

Clinical and Functional Outcomes of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Grafts Fixed with Aperture Vs Suspensory Device

Bibek Kumar Rai¹, Ajoy Kumar Manav²

¹Senior Resident, Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India

²Associate Professor, Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India

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Corresponding author: Dr. Bibek Kumar Rai

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Abstract

Aim: A comparative study of clinical and functional outcome of arthroscopic anterior cruciate ligament reconstruction using hamstring graft with aperture fixation versus suspensory device fixation. **Methods:** This prospective study was carried out in the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India from January 2018 to Dec 2018. Two groups with 20 patients each, with at least 1 year follow up were included in the study. The aperture fixation group underwent interference screw fixation at both femoral and tibial tunnels. The suspensory fixation group underwent endobutton fixation on the femoral side and interference screw on tibial side. **Results:** In the study population, 22 patients had isolated ACL injury and remaining 18 patients had ACL associated meniscal injuries. Associated meniscus tear was present in 8 (40%) and 10 (50%) patients of Group 1 and Group 2 respectively. Of the 8 patients in Group 1, 6 patients had medial meniscal tear and remaining 2 had lateral meniscal tear. And among 10 patients in Group 2, 4 patients had medial meniscal injury, 4 had both medial and lateral meniscal injury and remaining 2 had isolated lateral meniscal injury. But none required any intervention for meniscal injury. Lachman's test was positive preoperatively in 85% in Group 1 (Interference screw) and 90% in Group 2 (Endobutton), with 100% negative at the end of 12 months in both groups. Anterior drawer test was positive in 85% in Group 1 and 75% in Group 2, with 100% negative at the end of 12 months in both groups. Pivot shift test was positive in 100% in Group 1 and 100% in Group 2 when examined under anaesthesia preoperatively, with 100% negative at the end of 12 months in both groups. The pivot shift test was deferred till 6 months post operatively. The preoperative Tegner Lysholm knee score was poor in all the patients among both the groups (< 65). Post operatively in Group 1, 16 patients (80%) had excellent functional outcome while 4 patients (20%) had good outcome. In Group 2 (Endobutton), 15 patients (75%) had excellent functional outcome while 5 patients (25%) had good outcome. There was statistically significant improvement in Tegner Lysholm knee score from preoperative to postoperative with p value <0.001 in both groups, whereas there was not statistically significance difference in post-operative scores between the two groups. **Conclusion:** Arthroscopic anatomic single bundle anterior cruciate ligament reconstruction with quadrupled hamstring graft is an excellent treatment option for anterior cruciate ligament deficient knees.

Keywords: Anterior Cruciate Ligament, Quadrupled Hamstring Graft, Reconstruction.

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Introduction

The choice of graft for anterior cruciate ligament (ACL) reconstruction remains controversial and depends largely on the preference of surgeons. The historically accepted gold standard of choice is the autologous bone-patellar tendon-bone (BPTB) graft. Recent biomechanical studies[1-3] have reported that the biomechanics of the ACL can be effectively restored when the femoral tunnel is created in the 10 or 2 o'clock position as opposed to the conventional 11 or 1 o'clock position during ACL reconstruction. However, the horizontal fixation of the femoral tunnel is likely to cause a greater graft-tunnel mismatch than the conventional vertical fixation. Moreover, the use of interference screws at the intra-articular aperture of the femoral tunnel during graft fixation has been shown to exacerbate the graft-tunnel mismatch[4,5].

Femoral cortical suspension devices such as Endobutton (Smith & Nephew Endoscopy, Andover, MA, USA) can be used to adjust and match the length of the BPTB graft to the anatomical femoral tunnel[6]. Tecklenburg et al.[7] reported satisfactory outcomes after a 2- to 5-year follow-up in patients who received Endobutton femoral cortical suspensory fixation with autogenous patellar tendon-bone grafts. However, no prospective studies have compared the outcomes between femoral cortical suspensory fixation and conventional interference screw fixation for anatomical ACL reconstruction.

