Arthroscopic ACL Reconstruction Using Single Bundle BPTB Autograft: Transtibial *versus* Anteromedial Portal Technique for Femoral Tunnel Placement

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ABSTRACT

Objective: To compare the postoperative outcome in patients who underwent arthroscopic single-bundle non-anatomic reconstruction of anterior cruciate ligament (ACL) through transtibial portal technique for femoral tunnel placement versus single-bundle anatomic ACL reconstruction through anteromedial portal technique for femoral tunnel placement.

Methods: This retrospective comparative study was conducted on 120 patients who underwent ACL reconstruction in Combined Military Hospital Lahore and Rawalpindi between March 2012 and March 2015 were included. Group 1 had ACL reconstruction through Transtibial (TT) Portal and in Group 2 Anteromedial (AMP) portal was used for femoral tunnel placement. At a minimum follow-up of 1 year (13-25 months), the clinical and functional outcomes were obtained and analyzed.

Results: Mean Tegner-Lysholm score improved from 41 preoperatively to 80 (fair) in TT portal group and from 42.2 to 85 (good) in AMP Portal Group. Mean Knee Injury and Osteoarthritis Outcome Score (KOOS) improved from 48.8 and 47.5 to 81 and 83 in TT portal group and AMP portal group respectively. The difference in post-op scores did not show significant difference between two groups ($p>0.05$). Residual anterior laxity was found in 11 (18.3%) patients in TT portal group compared to 10 (16.7%) patients in AM portal group ($p>0.05$). Out of these patients pivot shift test was abnormal in 8 (13.3%) patients in TT portal group and 3 (5%) patients in AMP portal group and this difference was significant ($p<0.05$).

Conclusion: AMP portal technique for femoral tunnel placement leading to anatomic single-bundle ACL reconstruction is better than non-anatomic TT portal technique in overall postoperative clinical outcomes. Though anterior tibial translation is not much different but rotary stability improves significantly with femoral tunnel placement through anteromedial (AMP) portal.

Key Words: ACL reconstruction, Femoral tunnel, Transtibial portal, Anteromedial portal

INTRODUCTION

ACL injury is one of the most frequently seen injuries in sports and it has serious effects on patient's daily activities, life style and its quality [1]. The ACL injury is usually outcome of three mechanisms, a sudden deceleration, hyperextension and rotation. A sharp turn may cause the injury most frequently. If mechanism of injury is a hit from side, there may be complex injury involving menisci and collateral ligaments. Unhappy triad is injury to ACL, MCL and meniscal cartilage. In adults it may involve a tibial spine avulsion [2].

ACL reconstruction is aimed at bringing the patients back to pre injury level, but in few patients, revision surgery and failures are noted as well [3, 4]. There are three surgical techniques of creating a femoral tunnel in ACL reconstruction; transtibial, anteromedial and outside to in technique. There is still disagreement regarding the best surgical technique for ACL reconstruction. With popularity of anatomic ACL reconstruction many surgeons support femoral tunnel drilling through AM portal [5, 6]. Vertically placed ACL influences the kinematics of knee and increase the chance of failure [7, 8]. If rotational instability is present after reconstruction and pivot shift test is positive, it is not possible to return to pre injury level of activity. A more anatomic reconstruction is favored

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which controls both anterior tibial translation and rotational stability of the knee [9, 10]. The graft should be placed lower on the lateral condyle of femur to make its orientation horizontal. Literature suggests that maintaining the original ACL orientation and obliquity makes knee more stable [8, 9]. Biomechanical studies support that anatomical graft serve better and give rotational stability than non-anatomical graft [11, 12].

Clinical evidence comparing two techniques also supports AM portal technique [13, 14]. Our study is aimed at comparing the postoperative outcomes in patients who underwent arthroscopic non-anatomic (TT) single-bundle Bone-Patellar Tendon-Bone (BPTB) reconstruction of the anterior cruciate ligament (ACL) versus single-bundle anatomic (AMP) ACL reconstruction.

