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Original Research Article

Assessment of foot print of femoral tunnel placement with commercially available off set guide in arthroscopic ACL reconstruction

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ABSTRACT

Background: Accurate placement of the femoral tunnel is critical for long-term clinical success following anterior cruciate ligament (ACL) reconstruction. Current trends in ACL reconstruction favor anatomic positioning of ACL attachment sites. Surgical inaccuracy in femoral tunnel positioning can lead to potential early graft failure and early-onset osteoarthritis. The purpose of this study was to evaluate the functional outcome in patients who underwent arthroscopic anatomic ACL reconstruction using hamstring tendon graft.
Methods: The study was conducted in the Orthopedics Department of IIMCHRC, Indore the placement of femoral tunnel, using femoral off set guide with other techniques. All the patients who were diagnosed clinically and radiologically with ACL tear and all who gave the consent were included in the study. All patients were enrolled to undergo primary arthroscopically assisted ACL reconstruction.
Results: In the present study out of 42 patients; 23 patients (55%) had right sided ACL injury and remaining 19 patients (45%) had left sided ACL injury. We assessed functional outcome of the patients through pre-operative and post-operative IKDC scoring. The mean of the pre-op IKDC scoring was 33.61 with SD of 9.67 and the mean of the post-operative IKDC scoring was 77.95 with SD of 15.15.
Conclusions: The commercially available off set guide technique of the femoral tunnel placement in arthroscopic ACL reconstruction is easy, reliable and reproducible with the foot print at anatomical place on the femoral site.

Keywords: Anterior cruciate ligament (ACL), Femoral tunnel, Arthroscopy, ACL reconstruction

INTRODUCTION

The anterior cruciate ligament is the weaker of the two cruciate ligaments and therefore may be it get torn easier than the posterior cruciate ligament.[1] The most common mechanism is that of a sudden pivoting or cutting maneuver during sporting activity, which is commonly seen in football, basketball & soccer. The ligament can also tear due to work injuries or automobile accidents. Recent studies have contributed substantially to our understanding of anterior cruciate ligament anatomy and have revealed that common techniques for anterior cruciate ligament reconstruction may fail to replicate native ligament origins or insertions.[2-7] Anatomic placement of an anterior cruciate ligament (ACL) graft is critical to the success and clinical outcome of ACL reconstruction. Anatomic ACL graft placement is defined as positioning the ACL femoral and tibial bone tunnels at the center of the native ACL femoral and tibial attachment sites. Clinical studies have demonstrated that non-anatomic ACL graft placement is the most common technical error leading to recurrent instability following ACL reconstruction.[8] The arthroscopic approach to the ACL tear treatment has the advantages of smaller skin &

capsular incision, less extensor mechanism trauma, improved viewing of the tunnel & attachment sites, less post-operative pain, fewer adhesions, earlier motions, easier rehabilitation.[9] There is some evidence that graft placement aligned with native insertion sites results in superior clinical outcomes.[10,11] Placement of femoral tunnel in arthroscopic ACL reconstruction surgery is a subject of great debate. ACL reconstruction has been commonly performed using a trans-tibial technique in which the ACL femoral tunnel is drilled through a tibial tunnel positioned in the posterior half of the native ACL tibial attachment site. In transtibial technique, positioning the ACL tibial tunnel in the posterior half of the ACL tibial attachment site is dictated by the need for endoscopic drill bit to reach the region of ACL femoral attachment site and the desire for the ACL graft to avoid impingemnt against the roof of the intercondylar notch when the knee is in full extension. However in transtibial technique the femoral tunnel made is too deep and too high and will be vertically oriented in both coronal and sagital planes. Biomechanical studies have shown that a vertically oriented ACL graft may resist the motion of anterior tibial translation, but may fail to control the combined motions of anterior tibial translation and internal rotation which occurs during the pivot shift phenomenon.[12] This may result in patient experiencing continued symptoms of instability and giving away episodes due to the pivot shift phenomenon. Still many surgeons prefer trans-tibial technique of femoral drill. The positioning of the tunnels for placement of the graft is the most critical factor influencing the results from ACL reconstruction.[13,14] It is potentially influenced by, among other things, the angle of knee flexion at the time of drilling the tunnels, the locations of the portals and the anatomical variations between individuals.[15]

After the introduction of anatomical ACL reconstruction femoral tunnel is made from antero-medial portal or accessory antero-medial portal.[16] Still there are 3 major techniques to make femoral tunnel through antero-medial portal. They are as follows:

- By commercially available off set guide
- Ruler technique [17]
- Femoral quadrant technique [18]

Preference is given for ACL reconstruction with commercially available off set guide with knee around 110-130 degree of flexion while drilling femoral tunnel.

