International Journal of Research in Orthopaedics
Singh B et al. Int J Res Orthop. 2019 Mar;5(2):321-325
http://www.ijoro.org

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20190799

Anteromedial versus trans-tibial technique for anterior cruciate ligament reconstruction using quadrupled hamstring graft: a comparative study

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Received: 13 December 2018
Accepted: 04 February 2019

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ABSTRACT

Background: Femoral tunnel position plays a pivotal role for successful outcome in anterior cruciate ligament (ACL) reconstruction surgeries. Recently, the anteromedial techniques have gained popularity over the trans-tibial technique due to better anatomical position and better stability rotationally and antero-posteriorly then the later. The aim of the present study was to compare the technical difficulty and ease, functional and radiological outcome of trans-tibial and anteromedial portal techniques in ACL reconstruction.

Methods: Thirty patients between March 2015 and February 2016 with ACL tear underwent arthroscopic reconstruction using quadrupled hamstring graft and were divided into two groups A (anteromedial) and group B (trans-tibial) as per the technique used. Patients with multiligament injuries, revision surgeries, and osteoarthritis knee were excluded. All the patients were followed-up for 24 months and clinical Lysholm and IKDC scores along with radiological outcome were calculated.

Results: The mean age of patients were 32.4±6.3 years. Isolated ACL tear was seen in 16 (53.4%) cases followed by medial meniscus injury in 11 (36.6%) patients. The mean duration between injury and surgery was 14.8±8.99 and 21.6±3.23 days in group A and B respectively (p=0.0122). The radiological position of femoral tunnel in sagittal and coronal plane was statistically significant in both the groups. The Lysholm and IKDC scores showed statistically significant difference at 3 months post-operatively.

Conclusions: Anteromedial and trans-tibial techniques have similar long term functional outcomes. However, more anatomical position of the graft through the anteromedial technique and better rotational and anteroposterior stability makes it theoretically to be superior to the trans-tibial technique.

Keywords: Anterior cruciate ligament, Anteromedial, Trans-tibial, Arthroscopic reconstruction

INTRODUCTION

Anterior cruciate ligament (ACL) is one of the main structures of the knee and is responsible for antero-posterior and rotational stabilization in transverse and frontal plane.[1,2] Anterior knee instability associated with rupture of the anterior cruciate ligament is a disabling clinical problem, especially in an athletic individual, it predisposes the knee to subsequent injuries like secondary meniscal tear and chondral injuries.[3] Tunnel position at femur and tibial side and subsequent graft position are of one of the major determinants for a long term successful outcome in ACL injuries.[3-5] The tunnel position on the femoral side is of importance in terms of the stability in the coronal and sagittal plane. The two commonly used techniques can be either trans-tibial (drilling the femoral tunnel through the tibia) or anatomical (femur tunnel preparation through the outside

in or medial portal. The trans-tibial technique has been widely used in the last two decades.[3-5] However, biomechanical studies have shown that this technique is associated with improper placement of the graft as compared to the anatomical technique.[6-8] Nevertheless, there is no consensus regarding long term clinical results and re-rupture.[9]

The aim of the present study was to compare the technical difficulty and ease, functional and radiological outcome of trans-tibial and anteromedial portal techniques in ACL reconstruction.

METHODS

A prospective study was conducted at a tertiary care centre in New Delhi city between March 2015 and February 2016 on 30 patients with anterior cruciate ligament (ACL) injuries and was treated with arthroscopic ACL reconstruction using anteromedial (anatomical) and trans-tibial technique. All skeletally matured patients between 18 and 45 years of age with closed ACL tear with or without stable meniscus injuries were included in the study. Patients with osteoarthritis knee, previous history of fracture, revision ACL surgeries and multiligament injuries were excluded from the study. All the patients were randomly divided using the closed envelope technique. The randomization was done by another surgeon who was not the operating surgeon. Thirty-eight patients with ACL injuries fulfilled the inclusion criteria, out of which 8 refused to participate in the study. The patients included in the study were explained about both the techniques and well written informed consent was obtained from them. The ethical committee approval was obtained prior to the commencement of the study. The patients were divided into two groups. Group A had 16 patients who were treated using the antero-medial portal technique while 14 patients in group B were operated using the trans-tibial technique. All the patients were operated using the autologous quadrupled hamstrings graft which was fixed at the femoral side using the Arthrex tightrope RT double loaded (Arthrex® USA) and Bio Composite Arthrex interference screw (Arthrex® USA) was used for tibial fixation.

