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Original Research Paper

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POST OPERATIVE EVALUATION AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: MEASUREMENT AND ABNORMALITIES ON X-RAY

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ABSTRACT **BACKGROUND** The accurate tibial and femoral tunnel placement has a significant effect on outcomes after anterior cruciate ligament reconstruction. The aim of this study was to examine the radiographic location of the tibial tunnel and the femoral tunnel. **MATERIAL AND METHODS** 60 patients underwent arthroscopic ACL reconstruction, post-operative radiograph were studied from 31/05/2017 to 31/05/2019. Femoral tunnel and tibial tunnel position, graft impingement and femoral roof angle were measured in this study. **RESULT** The position of the tibial tunnel were found to be at an average of 0.40 0.025SDmm posterior from the anterior edge of the tibia. The position of femoral tunnel were found at an average of 0.31 - 0.031SDmm anterior to the femoral cortex **CONCLUSION** The tibial tunnel and femoral tunnel placement correlate well with the anatomical landmarks

KEYWORDS : Arthroscopy, ACL, Femur

INTRODUCTION

The knee joint is one of the most commonly injured joint in our body and the most commonly injured ligament in knee is the anterior cruciate ligament. Due to the ever-increasing Road traffic accidents and increased participation in sporting activities, there is an increase in incidence of ligament injuries of the knee. The ACL along with other ligaments, capsule is the primary stabiliser of knee and prevents anterior translation, and restricts valgus and rotational stress to a certain degree.[1]

The ACL is a structure that connects the femur and tibia composed of numerous fascicles of dense connective tissue. It originates on the posterior aspect of medial surface of lateral femoral condyle and inserts into wide area in the centre of the tibial plateau. The ACL has an oblique course within the knee joint passing from lateral and posterior at its origin to medial and anterior near its insertion. The ACL is surrounded entirely by the synovium. Hence it is an extra-synovial intra-articular structure. The ACL has a cross section of 44 mm near mid-substance, which varies along its course. The cross section area near its origin and insertion is about three times the area in the mid-substance 42, 43, 44. The approximate length of the ligament is 31 to 38 mm45.[2-5]

Symptoms of ACL injury are the symptoms of knee instability, pain and a decrease in joint function occur. Although conservative treatment with intensive physiotherapy, bracing and lifestyle modification can be tried in some patients with less anticipated knee function, in symptomatic young active individuals, ACL reconstruction is necessary.[6-8]

The articular cartilage of the knee joint may be injured in acute ACL tears, whose incidence range from 16 – 46%, and in chronic tears, the incidence increases further To prevent the deterioration of the existing lesions and to prevent occurrence of new lesions, a stable knee is necessary.[9,10]

The first prosthetic ACL made of Dacron was developed by Rubin, Marshall and Wary in 1975. Today Arthroscopic reconstruction of the injured ACL has become the gold standard. Open reconstruction of ACL which was done earlier is not practised nowadays due to the complications associated such as increased post op pain, stiffness and a lengthy rehabilitation phase. Hence, the current study was planned to evaluate the results after procedure and to find out the measurements and abnormalities on X ray.[11]

Aims & objectives

- To examine the radiographic location of tibial & femoral tunnel in patients who underwent arthroscopic ACL reconstruction using anatomical landmarks.
- To calculate various angles on anteroposterior & lateral views of radiograph after arthroscopic ACL reconstruction.

Methodology

The study was conducted at a tertiary care hospital. The study was a retrospective cross sectional study conducted by analysing records of patients of past two and half years who underwent arthroscopic anterior cruciate ligament reconstruction. The sample size after including all the patients who fulfilled the inclusion criteria and after excluded patients of exclusion was [60].

The post-operative radiograph of 60 patient in anteroposterior and lateral view in full extension were included in study. The position of femoral and tibial tunnel and the various angles on post-operative radiograph were assessed.

The "Blumensaat's line" and "Bernard and Hertel grid" were commonly adopted radiographic markers to determine the location of tunnel in the distal femoral shaft. The "Amis and Jacob" line were most commonly used method to evaluate the anteroposterior direction of tibial tunnel.

