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Study of arthroscopic anterior cruciate ligament reconstruction using single bundle hamstring auto-graft by trans-portal technique

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ABSTRACT

Background: Anterior cruciate ligament (ACL) tear is a serious injury that results in immediate knee instability, lengthy rehabilitation and increased risk of early onset knee osteoarthritis. The goal of anatomic reconstruction is to place the ACL graft at a more anatomic location on both tibia and femur. The purposes of the study were to evaluate the outcome of trans-portal arthroscopic ACL reconstruction clinically and radiologically and to compare the results with reported studies.
Methods: 52 patients with complete tear of the ACL were treated with arthroscopic ACL reconstruction. The patients were regularly followed up at 4, 8, 12 and 24 weeks whereby laxity, pain and range of motion were assessed.
Results: There were 43 male and 9 females with the mean age being 30.38 years. Left sided injury was more common seen in 31 patients (59.62%) where domestic twist injury caused most of the ACL tears. Only 4 cases (7.69%) had isolated ACL tears and lateral meniscus was the most common associated injury found in 25 patients (48.07%) Average operative time was 113 minutes. Pain was the most common post-op complication seen in 16 patients (30.76%) while laxity was noted in 4 patients. Average flexion of 111.44 degrees was reached at 6 months. 37 cases (71.15%) had excellent post-op outcome at 6 months as per the modified cincinnati rating system.
Conclusions: ACL reconstruction using the arthroscopic trans-portal technique provides good post-op knee stability and satisfactory range of motion.

Keywords: Knee, Arthroscopy, Modified cincinnati rating system, ACL reconstruction

INTRODUCTION

Anterior cruciate ligament (ACL) tear is a serious injury that results in immediate knee instability, lengthy rehabilitation and increased risk of early onset knee osteoarthritis.[1]

Numerous studies support the efficacy of anatomic ACL reconstruction in restoring normal kinematics and postoperative function of the knee. The goal of anatomic reconstruction is to place the ACL graft at a more anatomic location on both, tibia and femur.[2]

Femoral tunnel placement in ACL reconstruction is critical to a good outcome. There are two alternatives for a good tunnel placement: trans-portal and trans-tibial approach. The trans-tibial approach for femoral tunnel placement is limited by the angulation of the tibial tunnel. Therefore, the trans-portal technique was introduced to overcome these limitations, to increase rotational stability of the reconstructed ACL and it is more anatomical.[3]

Alentom-Geli et al compared functional and clinical outcomes of ACL reconstruction using the trans-tibial and trans-portal technique for drilling the femoral tunnels. They concluded that trans-portal group

demonstrated a significantly lower recovery time from surgery to walking without crutches, to return to normal life and to return to play.[4]

Similar studies were conducted by Kutras et al, Ku-Kim et al Mardani-Kivi et all showing superior clinical results with trans-portal technique.[5-7]

Rahr-Wagner et al studied the findings of the Danish knee ligament reconstruction register to ascertain revision rates after ACL reconstruction using the two techniques.[8] Their findings suggested higher cumulative revision rate of ACL reconstruction with Trans-portal technique compared to the trans-tibial technique. The increased revision rate was explained by the technical difficulties faced during the longer learning curve of this surgical technique.

For ACL reconstruction, trend is to use the Hamstring tendon graft compared to the earlier employed Bone-Patellar bone tendon graft. Hamstring tendon graft has been reported to be better than BPBT graft due to its lesser impact on knee joint anatomy. It is also associated with lesser risk of patellar fracture and less post-op morbidity.

This study is intended to bring out various advantages and disadvantages of Trans-portal technique in ACL reconstruction, its technical difficulties and clinical outcome.

METHODS

Material

We conducted a prospective longitudinal observational study from 03-12-14 to 03-06-16 at department of Orthopaedics (Figure 1).