Material and methods

This prospective study was carried among patients undergoing arthroscopic anterior cruciate ligament reconstruction in the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India from January 2018 to December 2018, after taking the approval

of the protocol review committee and institutional ethics committee.

In our study 80 patients were initially considered eligible to be included in the study. 40 patients were eventually excluded from the study due to no follow up data. Two groups with 20 patients each, with at least 1 year follow up were included in the study. The aperture fixation group underwent interference screw fixation at both femoral and tibial tunnels. The suspensory fixation group underwent endobutton fixation on the femoral side and interference screw on tibial side.

All patients with exclusive ACL tear clinically and radiologically with or without associated menisci injuries which do not alter postoperative rehabilitation were included in study. Patients with multi ligament injuries, meniscal injuries requiring repair, previous knee surgeries, associated osteoarthritis and avulsion fractures were excluded from study.

All the patients in both the groups, interference screw (group 1) & endobutton (group 2) evaluate preoperatively for laxity, clinically with Lachman, Anterior drawer and Pivot shift test and assessed functionally with Tegner Lysholm knee scoring system which includes 1. Limp, 2. support, 3. locking, 4. Instability, 5. Pain, 6. Swelling, 7. climbing stairs, 8. squatting and grading will be done as poor, fair, good or excellent based on total score. All patients were also evaluated by X-ray and MRI of knee preoperatively. Operations were done by different surgeons using standard portals following diagnostic arthroscopy, ACL reconstruction with autogenous quadrupled hamstring graft. Intraoperative (tourniquet time, graft rupture) and post-operative (persistent anterior knee pain, persistent effusion, infection, DVT/PE) parameters were compared in between the groups. All

patients were subjected same rehabilitation protocol post operatively. Patients were regularly followed till 12months, laxity tests and functional outcome with Lysholm score were assessed at 2 weeks, 3, 6 and 12 months.

Statistical Analysis

Collected Data was analyzed using IBM, SPSS version 22.0. All quantitative variables were expressed as Mean +/- SD. All qualitative (categorical) variable were expressed as percentages or frequencies. To find statistical significance between Intergroup Paired T Test and in-between

both groups comparison was done using Unpaired T Test. P value less than 0.01 was considered as statistically significant.

Results

Majority of the patients were of third decade of life, with youngest patient being 20 years (in both the groups) and the oldest being 45years (Endobutton), with mean age of 28.40 ± 4.46 years in Group 1 (Interference screw) and 31.53 ± 6.56 years in Group 2 (Endobutton) In our study male preponderance was noted, similar to other studies with 85% males and 15% female in overall study population

Age in years	Group 1 (Interference screw)		Group 2 (Endobutton)	
	Number	%	Number	%
Below 20	3	15	1	5
20-30	11	55	13	65
30-40	7	35	3	15
40-50	0	0	3	15
Total	20	100	20	100

Nature of the injury in our study was mainly, Sports injury, which accounts for 20 patients (50%) and rest were Road traffic accident, Injury at work and slip and fall which account for 10(25%), 8(20%) and 2(5%) respectively.

Right side was affected in 28 (70%) patients and left side 12 (30%) patients.

In the study population, 22 patients had isolated ACL injury and remaining 18 patients had ACL associated meniscal injuries. Associated meniscus tear was present in 8 (40%) and 10 (50%) patients of Group 1 and Group 2 respectively. Of the 8 patients in Group 1, 6 patients had medial meniscal tear and remaining 2 had lateral meniscal tear. And among 10 patients in Group 2, 4 patients had medial meniscal injury, 4 had both medial and lateral meniscal injury and remaining 2 had isolated lateral meniscal injury. But none required any intervention for meniscal injury.

