

ORIGINAL ARTICLE

Comparison between Transtibial Versus Anteromedial Portal Femoral Tunnel Drilling Technique in Arthroscopic Anterior Cruciate Ligament Reconstruction with Hamstring Autograft: A Comparative Study

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ABSTRACT

Background: The most common ligament damage pertaining to the knee joint is an anterior cruciate ligament (ACL) injury. The independent drilling approach is now the primary emphasis for femoral tunnel preparation, rather than the transtibial technique (TT).

Objective: To determine the anteromedial portal's mean Lysholm score with TT for the femoral tunnel drilling technique used in hamstring autograft-assisted ACL repair.

Material and methods: In the Department of Orthopaedic Surgery at the Ibne Sina Hospital and Research Institute in Multan, Pakistan, a comparative research was carried out.

Total duration of this study was two years. (from 10th dec 2020 to 10th dec 2022) .A total number of 60 patients were taken using random sampling technique (divided into group A which was TT technique, and group B which was Am technique. Baseline characteristics which includes BMI, weight, age, height, gender, as well as side of injury were noted.

By using knee range of motion along with the Lysholm score, the functional outcome was evaluated six months after surgery.

Results: The participants' average age was 30.9 ± 5.2 years. There were 66.7% males. Fall injuries were the most frequent type which was 38.3%, after the sports (33.3%). Mean Lysholm score of the participants was 93.7 ± 2.4 . Mean Lysholm score of participants in Anteromedial portal group was significantly higher compared to trans-tibial approach (95.3 ± 2.0 vs. 92.1 ± 1.7 , p-value < 0.001). However, hospital stay and knee range of movements did not noticeably differ in both the sets (p-value > 0.05).

Conclusion: Our study concluded that AMP technique is better compared to TT technique in the terms of mean lysholm score post-operatively.

Keywords: Anterior cruciate ligament reconstruction, Lysholm Knee Score, Knee injuries

INTRODUCTION

The most frequent traumatic ligament injury affecting the knee joint is an anterior cruciate ligament (ACL) damage¹. The reconstruction of ACL is a standard treatment needed in persons with ACL complete rupture and who want to resume their high quality physical². The basic purpose of ACL reconstruction (ACLR) is to reinstate biomechanics of knee, restoring functionality, enabling the full recovery of physical activities and enhancing the quality of life in relation to health. Therefore, ACLR is now a frequent procedure in orthopaedic surgery³. For ACLR, autograft arthroscopic single-bundle surgery is regarded as the "gold standard."⁴

ACLR is a frequently performed method but there is a controversy as many Research has confirmed that anatomically situating the femoral tunnel has higher biomechanical benefits⁵. There are two different ways to drill the femoral tunnel. The initial approach is called the transtibial (TT) drilling method, and it involves drilling the tibial tunnel first. The tibial ACL footprint serves as the intra-articular location for a drill guide, when the second quadrant from anterior to posterior is addressed. The femoral tunnel is drilled via the tibial tunnel, with the tip of the drill being the posterior fourth quadrant of the femoral condyle in the sagittal plane, as well as the right knee at 10 o'clock and the left knee at 2:00 o'clock in the frontal plane. By arranging the femoral tunnel in a more oblique configuration, anteromedial (AM) drilling—which is carried out from a low anteromedial portal—is thought to improve rotational stability to the knee. The anatomical femoral insertion of the ACL is comparable to this drilling method⁶.

Now a days, In order to restore native ACL knee kinematics, the right knee's femoral notch is home to the femoral tunnel, which is situated in the middle of the ACL footprint's AM

bundle. The TT approach was once the primary method for preparing the femoral tunnel; now, the independent drilling technique is chosen. The AM portal drilling approach has been used more lately, with surgeons utilising it at a rate of 90% in 2016 compared with 68% in 2013⁷.

According to the research conducted by Ozer et al. the postoperative Lysholm scores for AM femoral tunnel group and TT group were 96.4 ± 3.69 and 90.7 ± 6.40 thus showing significantly better results of AM femoral tunnel group ($P=0.001$)⁸. Another retrospective comparative study conducted by K. Bas Delioglu et al having total of 30 cases, 17 ± 6.4 months was the average follow-up period. According to that investigation, the average post-operative Lysholm knee score for the AMT group was 96.714 ± 3.38 while this score was 92.375 ± 4.395 in TT group with p value of 0.002⁹.