Advantages of this technique over others are:

- No X–ray exposure
- Only two portals
- Easy, reliable, reproducible

So study was done to evaluate the functional outcome in patients who underwent arthroscopic anatomic ACL reconstruction using hamstring tendon graft.

METHODS

The present prospective, observational study was conducted between January 2015 to June 2016 at Department of Orthopedics, Index Medical College Hospital & Research Centre, Indore (MP) after taking Institutional Ethics Committee permission. All the patients operated during the study period for arthroscopic ACL reconstruction surgery. For the study, we had included 54 cases. Out of 54 cases 42 were available for follow up of at least 6 months.

Inclusion criteria

Patients of both genders operated for ACL reconstruction surgery and patients and/or his/her legally acceptable representative willing to provide voluntary written informed consent for participation in the study were included in the study.

Exclusion criteria

The exclusion criteria were patients with multi-ligamentous injuries, patients with pre-existing osteoarthritis, patients with high-grade chondral injuries, patients with ipsilateral limb fractures, patients undergoing revision ACL surgery, patients with nerve or vascular injury, immature skeleton and patients and/or his/her legally acceptable representative willing not to provide voluntary written informed consent for participation in the study

Instrumentation

- Arthroscopic surgery unit & instrument
- Endo button
- Interference screw
- Digital Radiography/CT scan

The patient's clinical history and examination findings were recorded prospectively in a case record form. Detailed clinical and radiological examination was carried out. The clinical assessment involved detailed history, clinical examination, and neurological examination. The patients were asked for duration of symptoms, mode of initial treatment taken and limitation of activities of daily living. Written and oral consent was taken from the patient explaining clearly to the patient in their own language the procedure, risks and proposed benefits. Follow up of the patient is done for 6 months post operatively.

All the patients who were diagnosed clinically and radiologically with ACL tear and all who gave the consent were included in the study. All patients were enrolled to undergo primary arthroscopically assisted ACL reconstruction. The study was approved by the local

ethical committee and the patients gave their informed consent to participate.

Descriptive statistics were used to assess demographic particular of the study participants and functional outcome of the patients through pre-operative and post-operative VAS and IKDC scoring. We analyzed the data through SPSS software and applied paired t test. The P value came out to be 0.0001 which is highly statistically significant.

Surgical procedure

Intravenous antibiotics were started one hour before the incision. All cases have been done under spinal anaesthesia with tourniquet control in supine position with knee flexed to 90^{o} hanging in leg holder at the edge of the OT table. A high anterolateral portal was made to avoid the highest part of the fat pad and for better 'look down' view of the tibial attachment site of ACL easily. Establishing the AM portal at the correct height above the medial joint line is extremely important to the success of the procedure.

Figure 1: Surface marking & portals for arthroscopic ACL reconstruction.

Figure 2: Torn ACL.

Hamstring tendon graft harvation

A 3 cm medial skin incision was made midway between tibial tuberosity and medial most aspect of upper tibia. The tendons were palpated and the sartorius fascia was incised parallel to the fibers of the fascia just above the thicker and more distally inserted hamstring tendons. After the vinculae had been cut under visual control, the distal end of tendons is cut and graft is harvested with a semi-blunt, circular closed tendon stripper.

Hamstring tendon graft preparation

The tendon was prepared for quadruple graft, depending on the length of the tendon, 7 cm being the minimum accepted length for the final graft. No.5Ethibond suture was used for preparation of proximal and distal ends of the graft by whip stitch method. Two No. 5 non absorbable Ethibond sutures were used as the lead sutures at the distal and proximal ends. The thickness of the graft is measured using a sizer.

Femoral tunnel preparation

Maximal possible knee flexion of the knee with the leg holder on was achieved. One assistant was used to maintain the knee flexion position while drilling the femoral tunnel. The femoral aimer of appropriate offset (radius of the graft diameter +3) was used to avoid posterior cortex blowout. The beath pin was drilled through the aimer until it exited at the anterolateral aspect of the thigh which was held by a hemostat. Femoral tunnel was prepared with calibrated, cannulated reamers to the desired length and diameter of the graft.