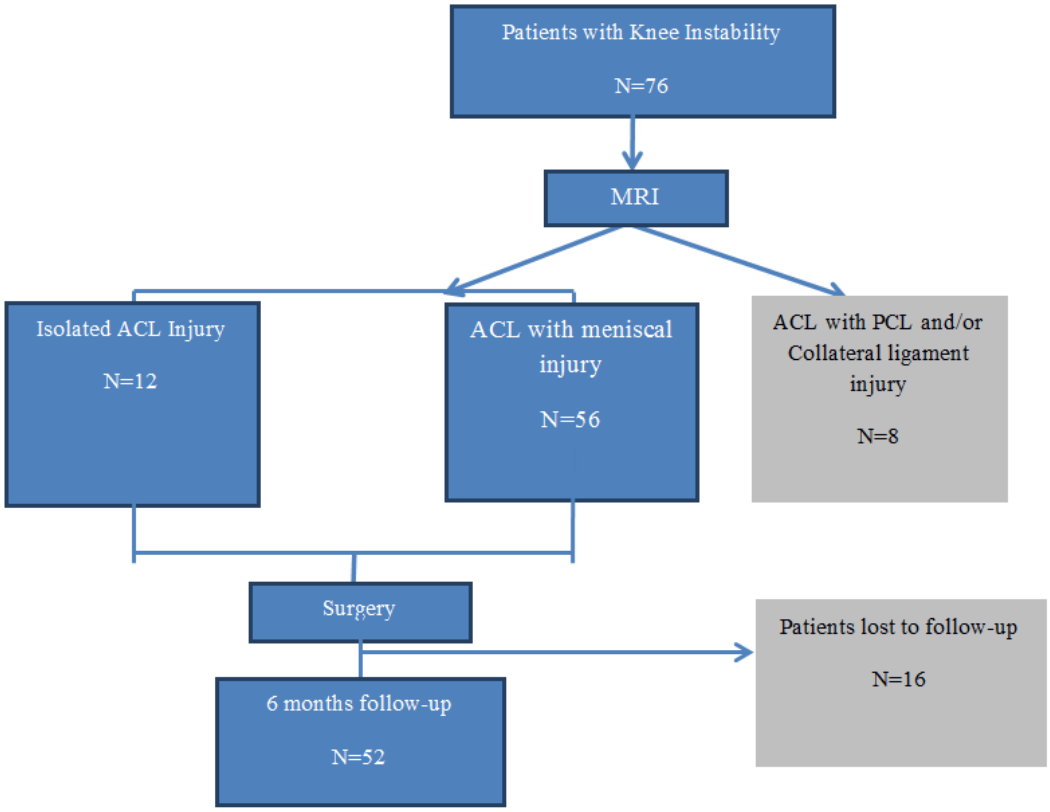

Figure 1: Flowchart describing the overall trend of patient presentation and selection of material for this study.

Plan of research

All cases of ACL tear meeting inclusion and exclusion criteria admitted at the hospital were included in this study (Figure 2).

All procedures performed in this study were approved by the Institutional Ethics Committee.

The operative procedure was performed under spinal-epidural anaesthesia in supine position with legs hanging and a tourniquet was used at a setting of pressure more than 150mm Hg above the systolic pressure and for a duration less than 2 hours.

Surgical technique[9, 10]

The procedure of arthroscopic ACL reconstruction was performed at this centre by three orthopaedic surgeons-

Dr. A, Dr. B and Dr. C. All three surgeons had received training at different centres and were at different stage of the arthroscopy learning curve. The steps elaborated below maintain the principles mentioned in Textbook of Campbell and Weisel with preferences and modifications adopted by the faculty.