All the patients were operated under spinal combined with epidural anaesthesia. All the patients were given three doses of intravenous second generation cephalosporin (cefuroxime 1.5 g, one just after the induction and two doses at an interval of 12 hours post-operatively)

Surgical technique

Diagnostic arthroscopy

Using standard anteromedial and anterolateral arthroscopic portals, a diagnostic arthroscopy was performed in the standard manner evaluating the patella-femoral joint, medial and lateral compartments and the cruciates. ACL tear was confirmed by seeing the empty notch sign. Meniscal tears were treated surgically prior to the reconstruction of anterior cruciate ligament.

Harvesting the hamstring graft

A 2-3 cm vertical incision was made over anteromedial side of tibial tuberosity directly over pes anserinus. The gracilis and semitendinosus tendons at their distal insertion on the anteromedial aspect of tibia were identified and harvested using the tendon stripper. Each of the harvested tendons then prepared using non-absorbable number 5 ethibond sutures in krackow fashion.

Antero-medial portal technique[10]

A low antero-medial portal was made just above the superior edge of the medial meniscus. The tibial tunnel was prepared in the same fashion as that in trans-tibial technique. With the knee maximally flexed, an over-the-top guide was inserted through the medial portal and placed in the over-the-top position at the 2-o'clock position for left knees and the 10-o'clock position for right knees. A guide wire was then advanced through the guide and into the lateral femoral condyle through the notch to a depth of 30 mm. The diameter of the reamer varied with the size of the graft used in each patient. The arthrex tightrope was fixed to the graft and then passed from the tibial and femoral tunnels respectively. The femoral side fixation was done using the end button of the tightrope. The knee was then cycled several times from full extension to maximum flexion while manual tension was applied distally to the hamstring graft, to attain graft pre-tensioning and settling. With the knee in 15 to 20 degree of flexion and while doing posterior drawer, an arthrexBioComposite interference screw was used to achieve tibial fixation. The wound was closed over layers and compression dressing along with long knee extension brace was applied.

Trans-tibial technique[11]

A commercial aiming tibial guide at 55 degree to the long axis of tibia was placed through the anteromedial portal and seated lateral to medial tibial spine and midway between posterior cruciate ligament and posterior edge of the anterior horn of the medial meniscus. The tibial guide wire was drilled and reamed equal to the graft diameter. With knee in 90degrees flexion, the femoral tunnel was made at the intersection of lateral wall of the posterior femur and the roof, by using a trans-tibial femoral guide at 10:30 o' clock position for the right knee and 1:30 o'clock position for the left knee leaving 2-3 mm of bone from the posterior lateral femoral cortex. After drilling the femoral tunnel, reaming was performed with the reamer equivalent to the size of the graft diameter. The graft was fixed on both the sides which was similar to the antero-medial technique. The wound was closed over

layers and compression dressing along with long knee extension brace was applied.

Post-operative care

Gradual active knee bending was begun from the second post-operative day upto 30 degrees of flexion. The patients were asked to use a hinged knee extension brace after 2 weeks using the accelerated ACL rehabilitation programme.

Follow-up: Regular follow-up was done for all the patients at 3,6,12 and 24 months respectively. Clinical assessment was done by Lachman and Pivot shift test. Weight bearing antero-posterior and lateral view x rays were obtained of all the patients to assess the graft position. Lysholm and international knee documentation committee (IKDC) scores were recorded at each follow up.[12,13] Any complications of the procedure were also taken into account. The Lysholm scale is a subjective one which consists of eight items namely pain, instability, locking, swelling, limp, stair climbing, squatting and need for support. The total score value may be between 0 and 100 which is calculated on the basis of the response to the questionnaire. The higher scores indicate a better outcome. The IKDC is a subjective assessment consisting of ten questionnaire with respect to the knee function, activities of daily living and ability to play sports. The score ranges between 0 and 100 with higher scores predicting a better outcome.

Statistical analysis

Two sample independent t-test was used to assess the radiological paramaters post-operatively and Lysholm and IKDC scores. The results were expressed as mean with standard deviation and $p<0.05$ was considered to be statistically significant. Analysis was done using the Epi-info software (Version 3.4.3) and Microsoft Excel 2013 (Microsoft Office v15.0).

RESULTS

The mean ages of the patients were 32.4±6.3 years. There were 17 (56.7%) males and 13 (43.4%) females in the present study. Nineteen (63.4%) patients had right sided involvement. Isolated ACL tear was seen in 16 (53.4%) patients followed by medial meniscus injury with 11 (36.6%) patients. The most common mechanism of injury was sports related activities comprising of 14 (46.7%) patients. The mean duration between injury and surgery was 14.8±8.99 and 21.6±3.23 days in group A and B respectively (p=0.0122). The mean duration of follow-up was 21.4±6.9 weeks in group A and 22.7±4.7 weeks in group B (p=0.5573). There were 2 (12.5%) patients in group A and 1 (7.1%) patient in group B who had loss of terminal extension. Out of this one patient achieved full range of movements at the end of 6 months with accelerated rehabilitation. One (7.1%) patient in group B had superficial infection which was treated with oral antibiotics. No patients had re-tear of ACL. The position of the tibial tunnel in sagittal and coronal plane showed no statistically significant difference in both the groups. The position of the femoral tunnel in sagittal and coronal plane was statistically significant in both the groups (Table 1). The pre and post-operative Lysholm and IKDC scores were as shown in Table 2.

