

Comparative Evaluation of Functional and Radiological Outcomes of Trans-Tibial and Anatomical Anterior Cruciate Ligament Reconstruction

Anurag Baghel¹, Nikhil Kumar², Narendra Singh Kushwaha³

ABSTRACT

Introduction: Anterior cruciate ligament(ACL) injury is one of the commonest type of sports injury in knee joint. Arthroscopic ACL reconstruction is the gold standard treatment now a days and this is performed by two techniques- Transtibial and anatomical. So this study was performed to compare the functional and radiological outcomes of both techniques.

Material and Methods: The study population comprised of two groups, Group I – The patients treated by trans-tibial ACL reconstruction approach and Group II – Patients treated by anatomical medial portal ACL reconstruction approach. Surgical procedure was carried out as per standard protocols including pre- operative patient preparation and Diagnostic arthroscopy and follow up. Functional evaluation was done using Lysholm knee score and radiological evaluation was done at 6 weeks, 12 weeks and 6 months of time with the help of digital radiography.

Results: The Lysholm knee score was significantly ($p=0.01$) higher among the patients of Group II (91.56 ± 2.68) compared with Group I (89.20 ± 2.00). However, Tibial tunnel angle was higher among the patients of Group I (67.47 ± 4.29) than Group II (63.19 ± 2.97) and the difference was statistically significant ($p=0.003$). The Lachman's test and anterior drawer test was positive 3+ among all the patients of both the groups preoperatively.

Conclusion: Anatomical medial portal ACL reconstruction has better outcome with rotational stability and near to natural biomechanical stability of complex knee joint as compared to trans-tibial approach.

Keywords: Anterior cruciate ligament, Lachman's test, Lysholm knee score, Anterior Drawer Test, Trans-tibial reconstruction, Anatomical medial portal reconstruction, Rotational stability.

INTRODUCTION

Anterior cruciate ligament (ACL) reconstruction is one of the most commonly performed arthroscopic surgeries in orthopedics (Emond et al, 2011).¹ Numerous femoral fixation methods are used for hamstring tendon grafts. Several studies have compared fixation methods, and although the methods show mechanical differences in laboratory studies (Milano et al, 2006)² (Shen et al, 2010)³ (Oh et al, 2006)⁴ they are clinically similar when correctly used (Han et al, 2012; Stengel et al, 2009).^{5,6}

In the last two decades, the most commonly used method worldwide has been the trans-tibial technique (Steiner, 2009).⁷ However, anatomical studies have shown that with this technique, the tunnel is not positioned in the center of the origin of the ACL (Heming et al, 2007; Steiner et al, 2009).^{8,9} The clinical studies have shown advantages with regard to the stability gained with the more anatomical position of the femoral tunnel (Alentorn-Geli et al, 2010; Hussein et al, 2012).^{10,11}

Present study aims to examine the outcomes of trans-tibial and anatomical medial portal ACL reconstruction functionally and radiologically.

MATERIAL AND METHODS

This was a retrospective as well as prospective study conducted among the patients admitted in the Department of Orthopaedics, KGMU with ACL injuries along with those treated for the same previously within last one year available for follow up were included in the study.

A sample size of 31 patients, selected randomly, irrespective of gender or religion were included in the study and they were divided into two groups. Two groups were made depending on the arthroscopic surgical technique adopted by the operating surgeon:

Group I – The patients treated by transtibial ACL reconstruction approach were taken retrospectively.

Group II – Patients treated by anatomical medial portal ACL reconstruction approach taken prospectively.

Inclusion criteria: The inclusion criteria included the patients of age group 18-45 with clinical / radiological / arthroscopic evidence of anterior cruciate ligament deficiency which were symptomatic even after conservative therapy of adequate duration with normal contra lateral knee. The important criteria for patients included in the study was that the acute inflammatory phase of the injury had subsided and full range of motion and good quadriceps strength had been regained with no extensor lag.

Exclusion criteria: The patients with bilateral ACL tear, other systemic diseases compromising their Pre-anaesthetic fitness, associated fractures involving lower limbs and /or spine/ neurovascular injuries, any other associated ligament injuries of the Knee (complete tear of posterior cruciate ligament, medial and lateral collateral ligament requiring treatment/ with significant articular cartilage lesion exceeding grade III) were excluded. ACL reconstruction of those with open physis, significant arthritis and local skin infections were also excluded from the study.