Lachman's test was positive preoperatively in 85% in Group 1 (Interference screw) and 90% in Group 2 (Endobutton), with 100% negative at the end of 12 months in both groups. Anterior drawer test was positive in 85% in Group 1 and 75% in Group 2, with 100% negative at the end of 12months in both groups. Pivot shift test was positive in 100% in Group 1 and 100% in Group 2 when examined under anaesthesia preoperatively, with 100% negative at the end of 12 months in both groups. The pivot shift test was deferred till 6 months post operatively.

Among 20 patients in Group 1, 15 (75%) patients had no donor site pathology, 1(5%) had tenderness at the Graft harvest site, 3(15) patients had numbness in the harvest site and lateral to the harvest site, 1(5%) patient had a hypertrophic scar. Out of the 20 patients in Group 2, 15 (75%) patients had no donor site pathology, 3(15%) had tenderness at the Graft harvest site, 2(10) patients had numbness in the harvest site and lateral to the harvest site.

In Group 1, 2 patients had joint effusion, patellar tap was positive and in Group 2, 1 patient had effusion, patellar tap was positive. The effusion gradually reduced in all the patients without requiring any intervention. There were no graft ruptures, persistent anterior knee pain, infection or Deep vein thrombosis/Pulmonary Embolism.

The preoperative Tegner Lysholm knee score was poor in all the patients among both the groups (< 65). Post operatively in Group 1, 16 patients (80%) had excellent

functional outcome while 4 patients (20%) had good outcome. In Group 2 (Endobutton), 15 patients (75%) had excellent functional outcome while 5 patients (25%) had good outcome.

There was statistically significant improvement in Tegner Lysholm knee score from preoperative to postoperative with p value <0.001 in both groups, whereas there was no statistically significance difference in post-operative scores between the two groups.

Table 2: A: Association between pre op and post op Tegner Lysholm knee score in Group 1 B: Association between pre op and post op Tegner Lysholm knee score in Group 2 C: Association between post op Tegner Lysholm knee score between Group 1 & Group 2

Table 2A: Tegner Lysholm knee score in Group 1

Tegner lysholm knee score	N	Mean	St deviation	P value
Pre-OP	20	42.47	11.14	
AT 12 months	20	95.07	4.62	

Table 2B: Tegner Lysholm knee score in Group 2

Tegner lysholm knee score	N	Mean	St deviation	P value
Pre-OP	20	40.33	11.14	
AT 12 months	20	94.40	4.66	

Table 2C: Association between post op Tegner Lysholm knee score between Group 1 & Group 2

Tegner lysholm knee score	N	Mean	St deviation	P value
Group 1	20	95.07	4.62	
Group 2	20	94.40	5.66	

Discussion

The aim of ACL reconstruction procedure is to allow the patient to return to normal daily activity, avoiding further meniscal damage and prevent osteoarthritis and having normal knee function. Several factors are identified as significant influence for the biomechanical characteristics and functional outcome of an ACL reconstructed knee joint. These factors are [8]. Individual choice of graft material using either bone patellar tendon, hamstring graft, quadriceps tendon, various synthetic grafts or allograft.

1. Anatomical tunnel placement within the footprints of native ACL
2. Adequate substitute tension after preconditioning graft by cycling
3. Anatomical graft fixation.

The most commonly used grafts in ACL reconstruction are bone patellar tendon and hamstring graft. Each has its merits and demerits, in our study we used hamstring graft for ACL reconstruction in all study population.

Irrespective of the type of graft used, fixation of the graft is usually the site of failure rather than the graft itself. This usually occurs during early rehabilitation

phase as the graft integration has not occurred during this time. The fixation is of less significance after two to three months as the graft would have integrated with the bone[9-12]. There are chiefly two types of fixation devices used in ACL reconstruction in bone tunnels: Aperture fixation and Suspensory fixation. However, debate continues about which technique is better.

The purpose of our study was to compare postoperative knee stability, graft failure, and clinical and functional outcomes between aperture (Interference screw) and suspensory fixation (endobutton) of a hamstring tendon autograft on femoral bone tunnel in ACL reconstruction.