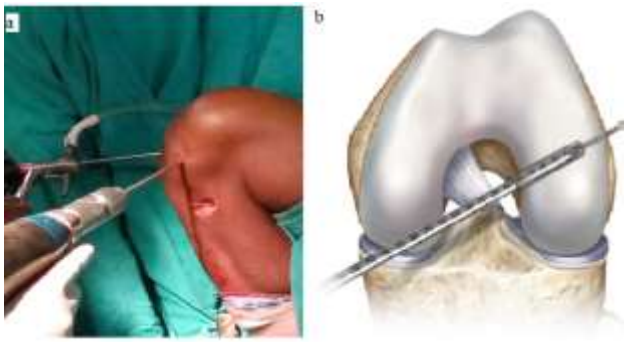

Figure 3 (a, b): Insertion of beath pin (The knee-joint is fully flexed to 140°. A 2.4 mm beath pin is interted via the anteromedial arthroscopy portal through the femoral socket and out through the lateral femoral condyle and the skin. With the beath-pin a large suture loop is pulled through the knee-joint.)

Tibial tunnel preparation

The ACL tibial jig was positioned via the antero-medial portal just over the tibial foot print of the original ACL. The cannulated guide was then pressed against the tibial cortex 1.5 cm medial to the tubercle and 1 cm proximal to

the pesanserinus tendons. A pin was drilled and observed arthroscopically as it entered the nominated site on the intercondylar region. The tunnel was prepared over the guide pin with cannulated reamers up to the desired size.

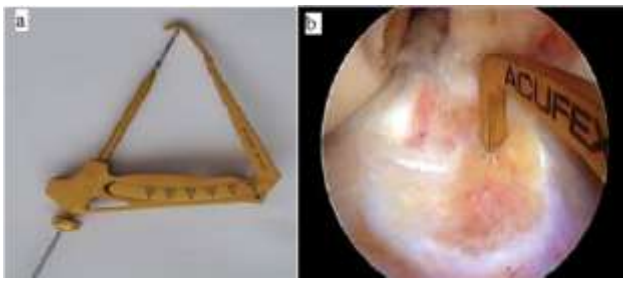

Figure 4 (a & b): ACL zig & placement site for tibial tunnel placement.

Graft placement and fixation

The graft was prepared with appropriate sized endo-button loop. Through the 'beath' pin one ethibond was pssed from tibial tunnel to femoral tunnel. The 'beath' pin was withdrawn from the femoral side by gentle pulling. The thick string of the endobutton was pulled and button was flipped at lateral cotex of the femur. An appropriate bio-absorbable interference screw was used to fix the graft at the tibial site in extension while giving the posterior drawer.

Figure 5 (a): Graft harvesting.

Figure 5 (b): Femoral socket preparation to offset guide in arthroscopic ACL reconstruction.

The wound was closed in layer, tourniquet removed and compression bandage, knee brace was applied. Distal pulses were assessed.

Post-operative care

Wound inspection was done on 2nd and 10th day. Sutures were removed on 10th-12th day. Long knee brace was applied to all cases during the immediate post-operative period and was continued till 6 weeks post-operatively. Post-operative X– rays of the operated knees were taken.

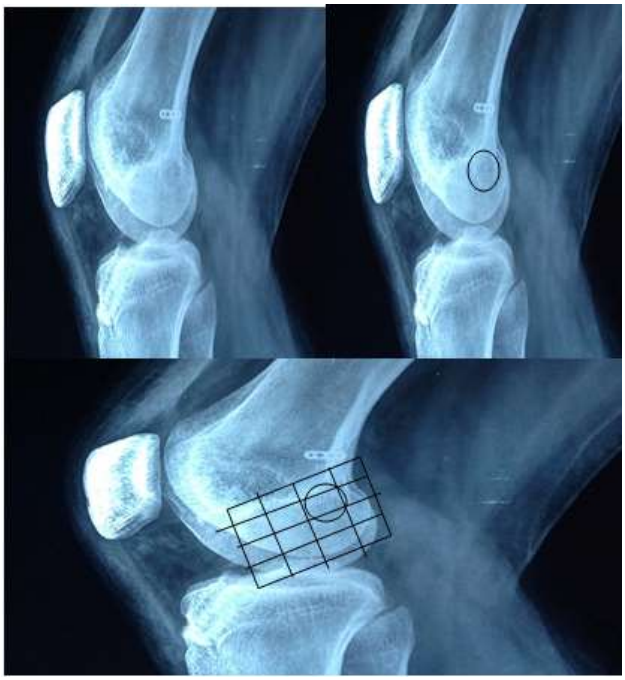

Figure 6 (A & B): Postoperative AP radiograph showing anatomic locations for tunnel placement.