¹Lecturer, Department of Orthopaedic Surgery, Government Medical College, Kannauj, Uttar Pradesh, ²Junior Resident, ³Associate Professor, Department of Orthopaedic Surgery, KG Medical University, Lucknow

Corresponding author: Dr. Anurag Baghel, House no. MS-52, Sector D Aliganj, Lucknow, Uttar Pradesh, India

How to cite this article: Anurag Baghel, Nikhil Kumar, Narendra Singh Kushwaha. Comparative Evaluation of Functional and Radiological Outcomes of Trans-Tibial and Anatomical Anterior Cruciate Ligament Reconstruction. International Journal of Contemporary Medical Research 2016;3(7):2053-2056.

Surgical procedure was carried out as per standard protocols including pre-operative patient preparation and Diagnostic arthroscopy and follow up. High anterolateral portal (viewing portal) was made just lateral to patellar tendon. The scope was introduced and knee was examined systematically in the 'W' sequence, starting from the suprapatellar pouch, then the patellofemoral joint, medial gutter, medial meniscus, intercondylar notch, lateral meniscus and lateral gutter. Once all the pathologies were recorded a second anteromedial portal (working portal) was made at the inferior pole of patella, just medial to patellar tendon.

A longitudinal incision was made for the harvesting and passage of grafts as well as the creation of the tibial tunnel. Care was taken not to injure the infrapatellar branch of the saphenous nerve. Once the hamstring tendons were identified, the sartorius fascia was carefully incised along the course of and in between the gracilis and semitendinosus tendon, taking care to preserve the integrity of fascia and deeper layer comprising medial collateral ligament.

The tendon were dissected proximally by using fingers towards their musculo-tendinous junction to release adhesion and accessory bands, while constant traction was applied on the threads. Then a closed-end stripper was passed over the tendon one by one. The stripper was then reinserted and tendon harvested. After harvesting, the graft was placed on *graft master board*. They were stripped of their residual muscle fibers proximally using the blunt end of scalpel blade. The tendon ends were carefully trimmed to uniform size and measured and made of equal lengths. They were placed together and using a number 2 ethibond suture a running baseball, stitch was placed in both tendons in a *Chinese finger trap configuration*.

Post operatively Patients were given intravenous antibiotics for 3 days and were discharged after wound inspection. On the 14th day, stitch removal was done. Post-operatively, patient was placed in knee brace. Mobilization was started immediately giving priority to the recovery of full extension. Active static quadriceps exercises and ankle pumps were started as soon as the patient recovered from anesthesia. The crutches were maintained until quadriceps control was reestablished. Standard ACL reconstruction rehabilitation protocol was then followed. Group I was evaluated by and data collected from previous record.

Group II was prospectively evaluated functionally by using lysholm knee score and radiological evaluation was done at 6 weeks, 12 weeks and 6 months of time. Grading of laxity was evaluated by anterior drawer test and Lachman's test.

Radiological evaluation was done on X-ray. Angle of tibial and femoral tunnels were measured on digital and immediate Post Operative Knee radiographs (Antero-posterior and True Lateral Views)

Comparison between clinical outcomes of Trans-tibial ACL reconstruction and Anatomical medial portal ACL reconstruction was done.

STATISTICAL ANALYSIS

The data was analysed by using SPSS 16.0 version (Chicago, Inc., USA). The Chi-square test was used to compare the categorical/dichotomous variables between Group I and Group II. The Unpaired t-test was used to compare the scores between

the two groups. The P-value<0.05 was considered significant.

RESULTS

In Group I, 46.7% were between 20-30 years and 26.7% were below 20 and above 40 years. In Group II, more than one third of the patients were between 31-40 years (43.8%) and 31.2% were between 20-30 years. However, 12.5% were below 20 and above 40 years in Group II. Majority of the patients were male in both the groups. Majority of the patients in Group I were very active (73.3%) and 75.0% were very active in Group II. The percentage of active (26.7%) were in group I and (25.0%) in group II. The RTA mode of injury was the commonest injury in both Group I (60%) and Group II (56.2%) patients (Table-1). The anterior drawer test was positive 3+ among all the patients of both the groups preoperatively. At 6 weeks, 31.3% were Positive 1+ among the patients of Group II and 43.8% were Positive 1+ at 6 months (Table-2).