METHODS

This is a retrospective study that was done at CMH Lahore and Rawalpindi in the Department of Orthopedics. Data was collected prospectively for all patients undergoing ACL reconstruction between March 2012 and March 2015. A total of 120 patients were included in the study. Consecutive sampling technique was used for dividing patients into two groups. Patients with arthritic changes in the knee, with complex ligamentous injuries involving more than ACL, with associated proximal tibial fracture and with associated ipsilateral lower limb fracture were excluded from the study.

A single incision arthroscopic ACL reconstruction with Bone Patellar Tendon Bone was used for both techniques. For TT technique, knee was held in 90 degree of flexion. Tibial guide pin was positioned medial and proximal to tibial tuberosity at 20 degrees in frontal plane and 50 degrees in sagittal. Guide pin was inserted and exited in line joining the posterior edge of lateral meniscus and medial tibial spine (Fig.1a, 1b). Guide pin was then over drilled by 9mm reamer. Following that, aiming instrument with 7mm offset was inserted through tibial guide and pushed towards ACL footprint under arthroscopic guidance (Fig.1c). Femoral side was reamed by 8, 9 size reamer till depth of 30 mm. All of this was guided by arthroscope (Fig. 1c, 1d). In AMP technique, a separate medial portal was used to pass guide wire at 9/10 o' clock position for Right knee and 2/3 o' clock position for left knee (Fig 2a). Knee was kept hyper flexed while preparing femoral tunnel. This prevents damage to cartilage and common peroneal nerve. The depth of tunnel remains 30 mm (Fig.2b, 2c). Graft tension was checked by manual tension at 30 degrees and by performing Lachman test postoperatively. Graft position was also confirmed using arthroscope that it did not impinge the notch through whole range of knee motion (Fig. 2d). In all cases autologous BPTB graft was used.

Knee immobilizer was used in all patients for 4 weeks postoperatively with advice to carry out 0-90 degrees flexion exercises several times a day. Stitches were removed at 14th postop day. After 4 weeks active full range of motion exercises was started. Muscle building against resistance started at 8 weeks along with start of jogging, swimming and cycling. Return to contact sports was allowed after 12 months if adequate muscle strength had been achieved.

At a minimum follow-up of 1 year (13-25 months), the clinical and functional outcomes were observed. 120 patients (60 in each group) were evaluated subjectively and objectively, using the Lysholm and Knee Injury and Osteoarthritis Outcome (KOOS) Scores. Manual knee laxity was checked through Lachman and Anterior Drawer tests in comparison with contralateral normal knee. Rotational instability was assessed with the Pivot shift test in all cases. Statistical analysis was done using SPSS v.20 statistical package (SPSS Inc., Chicago, IL). Frequencies, percentages along with means were determined. Comparison between two technique groups (TT portal and AMP portal) as regards to clinical/functional outcomes was carried out using independent sample t test for Lysholm and KOOS scores and chi square test for residual anterior laxity and Pivot shift test. p-value of <0.05 was taken to be statistically significant difference. This quantitative analysis formed the basis of final interpretations.

RESULTS

Mean age of patients in the study was 27 years in TT Portal group and 28.5 years in AMP Portal group. Male to female ratio was 59:1 in TT portal group and 58:2 in AMP Portal group. Mean Lysholm score was 41 preoperatively in TT portal group. At one-year follow-up the mean was 81, which was graded as fair. In AMP portal group mean pre-op score was 42.2 and at one-year follow-up it had improved to 85, hence graded as good. Difference between TT and AMP portal groups in this regard was not found statistically significant ($p>0.05$). Mean KOOS score improved from 48.8 -to 81 and 47.5 to 83 in TT portal group and AMP Portal group respectively. The difference of means in two groups

was found insignificant (p>0.05). Residual anterior laxity was found in 11 (18.3%) patients in TT portal group compared to 10 (16.7%) patients in AMP portal group (p>0.05). Out of these patients pivot shift test was abnormal in 8 (13.3%) patients in TT portal group and 3 (5%) patients in AMP portal group (p<0.05). (Table 1)

In our study population, associated meniscal injuries were found in 92 (76.6%) patients. Out of these meniscal surgery had been performed in prior arthroscopy in 70 (58.3%), whereas concomitant meniscal procedure was performed in 22(18.3%) of cases. (Table 2)