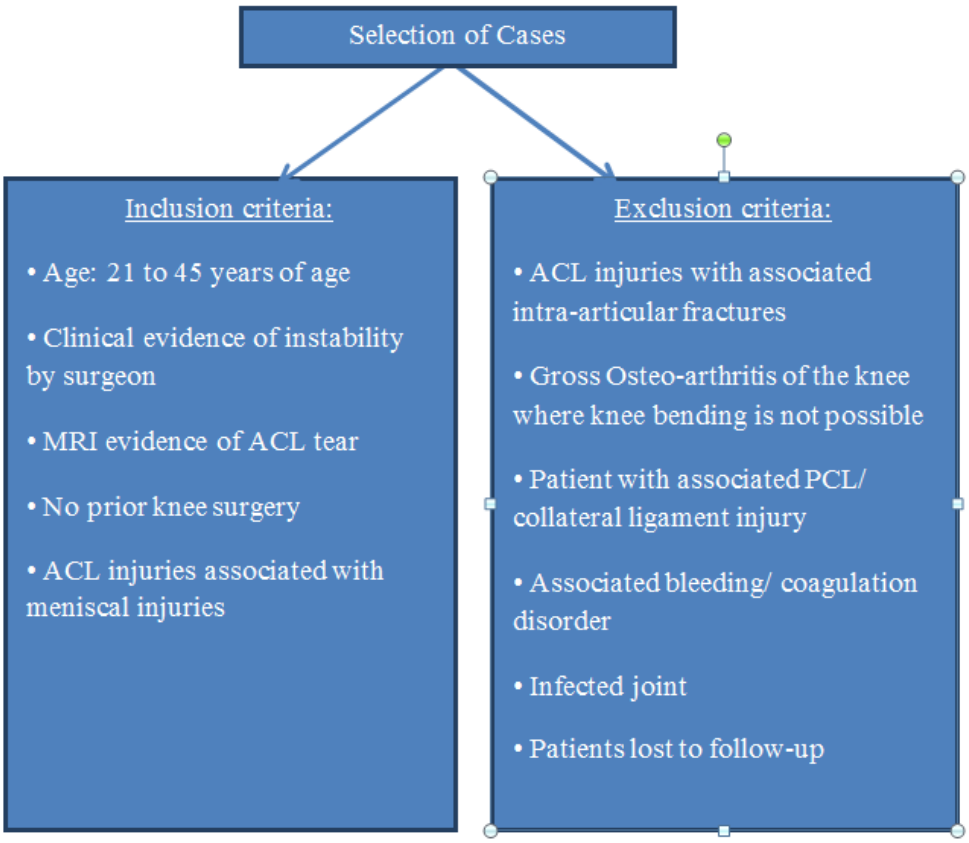

Figure 2: Criteria for selection of cases for the study.

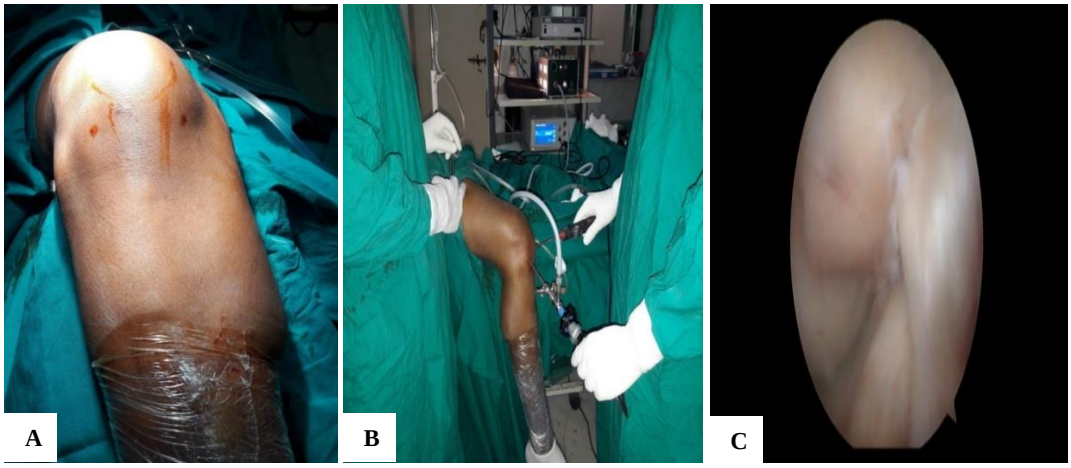

Figure 3: (A) Incision marking, (B) antero-medial and antero-lateral portal, (C) torn ACL.