The Lachman's test was positive 3+ among all the patients of both the groups preoperatively. At 6 weeks, 37.5% patients were Positive 1+ among Group II and 56.3% were Positive 1+ at 6 months (Table-3).

The excellent Lysholm knee score was in 37.5% of Group II patients and 20% in Group I patients. However, good was in 66% of Group I and 50% of Group II (Figure-1).

The Lysholm knee score was significantly ($p=0.01$) higher among the patients of Group II (91.56 ± 2.68) compared with Group I (89.20 ± 2.00). However, Tibial tunnel angle was higher among the patients of Group I (67.47 ± 4.29) than Group II (63.19 ± 2.97) and the difference was statistically significant ($p=0.003$). The femoral tunnel angle was also significantly ($p=0.0001$) higher among the patients of Group I (67.87 ± 3.79) compared with Group II (50.69 ± 6.69) (Table-4).

DISCUSSION

Surgical reconstruction has become the standard of care in the treatment of anterior cruciate ligament injury. The primary goal of the reconstruction is to restore the stability to the knee and

Basic profile	Groups				p-value ¹
	Group I (n=15)		Group II (n=16)		
	No.	%	No.	%	
Age in years					
<20	4	26.7	2	12.5	0.03
20-30	7	46.7	5	31.2	
31-40	0	0.0	7	43.8	
>40	4	26.7	2	12.5	
Gender					
Male	14	93.3	16	100.0	0.29
Female	1	6.7	0	0.0	
Level of activity					
Very active	11	73.3	12	75.0	0.25
Active	4	26.7	4	25.0	
Sedentary	0	0.0	0	0.0	
Minimally active	0	0.0	0	0.0	
Mode of injury					
Fall	6	40.0	7	43.8	0.83
RTA	9	60.0	9	56.2	
¹ Chi-square test					
Table-1: Basic profile of the patients					

thereby, presumably to restore its function and allow the patient to return to normal activities, including sports. Another goal is to prevent early degenerative changes.

The recovery and rehabilitation following these procedures has also been shortened.

In our study, ACL injury correlated with activity of person significantly. In our study, ACL injury was more with very active persons in both the groups. The incidence of ACL injury was more with the road traffic accidents in comparison to sports injury. Contrary to our findings, William et al (1981)¹² observed 88% of their cases the mode of injury was sports especially football as popular in western world.

Manual knee laxity tests were performed in all cases of ACL injury. First it was performed in normal knee which was taken as standard of that patient than it was performed in injured side. It was recorded as +, ++, +++ (if positive) and negative. Anterior Drawer Test and Lachman's test were positive in all the patients. Pulate et al (2012)¹³ also found significant difference in the functional outcomes between the two groups, the transportal ACL reconstruction having better outcome.

The anterior drawer test was also positive 3+ amongst all the patients of both the groups preoperatively. At 6 weeks, 31.3% were Positive 1+ among the patients of Group II and 43.8% were Positive 1+ at 6 months. The Lachman's test was positive 3+ among all the patients of both the groups. At 6 weeks, 37.5% were Positive 1+ among Group II and 56.3% were Positive 1+ at 6 months. There were no cases of severe instability in follow up after ACL reconstruction, in our series, with +++ positive for Lachman's test or Anterior drawer test.

The Lysholm knee score was significantly (p=0.01) higher among the patients of Group II (91.56±2.68) compared with Group I (89.20±2.00). The excellent Lysholm knee score was in 37.5% of Group II patients and 20% in Group I patients. However, good results were in 66% of Group I and 50% of Group II patients. The study by Lee et al. (2007)¹⁴ showed a significantly lower Lysholm related to residual pivot shift without definite antero-posterior laxity. More oblique positioning of the graft might have advantages in rotational stability, which in turn increased subjective patient satisfaction. Trans-tibial approach did not provide anatomical placement of tunnel and resulted in lower lysholm knee score. The study of Lee et al. (2007)¹⁴ supports our study that anatomical medial portal approach has better patient satisfaction and less residual laxity.