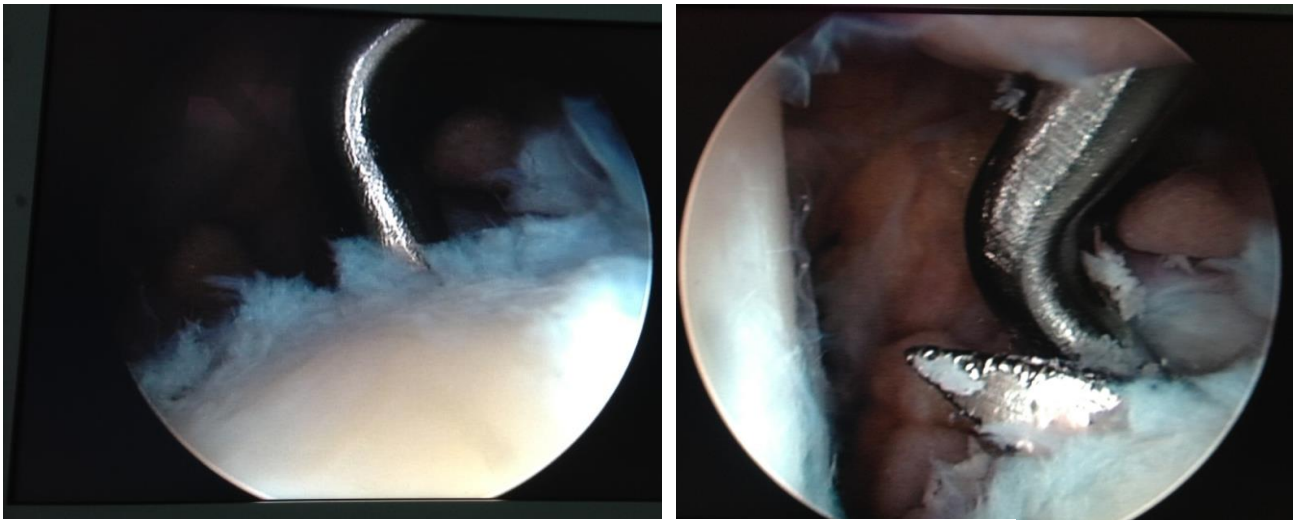
Table 1: Demograhic features and clinical/functional outcome

	TT Portal (n=60)	**AMP Portal (n=60)**	***p*-value**
Male: Female	59:1	58:2	
Mean Age	27 yrs	28.5 yrs	
Mean Lysholm score Pre-Op Post-Op	 41 80 (Fair)	 42.2 85 (Good)	 0.126
Mean KOOS score Pre-Op Post-Op	 48.8 81	 47.5 83	 0.403
Residual anterior laxity Grade 1 Grade 2/3	11 (18.3%) 7 (11.6%) 4 (6.7%)	10 (16.7%) 6 (10%) 4 (6.7%)	0.135
Abnormal Pivot shift	8 (13.3%)	3 (5%)	**0.0427**

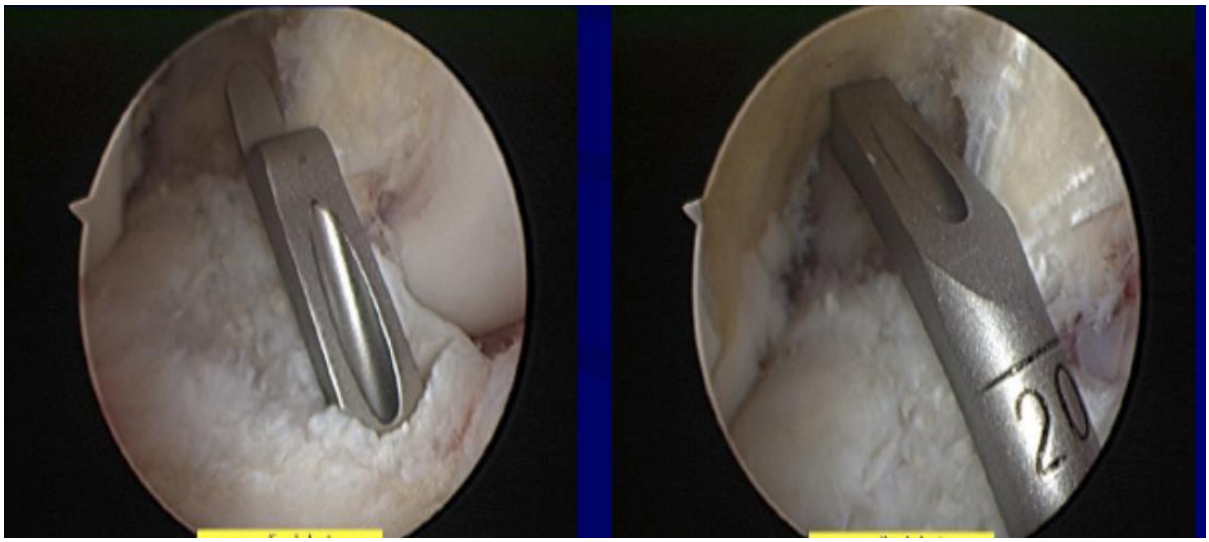
Table 2: Incidence of meniscal injuries in study population