Inclusion criteria

- The patient with grade 3 and grade 4 anterior cruciate ligament injuries
- Patient having ligament injury with hampered routine activities.
- Patients whose record are available

Exclusion criteria

- Patient with grade 1 and grade 2 anterior cruciate ligament injuries
- Patient who are asymptomatic.

- Patients whose record are not available.

Pre-operative work up:
Patients with ACL tear proven clinically and radiologically are admitted in Department of Orthopaedics. Routine investigations like haemoglobin, total and differential counts, platelet count, chest X ray, ECG were taken and anaesthetic assessment for regional and general anesthesia was done.

Pre-operative Rehabilitation:
Pre-operative strength and range of movement of knee joint were measured and documented

The parameters measured were as follows:
- Static and dynamic quadriceps exercise were taught to patients while awaiting surgery
- All patients were enlightened on post – operative rehabilitation

Consent:
All patient in this study were explained about the injury, diagnosis, various management options, complication of non - operative treatment and operative management, per-operative and post-operative complications, donor site morbidity, injury to surrounding structures, infection, compartment syndrome, anaesthesia risks, post - operative knee pain, restriction of range of motion.

Consent for surgery was obtained for all the patients who were included in this study. All consent was obtained prior to surgery. Patients and their attenders were well explained about the advantages and disadvantages of procedure. Risk benefit ratio was explained.

After surgery X ray was taken measurement severe made and looked for any abnormality .

Results
The study had majority, 25(41.7%) patients in the age group of 21 to 30 years. Majority 48(80%) were males. There were 34 (56.7%) who had left ACL tear and 26 (43.3%).Table 1 shows parameters mean and standard deviations.

The position of the tibial tunnel in sagittal plane were found to be at an average of 0.40 0.025SDmm posterior from the anterior edge of the tibia.

The position of femoral tunnel in sagittal were found at an average of 0.31 0.031SD mm anterior to the posterior femoral cortex along the Blumensaat's line. There is no radiographic impingement in any of the patient. The roof angle present at an average of 28.40° 2. 69 SD. The position of the tibial tunnel in coronal plane were found at an average of 0.40 0.019 SD mm from the medial edge of the tibial plateau. The coronal tibial tunnel angle at an average of 67.15° 3. 0SD.The coronal femoral tunnel angle at an average of 46.92° 2.86SD.

Table 1: Mean Values of Various Parameters

Variables	Mean	SD	Median	Mode	Minimum	Maximum
Age	32.10	10.51	30.00	24	17	58
Coronal measurements (ab/AB)position of tibial tunnel	0.40	0.019	0.41	0.41	0.37	0.45
Coronal measurements (α)angle of tibial tunnel	67.15	3.0	67.00	67	62	74
Coronal measurements (β)obliquity of femoral tunnel	46.92	2.86	47.00	47	39	52
Sagittal measurements (cd/CD)position of tibial tunnel	0.40	0.025	0.40	0.41	0.35	0.45
Sagittal measurements (ef/EF)position of femoral tunnel	0.31	0.031	0.32	0.32	0.25	0.38
Sagittal measurements (γ)femoral roof angle	28.40	2.69	28.00	25	25	34
Sagittal measurements (δ) graft impingement	0.00	0.00	0.00	0	0	0

DISCUSSION
The goal of anterior cruciate ligament reconstruction surgery is to provide an isometric, anatomical, impingement free graft for the torn ligament. Recently the multicentre ACL revision study showed some degree of technical error either in isolation or combination with trauma and/or biological issues as the major cause of failure after ACL reconstruction. In the patients who were felt to have technical problems contributing to their failure,80% believed to have femoral tunnel malposition.

Various studies have described arthroscopic and anatomic landmarks for successful placement of tibial and femoral tunnels for ACLR. We placed femoral tunnel slightly posterior to the center of the native footprint so that the tunnel will have 3 mm of intact posterior wall and about 3 mm superior to the articular cartilage. In the absence of the native foot print, the femoral tunnel was placed inferior to lateral intercondylar ridge and slightly posterior to the bifurcate ridge. The tibial tunnel was placed 7 mm anterior to the posterior cruciate ligament (PCL) and slightly medial and posterior to the inner edge of lateral meniscus. Studies have investigated the relationship between arthroscopic anatomic landmarks and postoperative radiological and functional outcomes.