Majority of the patients were of third decade of life, with youngest patient being 20 years (in both the groups) and the oldest being 45years (Endobutton), with mean age of 28.40 ± 4.46 years in Group 1 (Interference screw) and 31.53 ± 6.56 years in Group 2 (Endobutton). This indicates that young active population was most often involved. In study by Jomha NM[13], mean age was of 26 years, in D Choudhary et al.[14] had 27years as mean age, Williams RJ et al.[15] was 33years, Mahir et al.[16] was 24years and Kumar PA[17] was 27years. Albert O Gee in his study concluded that ACL reconstruction when done on patients aged > 40 years produced equivalent functional outcomes when compared with patients aged ≤ 25 years, without at an increase complication rate at an average of > 5 years after surgery. 18 In our study male preponderance was noted, similar to other studies with 85% males and 15% female in overall study population There were 6 female's patients, 1 patient in Group 2 (Interference screw) and 4 patients in Group 2 (Endobutton). In comparison to Jomha NM¹³, D Choudhary et al.[14], Williams RJ et al.[15], Mahir et al[16] and Kumar PA[17] where 73%, 93%, 59%, 100% and 97.1% was the percentage of males in their study respectively.

However, in study conducted by Wild CY[19] has stated that girls involving in sports activity have 8 times more chance of suffering ACL injury than boys. The reason given was:

- Narrower intercondylar notch and smaller ACL
- Wider pelvis
- More lax ligaments
- Slower reflex time
- Greater quadriceps/hamstring strength ratio
- Changes in Estrogen level
- Flat footed landing

However, in comparing the outcome between male and females after ACL reconstruction, Ferrari JD[20], has stated that outcomes are similar in both groups with equal chances of failure.

Nature of the injury in our study was mainly, Sports injury, which accounts for 20 patients (50%) and rest were Road traffic accident, Injury at work and slip and fall which account for 10 (25%), 8 (20%) and 2 (5%) respectively. Right side was affected in 28 (70%) patients and left side 12 (30%) patients.

Chappell JD et al.[21] suggested that ACL torn during sports activity are usually from non-contact sports. RTA is due to direct trauma to the knee or may be due to dashboard injury or fall from height with the twisting force.

Associated meniscus tear was present in 8 (40%) and 10 (50%) patients of Group 1 and Group 2 respectively. Of the 8 patients in Group 1, 6 patients had medial meniscal tear and remaining 2 had lateral meniscal tear. And among 10 patients in Group 2, 4 patients had medial meniscal injury, 4 had both medial and lateral meniscal injury and remaining 2 had isolated lateral meniscal injury. But none required any intervention for meniscal injury.

In study by D Choudhary et al[14] had Medial meniscal tear in 37.9% and lateral meniscal tear 16.7% of study population. In a study conducted by Hagino T et al.[22],

the incidence of meniscal tear associated with injury is higher in chronic case. Early ACL reconstruction is suggested to prevent secondary meniscal tear.

Minimum time taken for surgery following injury in the study subjects was 6 months and maximum was 24 months. Majority of the patients (90%) presented within 1 years of injury. The average time taken for surgery in Group 1 is 12.60 months and average time taken for surgery in Group 2 is 10.40 months. The mean averages of both the groups were 15.0 months. In the study by Jomha NM[13], 35.6% were operated within 3weeks, 18.6% between 3 to 12 weeks and 45.8% after 12 weeks from the time of injury. In the study conducted by Nikolaos K Paschos[23], the ACL injury is a significant factor for developing secondary knee osteoarthritis. The risk of osteoarthritis is doubled each year following ACL injury. Usually, the ACL reconstruction is delayed until 6 to 8 weeks after injury. Shelbourne et al.[24,25] in their study concluded that ACL reconstruction within first week of injury had a high incidence of arthro fibrosis compared to those who underwent surgery after 3 weeks. An interval of 6 to 8 weeks is necessary between injury and surgery for the injured knee to become free of irritation (swelling, effusion, erythema).