Associated Meniscal injuries	92 (76.6%)
Meniscal procedure on prior arthroscopy	70 (58.3%)
Concomitant meniscal procedure	22 (18.3%)

Figure 1: Transtibial (TT) portal technique for femoral canal placement



1a **1b**



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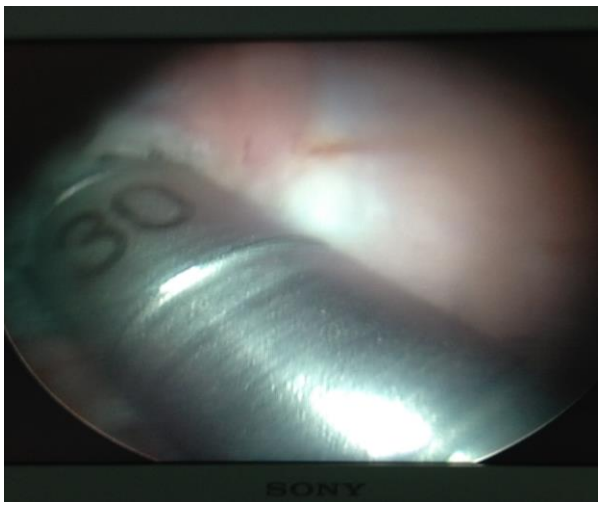

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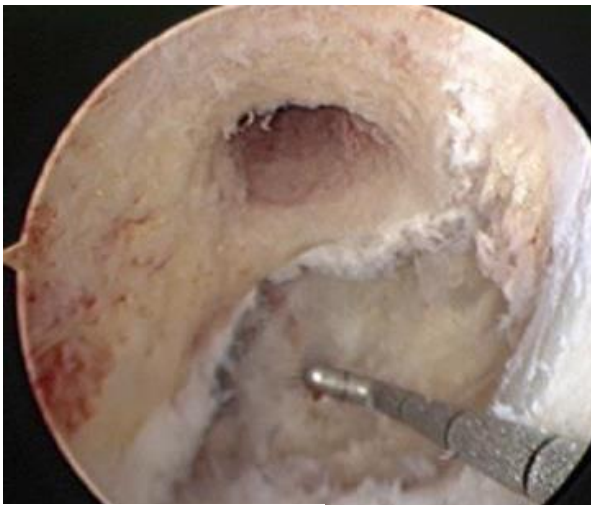
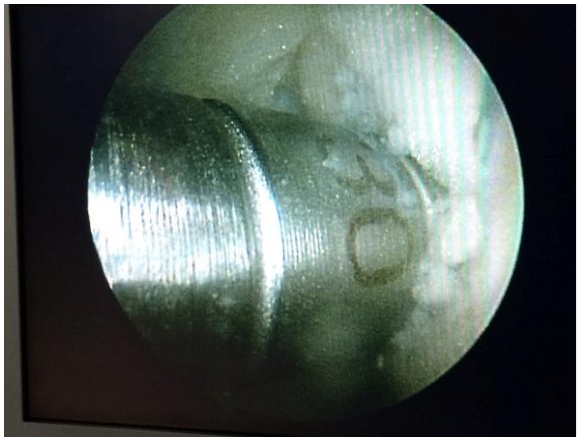