A meta-analysis conducted showed that seven studies documented the femoral tunnel drilling method: 5 were in consensus with anteromedial portal, and the remaining both were in favour of TT method.⁽¹⁰⁾ Another meta-analysis of twenty one (21) studies, which enrolled The implementation of the AMP resulted in greater knee stability as well as range of motion values, as well as a quicker return to running when compared to the TT approach, according to a total of 859 patients (257 in the AMP group and 602 in the TT group). In both the mid- and long-term follow-ups, the benefits of the AMP were not recorded, and a conclusive outcome was frequently lacking that one technique is better than the other.

As the published literature is inconclusive regarding the best method of femoral tunnel creation to restore a stable knee kinematics therefore, we have planned this study to determine the best method for creating a femoral tunnel.

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PATIENTS AND METHODS

This study, which had a total of 60 patients registered, was conducted over the course of two years (from 10th dec 2020 to 10th dec 2022) at the Department of Orthopaedic Surgery, Iqbal Sina Hospital and Research Institute, Multan, Pakistan. The study used a non-probability consecutive sampling method. The inclusion criteria included both male and female patients aged 20 to 40, as well as those who presented within six weeks of injury and were diagnosed with a complete ACL tear based on clinic-radiological evaluation, including MRI, evaluation under anaesthesia, and by diagnostic arthroscopy during the reconstruction process. While exclusion criteria was use of grafts other than Hamstring graft, Accompanying ligament or meniscal injury, Bilateral ACL injury, Revision surgery, Patients with comorbidities like diabetes mellitus (HbA1c >7%), renal failure (Serum Creatinine > 1.5 mg/dl).

Patients fulfilling the inclusion criteria were selected from the outpatient clinics of Orthopedic Surgery Department according to sample size. Informed agreement was obtained for this specific surgery and the use of the patient's data in research. Regarding secrecy and skill, they received assurances. Baseline characteristics including age, gender, height (assessed by scale in cm) weight (in kg assessed by weight machine), BMI and side of injury were noted.

By using a lottery method, the patients who satisfied the requirements for an ACL rupture were divided into two groups (Group A and Group B). TT technique was used for group A patients and group B patients underwent ACL reconstruction by AM technique. Rehabilitation program include weight-bearing as tolerated by patients. During the initial Knee flexion was permitted up to 90 degrees for six weeks, and at 120 degrees or higher for twelve weeks. For the first three months, a knee brace with an adjustable hinge was used. Following six months post-operatively functional outcome was assessed by the researcher neither involved in the study nor aware of treatment assigned Lysholm score and knee range of motion are used. Patients were cleared to

resume any athletic activities they had been involved in prior to injury after eight months, following a thorough physical examination and evaluation.

Data Analysis Procedure: The analysis of the data was done using SPSS version 24. Quantitative variables including height (meter), age, weight (kg), BMI (kg/m²), duration of injury (weeks) and lysholm knee score was analyzed by utilising the standard deviation and mean. For qualitative factors like gender, side of injury, and method of damage, frequency and percentage were computed. An independent sample t-test was used to compare the mean Lysholm knee score between the two groups, with a P value of less than 0.05 considered significant. Using a post-stratification independent sample and data stratification based on age groups, gender, and fracture duration, effect modifiers were managed. The mean Lysholm score of the anteromedial portal and the transtibial technique (TT) for the femoral tunnel drilling technique were compared using the T test. P-value less than 0.05 was deemed significant.

RESULTS

The mean age of participants was 30.9 ± 5.2 years. There were 66.7% (n=40) males, mean height of the participants was 1.8 ± 0.1 meters, mean weight was 82.4 ± 9.4 kg and mean BMI was 26.7 ± 3.0 kg/meter². Right side was most commonly affected (56.7%, n=34) and most common mode of injury was fall (38.3%, n=23) followed by sports (33.3%, n=20).

Mean duration of injury before reconstruction was 4.1 ± 0.9 weeks. Age, gender, height, mode of injury, side of injury and duration of injury in trans-tibial and Anteromedial portal approaches were comparable. However, weight of the patients in Anteromedial portal approach (86.2 ± 8.3 kg) was significantly higher than the trans-tibial approach (78.6 ± 9.0 kg). Similarly, BMI in Anteromedial portal approach was significantly higher than the trans-tibial approach (27.6 ± 3.0 vs. 25.9 ± 2.8 kg/meter² respectively, p-value 0.04). Table 1.