Arthroscopic portals

The standard arthroscopic portals are created: Anterolateral, Anteromedial & Accessory Anteromedial (Figure 3 A and B).

Diagnostic arthroscopy

A quick round of diagnostic arthroscopy is undertaken whereby the arthroscope is brought down from the supra-patellar pouch to the para-patellar gutter and finally in the inter-condylar notch region

ACL tear

Joint debridement is undertaken to remove any native ACL. Arthroscopic scissors are very useful for this step (Figure 3C).

Harvesting and preparing the graft

- Hamstring grafts are harvested through a 2-3 cm paramedian incision approximately 6 cm below the medial joint line where the sartorial fascia is exposed, and the tendons are palpated.
- Once the tendons are identified, a mixter is used to separate the tendons.
- A whipstitch is placed in them near their insertions so that they can be reflected off their insertions and mobilized. Both tendons- Semi-tendinosus and Gracilis are mobilized and all tendinous slips freed.
- Finger dissection is done to free the tendons of any septation.
- The tendons are then carefully harvested using the open-ended tendon stripper.
- After harvesting, the tendons are prepared on the back table using Krackow sutures.
- When the length of the graft is adequate, the graft is folded upon itself into a 6-fold or quadruple fold manner
- The sutures are taken using Ethibond no. 5
- The graft is sized using the graft sizer.
- The graft is then securely placed on the nurse's trolley tensioned over the graft master-board and kept moist using a gauze soaked in saline.
- Femoral aimer is placed over the desired femoral tunnel entry point with the knee flexed at 90 degrees and entry is made with a guide wire.
- Soon after the knee is hyper-flexed to 110 degrees to achieve a more horizontal orientation of the femoral tunnel.
- The guide-wire is drilled through the entire cortex of the condyle and out through the skin.
- The endoscopic reamer is advanced over the guide wire and the entire length of the cortex of the femoral condyle is drilled.
- Appropriate sized reamers are passed, in coordination with the graft size and the calculated length is drilled. Posterior cortex integrity confirmed by the classical Tunnel-in tunnel appearance (Figure 4C).

Tibial tunnel preparation (Figure 4 D and E)

- Through the anteromedial portal, ACL jig is passed into the joint with the tip in the centre of the ACL footprint.
- The external guide sleeve is advanced flush to the anterior tibial cortex.
- Guide wire is passed through the drill sleeve until it meets the point of the guide arm.
- Using appropriate size reamer, drilling is accomplished over the guide wire. The guide wire is protected with a curette to prevent inadvertent advancement
- Beath pin loaded with suture loop is passed into the femoral tunnel, and the loop is pulled out through the tibial tunnel using arthroscopic forceps.

The graft is then passed through the loop of suspensory fixation and introduced in the joint (Figure 5A and 5B).

Cycling and tibial fixation of the graft

- The graft is cycled to tension the graft inside the joint.
- Tibial end of the graft is secured with appropriately sized Interference screw.

Closure and dressing

- The wound is closed over a negative suction drain after thorough lavage of the joint with normal saline. (Figure 5C and D).

Evaluation was done using radiographs (Figure 6A and B) and the Modified Cincinnati Rating System Questionnaire:[11]

Grading the modified cincinnati rating system questionnaire

<30: Poor; 30-54: Fair; 55-79: Good; >80: Excellent.

The first version of the Cincinnati Knee Rating System was published in 1983, with additional modifications that were developed for occupational activities, athletic activities, symptoms, and functional limitations with sports and daily activities.[86]There are 11 components in the Cincinnati Knee Rating System. In addition to measuring symptoms and disability, there are sections of this rating system that measure physical examination, laxity of the knee based on instrumented testing, and radiographic evidence of degenerative joint disease.[87] Minimum score is 6 while maximum score comes to 100. This instrument is reliable, valid and responsive to clinical change.[12]

Post-op rehabilitation[9]

- Isometric exercises are started immediately post-op comprising of Ankle pumps and Static quadriceps exercises.
- Sequential knee bending is achieved up to full ROM over 6 weeks.