Post-operative protocol

- 1st Post-operative day: Isometric quadriceps and ankle mobilization exercises. Knee ROM exercises are begun with range set upto 90 degrees.
- 2nd Post-operative day: Partial weight bearing with knee brace and walker and Hip abduction exercises
- 2th post op day: Straight leg raising exercises with knee brace.
- 4 weeks: Knee ROM and quadriceps strengthening exercises.
- 8 weeks: Walking without brace and half squats.
- 3 months: Cycling and jogging
- 6 months: Recreational sports activities. Patients were followed up for 6 months and functional outcome of the patients will be checked with IKDC scoring.

RESULTS

In our study out of 42 patients 36 patients (86%) were male and 6 patients (14%) were females. About 23

patients (55%) had right sided ACL injury and remaining 19 patients (45%) had left sided ACL injury as shown in Table 1. If we compare the patients on the basis of the mode of injury 25 patients (60%) had RTA, 13 patients (31%) had sports injury and 4 patients (9%) had other mode of injury like fall from ladder or slip. On comparing the patients according to the associated injury 32 patients (76%) had isolated ACL injury, 5 patients (12%) had ACL+MCL injury and 5 patients (12%) has ACL+PCL injury as in Table 1. The average age of ACL injuries patients was 34.76 years (SD 8.94). If we divide the patients on the basis of graft diameter obtained during surgery 30 patients had 8 mm graft diameter, 8 patients had 7 mm graft diameter and remaining 4 patients had 9 mm graft diameter.

Table 1: Demographic particulars of the ACL injury patients [n=42].

Characteristics	N (%) or mean ± SD
Male	36 (86%)
Female	06 (14%)
Age (years)	34.76 ± 8.94
Rt. sided ACL injury	23 (55%)
Lt. sided ACL injury	19 (45%)
Mode of Injury	
RTA	25 (60%)
Sports injury	13 (31%)
Others	04 (9%)
Types of Injury	
Isolated ACL injury	32 (76%)
ACL+MCL injury	5 (12%)
ACL+PCL injury	5 (12%)

We assessed functional outcome of the patients through preoperative and postoperative IKDC scoring. The mean of the pre-op IKDC scoring was 33.61 with SD of 9.67 and the mean of the postoperative IKDC scoring was 77.95 with SD of 15.15. The mean of the pre-op VAS scoring was 5.73 with 0.81 and the mean of the post-operative VAS scoring was 4.25 with SD of 0.89 as shown in Table 2.

Table 2: Comparison of pre and postoperative result of validated knee scoring systems.

Validated knee scoring systems	Preoperative (Mean ± SD)	Postoperative (Mean ± SD)	P value
VAS	5.73±0.81	4.25±0.89	0.0001
IKDC Score	33.61±9.67	77.95±15.15	0.0001

DISCUSSION

Rupture of the ACL compromises the stability of the knee and leads to episodes of giving way, recurrent injury to the menisci, and premature degenerative changes.[19,20]

A lot of studies explored many factors involved in the different technical aspects of ACL fixation. Anterior cruciate ligament tear usually leads to torsional instability of the knee joint, which can cause secondary progressive degenerative meniscal and chondral lesions.[21-23] The advantages of arthroscopically assisted anterior cruciate ligament reconstruction include elimination of capsular incisions, avoidance of desiccation of the articular cartilage, better visualization of the femoral attachment, and a lower incidence of post-operative patella-femoral pain than with open reconstruction. In modern surgery various grafts and fixation methods are being utilized.

The transtibial technique can produce tunnels centered in the anterior cruciate ligament footprints, but a starting point close to the tibial joint line is required. This will result in a relatively short tibial tunnel.[24] Quantification of the centre of the resulting tunnel on specific lateral view radiograph has shown that the technique reproducibly places the tunnel close to the anatomic centre of the insertion as defined radio graphically using the grid method popularized by Bernard and Hertel.[25] Evaluation of knee stability postoperatively showed that none of the patient had instability. Preoperative VAS score was 5.73±0.81 which improved to a statistically significant score of 4.25±0.89 postoperatively. Currently activity scale and functional score reporting by the patient is an important criterion for assessment of these subjects. For assessment of score we used was IKDC score. All score showed significant postoperative improvement. This result correlates with different studies.[23,26-30]

Through the femur quadrant method we can reproduce the excellent anatomical femoral tunnel for arthroscopic ACL reconstruction, but radiation exposure is higher and the duration of surgery also increases. Anatomy never changes. Therefore we must perform arthroscopy carefully looking at the anatomy and try to restore it.

CONCLUSION

The commercially available off set guide technique of the femoral tunnel placement in arthroscopic ACL reconstruction is easy, reliable and reproducible with the foot print at anatomical place on the femoral site.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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