Table 1: Position of the tunnels of radiograph.

Position of the tunnel	Group A (n=16)	Group B (n=14)	P value
Tibial tunnel			
Sagittal plane	45.97±1.48	47.15±6.32	0.4738
Coronal plane	44.38±2.57	46.8±7.2	0.2168
Femoral tunnel			
Sagittal plane	81.55±2.06	77.44±4.62	0.0033*
Coronal plane	43.64±3.12	39.0 ±6.15	0.0132

*Statistically significant.

Table 2: Pre and post-operative scores used.

Score (months)	Group A n=16	Group B n=14	P value
Lysholm score			
Pre-op	53.6±6.05	50.4±6.3	0.1673
Post-op 3	69.6±6.94	74.73±6.61	0.0483*
Post-op 6	82.27±3.28	81.29±2.79	0.3893
Post-op 12	91.36±4.65	90.27±3.14	0.4649
Post-op 24	94.23±5.89	95.17±3.26	0.6005
IKDC score			
Pre-op	51.81±2.36	51.47±2.85	0.7234
Post-op 3	66.35±2.74	68.57±1.09	0.0084*
Post-op 6	80.82±4.12	79.46±5.36	0.4393
Post-op 12	93.45±3.14	92.04±2.58	0.1937
Post-op 24	95.36±1.08	94.59±2.74	0.0009*

*Statistically significant.

DISCUSSION

Traditionally, the trans-tibial technique has been commonly used for the ACL reconstruction owing to its simplicity, more familiarity with the procedure due to single incision, better sagittal stability, minimal graft impingement and more stable Lachman post-operatively. However, it is associated with issues such as less rotational instability due to non-anatomic vertical graft position of the femoral tunnel in the inter-condylar notch, graft length mismatch, posterior-cruciate ligament impingement and unstable pivot shift test post-operatively.[9,11,14] In order to reach the centre of ACL, the tibial tunnel needs to be transverse which can lead to short and subchondral tunnel.[15] Lee et al in their study, have used the modified trans-tibial technique with varus and internal rotation of the tibia when the trans-tibial guide is positioned on the femur, reaching a point very similar to the ACL centre.[16] We have no experience with such guides and all the femoral tunnels in group B were made with knee in hyper flexed position.

Antero-medial technique has gained more popularity recently due to a more vertical tibial tunnel, less graft tunnel mismatch, greater graft obliquity, centrally placed femoral graft, better pivot shift and rotational stability.[2,10,17] Nevertheless, anteromedial technique includes a risk of blow out of the lateral femoral condyle, articular damage, has a steep learning curve as compared to the trans-tibial technique, short femoral tunnel lengths making the graft passage little tedious.[7,18,19] In the present study, there was a statistically significant difference in both the groups in terms of femoral tunnel position. The femoral tunnel in patients with group A was more posterior to the Blumensaat's line in sagittal plane and more medial in coronal plane (10 O' clock position). Thus radiographically, the group A patients had the femoral tunnels in an ideal position.

In a study by Loh et al, it was observed that better rotational load resistance is achieved when the femoral graft is placed more laterally and closed to 10-o' clock position as compared to 11-o' clock position.[20] Similarly, the patients in group A had better pivot shift clinically at every follow-up as compared to the group B patients. However, the long term outcome were similar in both the groupswith no statistically significant difference.

In a study by Alentorn et al and Mardani et al, the patients with ACL reconstruction using the anteromedial technique had higher IKDC and Lysholm scores which were statistically significant.[8,21] Although, both these scores were statistically significant post-operatively at 3 months, no significant difference was seen on subsequent follow-ups. Few other studies did not find any significant difference between both the techniques on the basis of IKDC, Lysholm and Tegner scale scores.[22-24]

Smaller sample size, less adequate measurement of the degree of post-operative stability and less duration of follow-up remains the limitations of the study.

CONCLUSION

Anteromedial and trans-tibial techniques have similar long term functional outcomes. However, more anatomical position of the graft through the anteromedial technique and better rotational and anteroposterior stability makes it theoretically to be superior to the trans-tibial technique.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Singh B, Gaurav S, Akshay B. Anteromedial versus trans-tibial technique for anterior cruciate ligament reconstruction using quadrupled hamstring graft: a comparative study. Int J Res Orthop 2019;5:321-5.