We placed femoral tunnels at an average of 0.31±0.03mm anterior from the posterior femoral cortex along the Blumensaat's line. Studies have recommended placing the femoral tunnel at least 60% to 86% posterior along the Blumensaat's line. A positive correlation has been demonstrated between functional outcomes and posterior femoral tunnel placement on lateral radiographs. The angle of tibial tunnel placement in coronal plane is critical to avoid posterior cruciate ligament impingement and loss of flexion postoperatively. The angle of the tibial tunnel in coronal plane in our study was <75° in all patients. Howell et al. reported a coronal plane angle >75° which was associated with loss of flexion and increased laxity.

Pinczewski et al. 12 placed location of the tibial tunnel in the coronal plane in their study at a mean of 46% (standard deviation 3) lateral to the medial border of the medial tibial plateau. The location of tibial tunnel in our study was at a mean of 0.40 ±0.019mm lateral to the medial border of the

medial tibial plateau. Anterior graft impingement has been evaluated previously and found to be associated with increased effusions, lack of extension, and increased failure rates. Studies have recommended placement of tibial tunnel ≤50% (37%–47%) posteriorly along the length of the anterior tibial plateau in the 22–28 mm impingement-free zone to avoid impingement. Radiographic findings in revision ACLRs from the MARS cohort found variability in the tibial tunnel placement. We did not quantitate the distance of tibial tunnel center in millimetres in this study, but the tibial tunnel was placed at an average distance of 0.40 ±0.025mm posterior from the anterior edge of tibia along the tibial plateau. We could not compare radiographic and clinical impingement perioperatively because of retrospective nature of the study.
Sudhahar et al. 13 have demonstrated that the surgeon's ability to predict the femoral tunnel location is reasonable, but less so for tibial tunnel position. The graft inclination should be measured on a 45° posteroanterior weightbearing view (Rosenberg view) of the knee. We measured inclination of the graft indirectly by measuring obliquity of the femoral tunnel on coronal radiograph because of retrospective nature of the study. The average angle of the femoral tunnel on coronal radiographs in our study was 46.92°. The femoral tunnel placement in our study was through an accessory anteromedial portal instead of the trans-tibial technique where femoral tunnel placement is directed by the tibial tunnel. Coronal obliquity of graft is one of the most crucial factors for rotational stability of the knee. A femoral tunnel placed obliquely is more efficient in resisting rotatory loads when compared with a vertical tunnel close to the roof of the intercondylar notch. The reconstructed ACL can be closer to the native ACL by the creation of a more horizontal femoral tunnel.

The limitations of the study are that the cohort was retrospective. Poor technique or inadequate X-rays may preclude accurate measurements. Though correlation of functional outcomes and laxity measurements with radiological parameters would have been ideal, we were unable to do so because of the retrospective nature of the study.

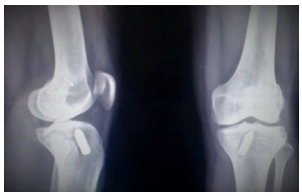
To conclude, femoral and tibial tunnel placements correlated well with anatomic landmarks without any graft impingement.

CONCLUSION

We under took the present study of 60 cases of anterior cruciate ligament reconstruction and assess them radiologically (x-rays).The various angles made after reconstruction and the position of various tunnels were measured. The observation were made and the result were analysed. The study were also compared with studies of other authors. Various aspects of the results have been observed and discussed in detail keeping in view the living condition of an average Indian.

The femoral and tibial tunnel placements were found to be correlated well with the anatomical landmarks. There is no radiological graft impingement in any of the patient included in the study. The various angle formed after ACL reconstruction on coronal and sagittal plane were measured. It is found that a tunnel position occupying a large anteromedial area of ACL origin and closure to the lateral femoral intercondylar ridge would be more efficient.

CASE 1 - MRI SHOWING ANTERIOR CRUCIATE LIGAMENT TEAR.



Case 1 : POST OPERATIVE X RAY AFTER ACL RECONSTRUCTION

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