Weight bearing is permitted immediately post-op up to 1 month with posterior knee brace; thereafter with hinged knee brace up to 6 months.

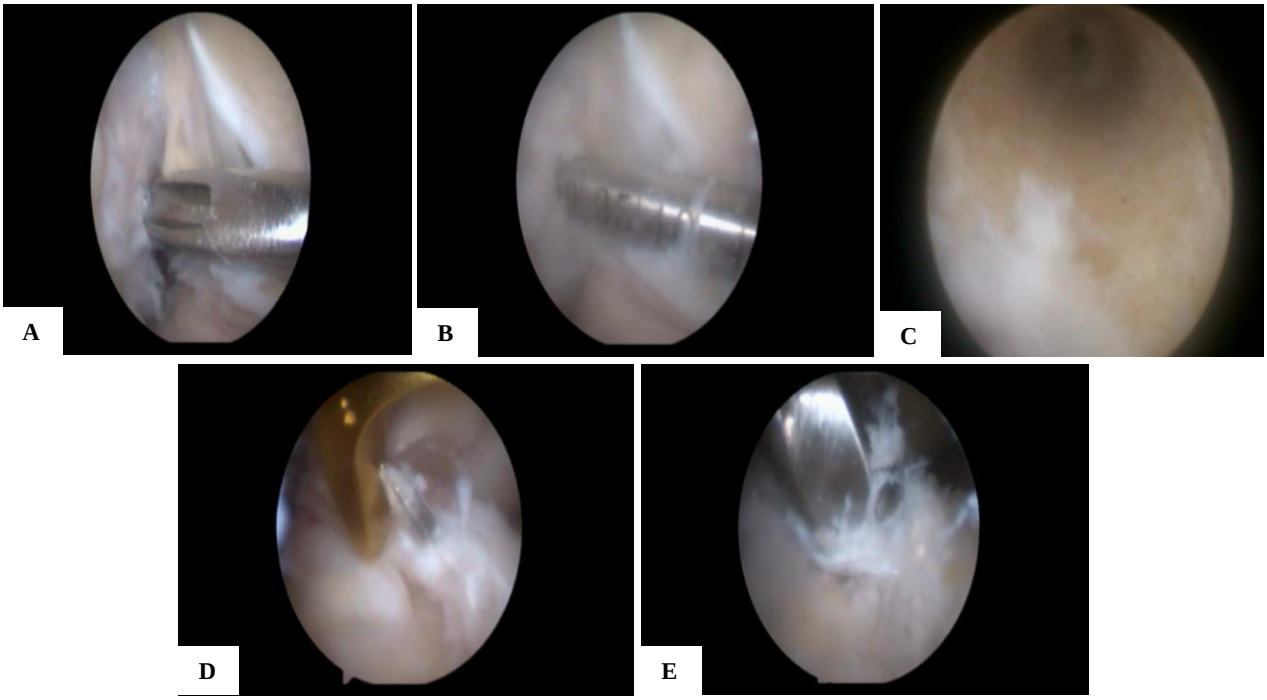

Figure 4: (A and B) Drilling the femoral tunnel, (C) tunnel-in-tunnel appearance, (D and E) drilling the tibial tunnel.