Table 1: Characteristics of patients undergoing arthroscopic reconstruction of anterior cruciate ligament (N=60)

Characteristics	Overall (N=60)	Trans-tibial approach (n=30)	Anteromedial Portal Approach (n=30)	p-value*
Age (years)	30.9 ± 5.2	31.3 ± 5.2	30.7 ± 5.3	0.68
Gender				
Male	40 (66.7)	20 (50)	20 (50)	1.0
Female	20 (33.3)	10 (50)	10 (50)	
Height (meter)	1.8 ± 0.1	1.7 ± 0.1	1.8 ± 0.1	0.14
Weight (Kg)	82.4 ± 9.4	78.6 ± 9.0	86.2 ± 8.3	0.001
BMI (Kg/m ²)	26.7 ± 3.0	25.9 ± 2.8	27.6 ± 3.0	0.04
Injury Side				
Right	34 (56.7)	17 (50)	17 (50)	1.0
Left	26 (43.3)	13 (50)	13 (50)	
Mode of Injury				
Sports	20 (33.3)	10 (50)	10 (50)	1.0
Fall	23 (38.3)	12 (52.2)	11 (47.8)	
RTA	17 (28.3)	8 (47.1)	9 (52.9)	
Duration of injury (weeks)	4.1 ± 0.9	4.1 ± 0.9	4.0 ± 0.8	0.13

*Independent sample t-test for numerical data, chi-square test for categorical data

Table 2: Clinical outcomes of patients undergoing arthroscopic reconstruction of anterior cruciate ligament (N=60)

Outcome	Overall (N=60)	Trans-tibial approach (n=30)	Anteromedial Portal Approach (n=30)	p-value
Hospital Stay (days)	3.1 ± 0.7	3.0 ± 0.8	3.1 ± 0.7	0.61
Lysholm Knee Score	93.7 ± 2.4	92.1 ± 1.7	95.3 ± 2.0	< 0.001
Knee ROM				
Satisfactory	55 (91.7)	27 (49.1)	28 (50.9)	1.0
Un-satisfactory	05 (8.3)	03 (60)	02 (40)	
Age groups				
Hospital Stay (days)				
≤ 30-years		3.25 ± 0.6	3.1 ± 0.8	0.54
> 30-years		2.9 ± 0.8	3.2 ± 0.7	0.29
Lysholm Knee Score				
≤ 30-years		92.3 ± 2.0	95.7 ± 1.2	< 0.001
> 30-years		92 ± 1.5	94.9 ± 2.5	< 0.001
Gender				
Hospital Stay (days)				
Male		3.1 ± 0.8	3.1 ± 0.7	1.0
Female		3.0 ± 0.8	3.3 ± 0.8	0.42
Lysholm Knee Score				
Male		92.4 ± 1.5	95.2 ± 1.7	< 0.001
Female		91.6 ± 2.0	95.4 ± 2.6	0.002

Obesity				
Hospital Stay (days)	Yes	3.0 ± 0.6	3.1 ± 0.7	0.70
	No	3.1 ± 0.8	3.2 ± 0.8	0.65
Lysholm Knee Score	Yes	93.3 ± 1.0	95.3 ± 1.8	0.002
	No	91.4 ± 1.6	95.3 ± 2.5	< 0.001
Duration of Injury				
Hospital Stay (days)	≤ 4-weeks	3.3 ± 0.7	2.8 ± 0.9	0.17
	> 4-weeks	2.8 ± 0.8	3.4 ± 0.5	0.019
Lysholm Knee Score	≤ 4-weeks	92 ± 1.8	95.6 ± 2.2	< 0.001
	> 4-weeks	92.2 ± 1.6	95 ± 1.9	< 0.001

The mean duration of hospital stay was 3.1 ± 0.7 days in the study participants. Knee range of movements were satisfactory in 91.7% (n=55) of the cases. Mean Lysholm score of the participants was 93.7 ± 2.4 . Mean Lysholm score of participants in Anteromedial portal group was significantly higher compared to trans-tibial approach (95.3 ± 2.0 vs. 92.1 ± 1.7 , p-value < 0.001) respectively. However, hospital stay and knee range of movements did not significantly differ in both the groups (p-value > 0.05). Hospital stay did not differ in Trans-tibial approach compared to Anteromedial Portal Approach after Stratification on age groups, obesity and gender but Lysholm Knee Score remained significantly higher in Anteromedial portal approach. Knee range of movements did not differ in Trans-tibial approach compared to Anteromedial Portal Approach after Stratification on age groups, gender and obesity.