1e

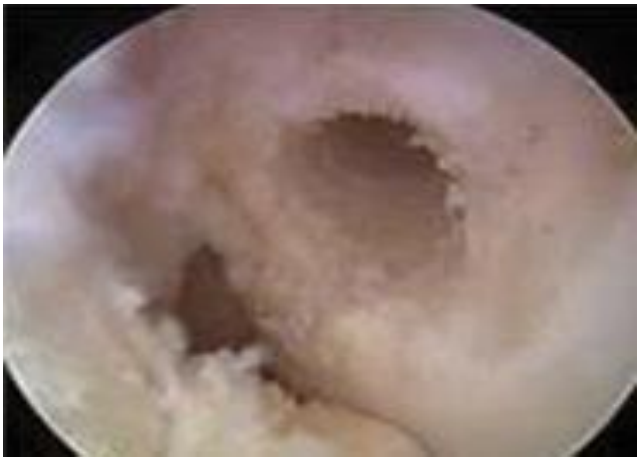
1a-Tibial jig placed at footprint on tibial side. 1b- Guide wire passed under arthroscopic assistance. 1c- Transtibial passage of femoral drilling jig. 1d- Depth of tunnel is 30mm. 1e- Non anatomic femoral tunnel.

Figure 2: Anteromedial (AMP) portal technique for femoral canal placement

2a



2b



2c

2d

2a- Femoral tunnel guide wire being placed through AMP portal at 2/3 o'clock for lrft knee. 2b- Depth of reaming is 30mm. 2c- Anatomic femoral tunnel.
2d- Impingement of placed graft being ruled out in whole range of motion.

DISCUSSION

One of commonest sports injuries encountered in orthopaedic practice is an ACL injury. During last decade, the concept of anatomic and non-anatomic ACL reconstruction has come under debate. The anatomic ACL reconstruction tends to reproduce

patients' own anatomy and reconstruct an ACL with all its original properties [15].

The purpose of this study was to compare the clinical outcomes in patients undergoing single-bundle BPTB ACL reconstruction, employing either trantibial (TT) or anteromedial (AMP) portal technique for femoral tunnel placement. Our results showed a notably less abnormal pivot shift in AMP group (5%) as compared to TT group (13.3%). In a study conducted by Eduard Alentorn-Geli et al, the similar results were obtained. They reported reduced anterior tibial translation in AMP group compared with TT group when measured by KT 1000 arthrometer. Similarly, IKDC score, Lachman test and pivot shift test assessment was better in AMP group than TT group [13].

In our study, AMP group was found to have slightly improved but comparable outcome in terms of residual laxity, KOOS score and Lysholm score. However, the use of AMP technique had marked improvement ($p<0.05$) in rotary stability of knee. The same was reflected in a study by Eduard Alentorn-Gel et al. In TT technique, the femoral tunnel is dependent and guided by tibial tunnel but in AMP technique the surgeon has more freedom to place graft at ACL Footprint [16]. The success in ACL reconstruction depends on many factors like a similar graft shape, tension and location close to anatomical location of ACL. Anteriorly placed graft does not provide a good anteroposterior stability [17], whereas a vertically positioned graft does not provide rotational stability [18].

AMP portal technique produces a femoral tunnel, which places graft more posterior, and at near anatomical location as compared with TT group [19]. In a study it has been reported that patients who had ACL reconstruction through transtibial technique for femoral tunnel had higher chances of repeat knee surgery as compared to AMP drilling technique group [20]. Decreased loading of non-anatomical graft and reduced rotatory stability in TT group for ACL surgery produced higher forces on meniscus and joint cartilage [21, 22] and later on resulted in higher chances of re-injury.

Additionally, it was also observed that ACL reconstruction through AMP technique had no PCL impingement as was observed in transtibial technique of femoral drilling which had a tendency to displace superiorly and showed impingement against lateral border PCL. This was due to placement of ACL in center of ACL femoral foot print [23]. Our study also confirmed this observation.

CONCLUSION

We conclude that AMP portal technique for femoral tunnel placement is better than TT portal technique in ACL reconstruction as regards to overall clinical outcome, with significant gain in rotary stability post-operatively. However, we recommend multi-centric randomized studies to further validate these results.

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