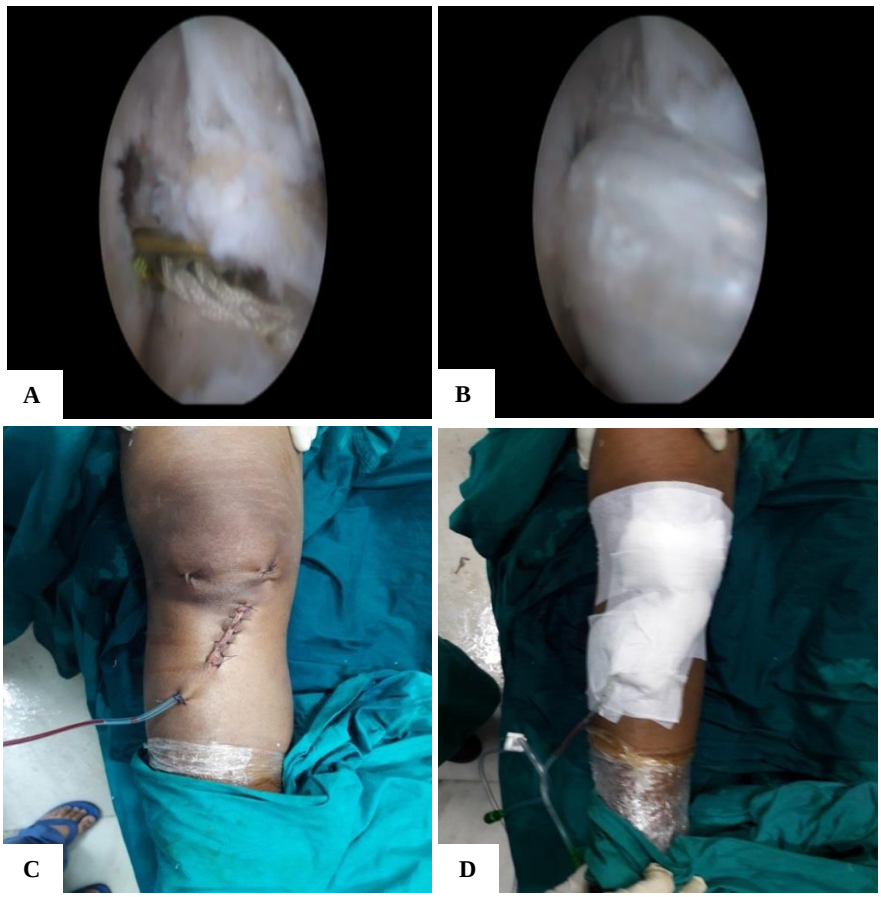

Figure 5: (A and B) Passing the graft, (C) closure and (D) dressing.

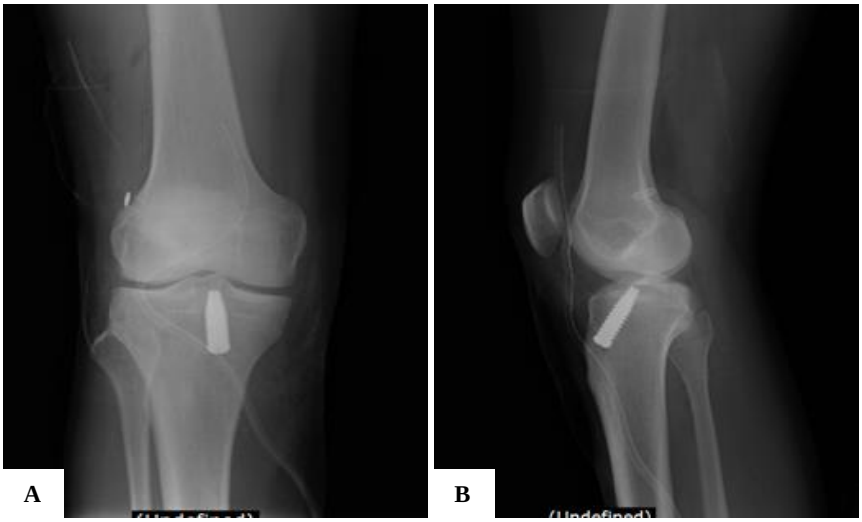

Figure 6: (A) Post-operative antero-posterior and (B) lateral view radiographs of the knee joint.

RESULTS

52 patients of ACL tear were followed up for a period of 6 months to 1 year. Mean follow-up period was 9 months.