Hospital stay was significantly higher in Anteromedial Portal Approach compared to trans-tibial approach (3.4 ± 0.5 vs. 2.8 ± 0.8 , p-value 0.019) in patients with duration of injury > 4-weeks. Lysholm Knee Score remained significantly higher in Anteromedial portal approach after stratification on duration of injury. While Knee range of movements did not differ in Trans-tibial approach compared to Anteromedial Portal Approach after Stratification on duration of injury Table 2.

DISCUSSION

Anatomic ACL reconstruction has become popular to retrieve the knee's original anatomy and kinematics. Certain benefits come with using the AMP technique for ACL reconstruction. These include the ability to prepare the femoral and tibial tunnels independently, place the graft more horizontally, lessen the need for notchplasty, drill the femoral tunnel without a special tool, and lessen the difficulty of revision surgeries^{12,13}

The AMP approach has a few drawbacks. Initially, the learning curve and operation length are longer. Second, improper knee flexion might result in a short femoral tunnel (25–30 mm). Graft attachment may be jeopardised by this, especially if the suspension technique is applied. The third possibility is damage to the cartilage in the medial femoral condyle.

It may be prevented by positioning a guide wire at least 2 mm away from the medial femoral condyle. Lastly, vision may be restricted since the femoral tunnel preparation requires at least 120° of knee flexion. As suggested by Cohen et al., the central anteromedial portal—which is formed into the medial third of the patellar tendon just above the joint line—may be easier to see as the femoral tunnel is being constructed in the AMP technique¹⁵. The transtibial approach has the following benefits: less time spent in the operating room, simple surgical method, and no need for knee flexion greater than 90° in order to drill a femoral tunnel.⁽¹⁴⁾ The TT approach is limited because the tibial tunnel's location dictates where the femoral tunnel should be placed¹⁶.

Failure of ACL restoration is caused by a variety of surgical procedure failures. Of all technological mistakes, tunnel malplacement is the most frequent one¹⁸. The tibial tunnel apertures were positioned medial to the anatomic posterolateral and anteromedial tunnels and posterior to the anteromedial tunnel, whereas the femoral tunnel's TT drilling technique was consistently positioned anterior (or "higher") to the anatomic anteromedial and posterolateral tunnels¹⁹. Non-anatomical bone tunnel implantation results in non-anatomical ACL restoration, which may eventually

contribute to knee instability.⁽¹⁶⁾ Compared to the TT approach, a controlled laboratory investigation found that the AMP method more effectively recovers the femoral external rotation at mid-stance and anterior-posterior translation during the swing phase.

The AMP and TT approaches for ACL repair were compared in the current investigation. In order to achieve ACL restoration within anatomical range and resume sporting activities, the AMP approach was determined to be preferable to the TT technique. In terms of mean Lysholm score, the AMP group outperformed the TT group at the six-month follow-up following ACL repair. It was observed that the AMP group outperformed the TT group in the lateral mobility tests (sidestep and carioca) and Lysholm score in the third and sixth months after surgery²⁰. Therefore, athletes who participate in sports that call for fast lateral movements, like basketball and team handball, should use the AMP approach.

Patients in both groups had a significant improvement in their clinical function scores at the follow-up visit after ACL repair, according to a research by Geng Y et al. However, during the final follow-up, there was no discernible change in the function ratings between the AMP and TT groups²¹. Metso L et al. came to the conclusion in their research that, when compared to the body of literature that was accessible, there was no proof that one femoral tunnel drilling technique was better than the other for controlling knee rotational instability after ACL repair. Both drilling techniques resulted in increased patient satisfaction and performance.⁽⁶⁾ Reconstruction of the ACL using the transtibial approach was associated with a considerably higher risk of revision ipsilateral knee surgery in comparison to reconstruction using the anteromedial portal method, according to a recent multicenter research including 380 patients²². The study has a lot of restrictions. Its sample size was tiny, to start. Secondly, the research was just temporary. Third, the precise tunnel position was not determined using computed tomography or X-ray control techniques. Long-term follow-up studies might be conducted to further explore the advantages of the AMP technique in relation to knee osteoarthritis and failure.

CONCLUSION

According to the results of our study, the AMP approach may be better than the TT technique in terms of the post-operative mean Lysholm score and the amount of time it takes to resume sports after ACL repair. More research with extended follow-up is required.

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