Ali et al (2013)¹⁵ found that there was no significant difference in

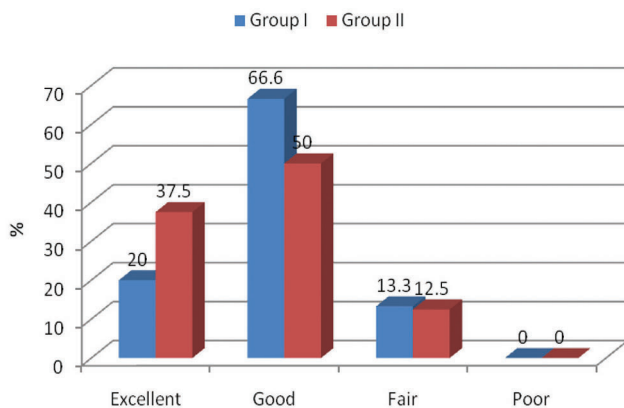


Figure-1: Lysholm knee score

	Groups				p-value ¹
	Group I (n=15)		Group II (n=16)		
	No.	%	No.	%	
Pre-op					
Positive 3+	15	100.0	16	100.0	NA
6 week					
Positive 3+	-	-	0	0.0	NA
Positive 2+	-	-	0	0.0	
Positive 1+	-	-	5	31.3	
Negative	-	-	0	0.0	
3 month				0.0	
Positive 3+	-	-	0	0.0	NA
Positive 2+	-	-		0.0	
Positive 1+	-	-	7	43.8	
Negative	-	-	9	56.3	
6 month and onwards					
Positive 3+	0	0.0	0	0.0	0.001*
Positive 2+	3	20.0	0	0.0	
Positive 1+	12	80.0	7	43.8	
Negative	0	0.0	9	56.3	

¹Chi-square test, NA-Not applicable, *Significant

Table-2: Comparison of Anterior drawer test from pre-operative to follow-ups

	Groups				p-value
	Group I (n=15)		Group II (n=16)		
	No.	%	No.	%	
Pre-op					
Positive 3+	15	100.0	16	100.0	NA
6 week					
Positive 3+			0	0.0	NA
Positive 2+			0	0.0	
Positive 1+			6	37.5	
Negative			10	62.5	
3 month					
Positive 3+			0	0.0	NA
Positive 2+			0	0.0	
Positive 1+			9	56.3	
Negative			7	43.8	
6 month and onwards					
Positive 3+	0	0.0	0	0.0	0.001*
Positive 2+	3	20.0	0	0.0	
Positive 1+	12	80.0	9	56.3	
Negative	0	0.0	7	43.8	

NA-Not applicable, *Significant

Table-3: Comparison of Lachman's test from pre-operatively to follow-ups

	Group I (n=15) Mean±SD	Group II (n=16) Mean±SD	p-value ¹
Lysholm knee score	89.20±2.00	91.56±2.68	0.01*
Tibial tunnel angle	67.47±4.29	63.19±2.97	0.003*
Femoral tunnel angle	67.87±3.79	50.69±6.69	0.0001*

¹Unpaired t-test, *Significant

Table-4: Comparison of Lysholm knee score, Tibial tunnel angle and femoral tunnel angle

the Functional outcome (Lysholm Knee score), anteroposterior stability (Lachman's test) and rotational stability. In our study we also studied functional status using lysholm scoring, that concluded that anatomical medial portal ACL reconstruction has better outcome with rotational stability and near to natural biomechanical stability of complex knee joint which proved contrary to above study.

Bedi et al (2011)¹⁶ reported that the anteromedial portal drilling of the femoral socket may allow for improved restoration of anatomy and stability with ACL reconstruction compared with conventional transtibial drilling techniques. Our study is comparable to the above study, that anatomical medial portal tunnelling technique has given better outcome than transtibial approach.

Amendola et al. (2003)¹⁷ conducted a study on the effect of fixation technique on graft position on ACL reconstruction. In their study two groups were made and quantification of bone tunnel length and exact position of graft was measured radiologically. The influence of these two techniques on the functional outcome was measured. Clinical outcomes were similar because graft placement was within the ideal range in both groups, contrary to our study.

Larger sample size with proper randomization is needed to validate effectively our findings and long term follow up studies are required in future to know changes in graft behavior and tunnels with time and the outcomes accordingly.

CONCLUSION

Patients with anterior cruciate ligament reconstruction by anatomical medial portal approach were found to have better post-operative knee stability and better functional outcome. AMP technique leads to reduction in time to return to routine activities, better therapeutic outcomes and higher satisfaction rates.