Our patients' age ranges from 21 years (youngest) to 45 years (eldest). This shows that most of the ACL tears occur between 26-30 years of age with an average age of 30.38 years.

Left side was affected in 31 of the 52 patients. Thus, affection of the left side was significantly more (59.62%) compared to the right side (40.38%).

55.76% of patients had domestic twist injury that caused the ACL tear. This data suggests that minimal trivial injury caused most of the ACL injuries (Figure 7).

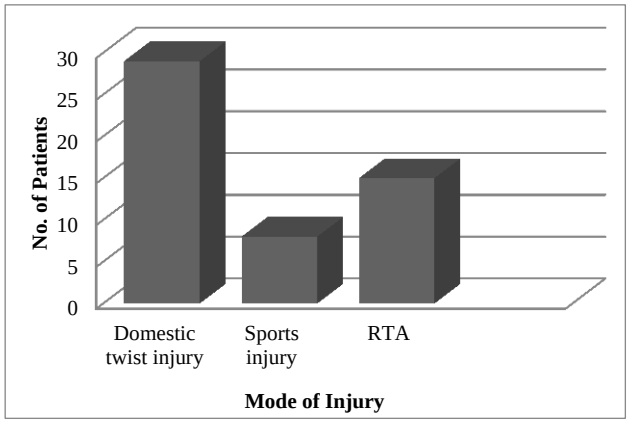

Figure 7: Mode of injury.

Lateral meniscal injury was present in 48.07% of the patients suggesting that it is a major problem to be treated concurrently with ACL tears. Also, isolated ACL injury is a rare entity (Table 1).

Table 1: Associated injury.

Associated injury	No. of patients	Percentage (%)
Medial meniscus	20	38.46
Lateral meniscus	25	48.07
Medial+lateral	03	05.76
None (isolated ACL injury)	04	07.69

Table 2: Post-op complications.

Serial no.	Complication	No. of cases	Percentage (%)
1.	Laxity	04	7.69
2.	Stiffness	07	13.46
3.	Pain	16	30.76
4.	Infection	01	1.92
5.	Paraesthesia	01	1.92
6.	None	23	44.23

Pre-op Modified Cincinnati rating system score averaged 32.76 with minimum score being 20 and maximum being 46.

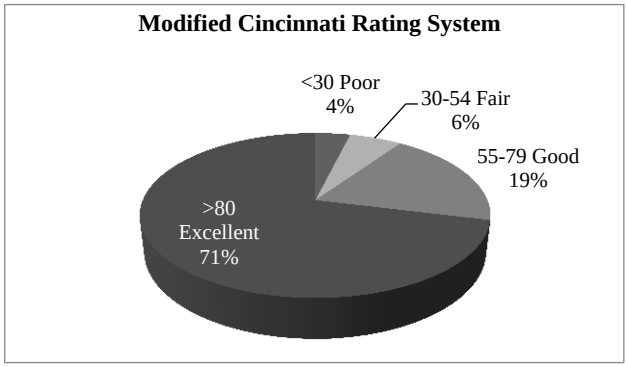

Figure 8: Post-op outcome.

Post-operatively the scoring improved to an average of 77.38 with minimum being 28 and maximum being 90. Thus, there was an average improvement of 44.62 with operative intervention (Figure 8).

DISCUSSION

The study comprised of 52 patients of ACL tear followed up post-operatively for a period of 6-12 months (average 9 months) averaging 30.38 years of age. Of this 43 were male whereas 9 were female patients. Left side ACL tears were found to be more common occurring in 31 patients.

Males were more common in this study the reason for which could be explained by:

- Smaller Q angle
- More number of unreported female cases
- Lesser involvement of females in sports activities in rural setting.