The common complications encountered in Arthroscopic ACL reconstruction are.²⁶

Persistent anterior knee pain

- Instability
- Joint swelling (Effusion)
- Infection
- Stiff knee
- Deep venous thrombosis

Among 20 patients in Group 1, 15 (75%) patients had no donor site pathology, 1(5%) had tenderness at the Graft harvest site, 3(15) patients had numbness in the harvest site and lateral to the harvest site, 1(5%) patient had a hypertrophic scar. Out of the 20 patients in Group 2, 15 (75%) patients had no donor site pathology, 3(15%) had tenderness at the Graft harvest site, 2(10)

patients had numbness in the harvest site and lateral to the harvest site.

Tunnel widening after ACL reconstruction is multifactorial, with several biological and mechanical factors. Among them are graft tunnel motion, stress deprivation of the bone within the tunnel wall, improper graft tunnel placement, tunnel positioning, graft fixation method, aggressive rehabilitation and bone quality. Sagittal graft motion known as the windshield wiper effect can also occur leading to tunnel widening. CT scan is helpful to measure tunnel widening post operatively[27-31].

The mean tourniquet time for group 1 and group 2 was 104.3 and 107.6 minutes respectively.

In the post-operative clinical outcome of both the groups is measured by Ligament examination which includes Lachman, Anterior Drawer and Pivot shift test at the end of 6 and 12 months for AP translation. And functional outcome was measured by Tegner Lysholm knee score, in this scoring we take various factors including limp, support, locking, instability, pain, swelling, climbing stairs and squatting. Based on the total score, grading was done as poor, fair, good or excellent. Anterior stability tests were negative in all 40 patients at the end of 6 and 12 months. There was significant improvement in functional outcome based on Tegner Lysholm knee score from pre-operative to post-operative in both the groups. But there was no statistically significant difference in post-operative scores between the two groups. Functional outcomes are comparable between both the groups with mean Tegner Lysholm knee score of group 1 and group 2 are 95.07 and 94.40 respectively.

The results were comparable with studies by Jomha[13] D Choudhary et al[14], Williams RJ et al.[15], Mahir et al.[16] and Kumar PA[17] who had average Tegner Lysholm knee score of 94, 92, 91,93.5 and 90 respectively.

Meta-analysis study by Browning WM et al in USA, from 2004-2014 on single bundle ACL reconstructions using 4 stranded hamstring autograft in which 21 studies utilized aperture fixation and 20 utilized suspensory fixation with minimum 24 months follow up, stability and clinical outcome were compared between aperture and suspensory fixation using Lachman or pivot shift test or KT-1000 side-to-side difference (for stability) and clinical outcomes with International Knee Documentation Committee (IKDC), Tegner and Lysholm scores. The study concluded improved overall arthrometric stability and fewer graft ruptures with suspensory fixation compared to aperture fixation and no difference in IKDC, Lysholm, Lachman and pivot-shift[32]. Meta-analysis study by Colvin Aet al in USA in 2010. Study was performed on eight studies (those met the criteria among 1058 initial studies) reporting on surgical failures and postoperative International Knee Documentation Committee score. They concluded saying even thou literature suggests a trend toward decreased surgical failures with femoral fixation at the joint line with an interference screw, there is difference when postoperative functional outcomes are compared. Future studies are needed with standardized fixation methods and outcomes assessment to determine the importance of femoral fixation.

Conclusion

Arthroscopic anatomic single bundle anterior cruciate ligament reconstruction with quadrupled hamstring graft is an excellent treatment option for anterior cruciate ligament deficient knees. The absence of patellofemoral pain with the use of hamstring graft makes it a more desirable option. The study demonstrated improvement in overall stability of knee with ACL reconstruction using both methods on fixation of the graft. There were fewer complications, and they were comparable between the groups.

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