REFERENCES

1. Emond CE, Woelber EB, Kurd SK, Ciccotti MG, Cohen SB: A comparison of the results of anterior cruciate ligament reconstruction using bioabsorbable versus metal interference screws: a meta-analysis. *J Bone Joint Surg Am* 2011;93:572-580.
2. Milano G, Mulas PD, Ziranu F, Piras S, Manunta A, Fabbriani C: Comparison between different femoral fixation devices for ACL reconstruction with doubled hamstring tendon graft: a biomechanical analysis. *Arthroscopy*. 2006;22:660-668.
3. Shen HC, Chang JH, Lee CH, Shen PH, Yeh TT, Wu CC, Kuo CL: Biomechanical comparison of Cross-pin and Endobutton-CL femoral fixation of a flexor tendon graft for anterior cruciate ligament reconstruction; a porcine femur-graft-tibia complex study. *J Surg Res*. 2010;161:282-287.
4. Oh YH, Namkoong S, Strauss EJ, Ishak C, Hecker AT, Jazrawi LM, Rosen J: Hybrid femoral fixation of soft-tissue grafts in anterior cruciate ligament reconstruction using the EndoButton CL and bioabsorbable interference screws: a biomechanical study. *Arthroscopy* 2006;22:1218-1224.
5. Han DL, Nyland J, Kendzior M, Nawab A, Caborn DN: Intratunnel versus extratunnel fixation of hamstring autograft for anterior cruciate ligament reconstruction. *Arthroscopy*. 2012;28:1555-1566.
6. Stengel D, Casper D, Bauwens K, Ekkernkamp A, Wich

M: Bioabsorbable pins and interference screws for fixation of hamstring tendon grafts in anterior cruciate ligament reconstruction surgery: a randomized controlled trial. *Am J Sports Med* 2009;37:1692-1698.

7. Steiner M: Anatomic single-bundle ACL reconstruction. *Sports Med Arthrosc*. 2009;17:247-251.
8. Heming JF, Rand J, Steiner ME: Anatomic limitations of transtibial drilling in anterior cruciate ligament reconstruction. *Am J Sports Med*. 2007;35:1708-1715.
9. Steiner ME, Battaglia TC, Heming JF, Rang JD, Festa A, Baria M: Independent drilling outperforms conventional transtibial drilling in anterior cruciate ligament reconstruction. *Am J Sports Med*. 2009;37:1912-1919.
10. Alentorn-Geli E, Samitier G, Alvarez P, Steinbacher G, Cugat R: Anteromedial portal versus transtibial drilling techniques in ACL reconstruction: a blinded cross-sectional study at two- to five-year follow-up. *Int Orthop*. 2010;34:747-754.
11. Hussein M, van Eck CF, Cretnik A, Dinevski D, Fu FH: Prospective randomized clinical evaluation of conventional single-bundle, anatomic single-bundle, and anatomic double-bundle anterior cruciate ligament reconstruction: 281 cases with 3- to 5-year follow-up. *Am J Sports Med*. 2012;40:512-520.
12. Williams JG. *Sports injuries in children*. Medisport. 1981;3:122-6.
13. Pulate A, Jadhav A, Kakatkar S. Comparison of Functional Outcomes Following Arthroscopic Anterior Cruciate Reconstruction Using Trans-Tibial Technique and Trans-Portal Technique. *J Maha Ortho Assoc*. 2012;7:15-1.
14. Lee MC, Seong SC, Lee S, et al. Vertical femoral tunnel placement results in rotational knee laxity after anterior cruciate ligament reconstruction. *Arthroscopy*. 2007; 23:771-778.
15. Electricwala A, Latkar C, Patil S, Jog V, Mahajan A, Deshpande S. Transtibial vs Anatomical tunneling techniques for arthroscopic ACL Reconstruction in non-athletic population. *Journal Medical Thesis*. 2013;1:35-36.
16. Bedi A, Musahl V, Steuber V, Kendoff D, Choi D, Allen AA, Pearle AD, Altchek DW. Transtibial versus anteromedial portal reaming in anterior cruciate ligament reconstruction: an anatomic and biomechanical evaluation of surgical technique. *Arthroscopy*. 2011;27:380-390.
17. Amendola A, Menon M, Clathworthy M, and Fowler P J. The Effect of Fixation Technique on Graft Position in Anterior Cruciate Ligament Reconstruction *Iowa Orthop J*. 2003;23:29-35.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 25-05-2016; **Published online:** 30-06-2016