Almost 54% of the patients presented within 1 to 3 months since trauma whereby domestic twist injury was found to be the mechanism of injury in 55.76% of the patients. 43 out of the 52 patients had complaint of laxity with pain of which 48% of the patients had associated lateral meniscal injury and 38% had medial meniscal damage. Timing of surgery is debatable. The incidence of meniscal tears increases over time in ACL-deficient knee, and it has been shown that a meniscal injury increases the rate of osteoarthritis.[18-22] ACL reconstruction decreases the risk of secondary meniscal tears but may not decrease the likelihood of suffering posttraumatic osteoarthritis.[23,24]

Domestic twist injury dominated as the causative mechanism of injury which could be due to:

- Agriculture being the chief occupation.
- Less number of cases engaging in sports activities.

The overall average surgery time was found to be 113 minutes where the femur was drilled to 7.5 mm size of tunnel and tibia to an 8.4 mm tunnel (average values). Adjustable length loop devices (i. e: tight-rope like device) was the most preferred of the femoral suspension devices and the tibial end of the graft was secured most commonly using interference screw of 8x30 mm.

A very prompt rehabilitation programme being instituted immediately post-operatively led to range of motion of 29.23 degrees at 1 month, 73.94 degrees at 3 months and 111.44 degrees at 6 months. Previously, a slower rehabilitation programme was in place, which usually included the use of a hinged brace or cast for 4 to 6 weeks postoperatively. This was associated with considerable strength deficit.[13] However, the current surgical techniques, immediate mobilization and full weight bearing allow earlier and much more intense rehabilitation. Recent reports show clear strength deficit postoperatively, which is related to graft harvest. Quadriceps weakening is often noted after harvesting a BTB autograft.[14] Similarly knee flexion strength deficit is noted with the use of hamstring tendon.[15,16] These studies being short-term have shown considerable recovery in the affected muscles during the first two postoperative years.

Complications comprised of the following:

Laxity: 4 patients reported with laxity.

- 2 were promptly treated by physiotherapy.
- 1 patient had failure of femoral suspension which was revised to interference screw fixation, however laxity persisted
- 1 patient had persistence of laxity, the cause of which could not be ascertained.

When the quadriceps and hamstring strengths of the operated limb were close to those of the contralateral limb, the patients had less symptoms. Also, better stability evaluated with the KT-1000 arthrometer was associated with less hamstring torque deficit. This is in accordance with the findings of Li et al. (1996) [17] who showed that increasing the hamstring strength helped to stabilize the knee. On the other hand, the activity level of patients with a stable knee may be higher compared to those with an unstable knee. Overall, these results support the use of intense rehabilitation after ACL reconstruction.

Stiffness: 7 patients complained of stiffness.

- 3 patients were taken up for arthroscopic adhesiolysis within 3 months of index procedure and had improvement from stiffness.
- 4 patients had improvement from stiffness with aggressive physiotherapy.

Pain: 16 patients reported with pain.

- 1 patient had a long intra-articular interference screw which was revised with a smaller screw at 1 month from the index procedure.
- 1 out of 3 patients treated with partial medial and lateral meniscectomy developed pain.
- 6 out of the 18 patients who underwent partial medial meniscectomy complained of pain.
- 7 of the 21 patients who underwent partial lateral meniscectomy complained of pain.
- 1 patient had resolution of pain at 3 months post-op.

Infection: 1 patient had superficial surgical site infection at the graft harvesting incision which was promptly controlled by intra-venous antibiotics and the complaint resolved within 5 days. The low infection rate was probably due to the generous joint lavage which invariably happens in an arthroscopy case.

Paraesthesia: 1 patient complained of paraesthesia over the antero-lateral aspect of the knee. The patient was

operated with a longitudinal incision over the pes anserinus for the graft harvesting step of the operation. The paraesthesia was due to injury to the infra-patellar branch of the saphenous nerve. The paraesthesia persisted till the end of the study period.

None: 23 cases had no complications.

Limitations of this study

- The mean follow-up period of the study being 9 months, long-term functional outcome of the technique could not be assessed.
- The number of patients included in the study being 52, it is not completely representative of the dynamic population in the society.
- This being an observational study, comparison between different techniques was not possible.

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

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