehabilitation protocol focusing on regaining good hamstring power is essential to the success of ACL reconstruction surgery.

Table 1 Demographic Details

Age(years)	Frequency	Percentage
1) <=20	4	13.33%
2) 21-30	13	43.33%
3) >30	13	43.33%
Gender		
Male	28	93.3%
Female	2	6.6%
Affected Limb		
Right	16	53.3%
Left	14	46.7%
Occupation		
Students	11	36.67%
Self Employed	5	16.67%
Office Workers	4	13.33%
Farmers/ Manual Workers	9	30.00%
Military	1	3.33%

Table2- Mode Of Injury

Mode Of Injury	Number	Percentage
RTA	14	46.7%
Sports Related	8	26.7%
Fall on Ground	6	20%
Fall from stairs	2	6.7%
Associated Injuries		
1) Medial meniscus tear	7	23.4%
2) Lateral meniscus tear	3	10%
3) Both medial and lateral meniscus	1	3.33%
4) PCL laxity	1	3.33%
5) No associated Injury	18	60%
Time Lapse from Injury to Surgery		
1) 0-5 months	16	53.33%
2) 6-11 months	6	20.00%
3) 12-23 months	7	23.33%
4) 24-35 months	1	3.33%

Table 3: Results of pre and post-op Anterior drawer Test

Anterior Drawer Test	Negative	Grade 1	Grade 2	Grade 3
Preoperatively number of patients in groups			7(23.3%)	23 (76.7%)
Total (N)= 30				
Postoperatively	One patient excluded			
At 2 Weeks	22 (75.8%)	8 (27.5%)		
At 3Months	23 (79.3%)	7 (2.1%)		
A 6 Months	14 (48.3%)	15 (51.7%)		
Total (N)= 29				

Grade 1 =5mm, Grade 2: 6-10mm and Grade 3: >10mm

Table 4: Results of pre and post-op Lachmann drawer test.

Lachmann Test	Negative	Grade 1	Grade 2	Grade 3
Preoperatively number of patients in groups			1 (3.33%)	29 (96.6%)
Total (N)= 30				
Postoperatively	One patient excluded			
At 2 Weeks	25 (75.8%)	5 (27.5%)		
At 3Months	25 (79.3%)	5 (2.1%)		
A 6 Months	18 (48.3%)	11 (51.7%)		

Total (N)= 29

Table 5: Improvement in Lysholm's score

	LYSHOLM'S SCORE (MEAN VALUE)	P value
Preoperatively	47.53	
At 3 months	93.13	<.01
At 6 months	97.45	<.01

TIME	RESULT	NUMBER	PERCENTAGE
PREOPERTIVELY	POOR	30	100%
AT 3 MONTHS	GOOD	8	26.6%
	EXCELLENT	22	73.3%
AT 6 MONTHS	GOOD	1	3.45%
	EXCELLENT	28	96.5%
TOTAL 29 (one patient excluded)			

Table 6: Rolimeter reading (mm) of pre and post-op anterior tibial translation of affected side and of the affected side with the normal side at 6 months.

Time	Mean ± Stdev	Median	Min-Max	Inter quartile Range
Pre-op	10.8 ± 2.02	10	7-14	10.000 - 12.000
Post-op				
2 week	2.83 ± 1.49	2.5	1-5	2.000 - 5.000
3 month	2.9 ± 1.24	2	2-5	2.000 - 3.000
6 month	3.63 ± 1.27	3	2-5	3.000 - 5.000

COMPARISON OF ATT OF OPERATED WITH UNAFFECTED NORMAL OPPOSIT KNEE AT 90 KNEE FLEXION AT 6MONTHS POSTOPERATIVELY .				
Side	Mean ± Stdev	Median	Min-Max	P value
Normal knee	2.67 ± 0.84	3	1-5	0.555.
Operated knee at 6 months	3.63±1.2	3	2-5	0.755

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