Section: Orthopedics

Original Research Article

FUNCTIONAL OUTCOME OF ACL RECONSTRUCTION USING HAMSTRING GRAFT WITH ENDO BUTTON.

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ABSTRACT

Background: There are many structures which stabilizes the knee amongst which anterior cruciate ligament is one of the most important. It not only helps in preventing the anterior translation of the knee but also helps in counteracting valgus and rotational stress. Open visualization was practiced in older days but arthroscopic approach has become more common due to its small incision, better visualization of intercondylar notch for the operative techniques. It has also other advantages like early mobilization, reduced post-operative pain, fewer adhesions help in early rehabilitations.

Materials and Methods: Here is prospective study of 50 patients with ACL injury with or without meniscus injury between the age group 0f 15-50 years. All the patients were operated for ACL reconstruction with hamstring graft and fixed loop end button. Study was conducted in Bapuji hospital and CG Hospital attached to J.J.M.M.C Davanagere from November 2022 to April 2024.

Results: During the observed period of time, 50 patients were operated with ACL reconstruction with hamstring graft. Out of 50 patients, 46(92%) patients were male and 4(8%) patients were female. Most of the patients had Sports (44%) as mode of injury followed by RTA (36%). Results were evaluated by IKDC and Lysholm knee scoring scale. Majority of the patients had excellent results 92% and 8% had good results. No patients had fair or poor results. None had complications.

Conclusion: This procedure promises stable knee, reduces post-operative morbidity and provides early rehabilitation. The functional outcome is excellent and gallows the patient to return to pre injury level of activity. High success rate has been achieved after this procedure with regard to functional recovery of the patients.

Keywords: ACL, Hamstring graft, IKDC, Lysholm knee scoring, End button.

INTRODUCTION

The knee joint and the anterior cruciate ligament is the most commonly injured ligament in the body. The ever-increasing road traffic accidents and the increased participation in the sporting activities has led to increase in the incidence of the ligament injuries of the knee. The ACL along the with other ligament capsule is the primary stabilizer of the knee. This will prevent the anterior translation, and restrict valgus and rotational stress to certain extant.

One of the most frequently injured ligaments in the human body is the anterior cruciate ligament with the estimated incidences of 0.24-0.34 injuries per 1000 population. The anterior cruciate ligament rupture is the most common but yet a serious injury of the knee.[1] The rupture of the anterior cruciate ligament significantly alters the kinematics and laxity of the knee joint.[2]

The anterior cruciate ligament injury results in the symptoms of knee instability, pain and decrease in joint function. The anterior cruciate ligament reconstruction is necessary in symptomatic young active individuals, although conservative treatment with intensive physiotherapy, bracing and lifestyle modification can be tried in some patients with less anticipated knee function, the anterior cruciate

ligament injuries also are mostly associated with the injuries of the meniscus that need to be addressed, or else the patient can develop early onset of osteoarthritis of the knee.[3]

Therefore, in the case of injured anterior cruciate ligament, the gold standard is the arthroscopic reconstruction. The arthroscopic approach has advantages of smaller skin and capsular incisions with improved viewing of the intercondylar notch for the placement of the tunnel and attachment sites. It also has less postoperative pain, allows earlier motion, causes fewer adhesions, and aids in easier rehabilitation. The earlier practiced method of open reconstruction of the anterior cruciate ligament is not practiced now a days due to the complications associated such as increased post-operative pain, stiffness and lengthy rehabilitation phase.

Bone patellar tendon bone graft and hamstring graft are the most commonly used grafts. Several studies have been demonstrated comparable functional outcomes of the bone grafts. The quadruple hamstring tendon (semitendinosus-gracilis) graft has excellent material strength, minimal effect on the knee extensor mechanism and excellent post-operative recovery.[4] The method used for anterior cruciate ligament graft fixation should be strong enough to maintain the stability of the knee as well as the strength enough so as to prevent giving way in the knee for initiating movements. The graft fixation can be done on the femur side through several devices such as screw interference, rigidfix, femoral cross pin (transfix and biotransfix) endobutton, aprefic, etc.

MATERIAL AND METHODS

From November 2022 to April 2024, this prospective study was conducted in Bapuji Hospital and chigateri general hospital attached to JJM Medical college, Davanagere.

In this study, 50 were patients taken and out of that 44 patients were male and 6 were female. 20 patients had right sided injury, 28 had injury to left knee while 2 had bilateral involvement. The patient was followed up for an average duration of 18 months with minimum follow up of 6 months.

All young and middle age patients presenting with unilateral knee complaints and history of trauma to the knee in the orthopedic emergency department outpatient departments in Bapuji hospital and Chigateri hospital, Davanagere were evaluated by a thorough general and local examination of knee. The uninjured knee was examined first in a relaxed patient and in supine position, to establish ligament excursions after which the affected knee was examined.

The following specific tests were performed for diagnosing anterior cruciate ligament deficiency,

1. Lachman test
2. Anterior drawer test
3. Pivot shift test
4. Injuries associated with structures were assessed by performing the following clinical tests,
5. Valgus/varus test (for collateral ligaments)
6. McMurrey's test/Apley's grinding test (for menisci)
7. Posterior drawer test (for posterior cruciate ligament)

Routine radiographs of both knees in standing position in anterio posterior view and lateral view of the affected knee was taken. MRI of the knee was done in all anterior cruciate ligament anterior cruciate ligament torn cases for conformation.

Inclusion Criteria

1. The following patients were included
2. Clinical/MRI evidence of symptomatic individuals with anterior cruciate ligament insufficiency.
3. Patients between the age of 15-55 years (skeletally matured patients)
4. Associated with medial and lateral menisci injury.
5. Associated with symptoms of instability.

Exclusion Criteria

1. Anterior cruciate ligament avulsion fractures in ipsilateral or contralateral limb.
2. Fractures in the ipsilateral/contralateral limb.
3. Revision anterior cruciate ligament surgeries.
4. Contralateral anterior cruciate ligament injury.

Pre-operative work up

Patients with anterior cruciate ligament tear proven clinically and radiologically were admitted in the department of orthopedics, JJM medical college Davanagere. Routine investigations- CBC, Chest x ray, ECG were taken and anesthetic assessment for epidural and spinal anesthesia was done.

Pre-operative Rehabilitation

1. Pre-operative strength and range of movement of knee joint were measured and documented.
2. Static and dynamic quadriceps exercises were thought to the patients while awaiting for the surgery.
3. All patients were enlightened on post-operative rehabilitation.

Surgical techniques

All the patients in our study were operated under spinal anesthesia in supine position. The following tests were done under anesthesia- anterior drawer test, posterior drawer test, Lachman test, pivot shift test. A pneumatic torniquet is applied which is positioned in the upper thigh after soft padding. The limb is scrubbed from the ankle up to the torniquet. The patient is positioned supine and the knee joint is placed slightly away from the distal breakpoint of the standard operating table. The un involved limb is placed in extension adjacent to the operating limb. In all the cases, prophylactic antibiotic is usually given before the inflation of the torniquet. The limb is held upright to exsanguinate the limb before the inflation of the torniquet.

The technique of single bundle anterior cruciate ligament reconstruction was done with one tibial

tunnel and one femoral tunnel with their centers corresponding to the center of the native anterior cruciate ligament tibial and femoral attachment sites respectively. The femoral tunnel was made using the anteromedial portal there by creating an anatomic femoral tunnel position. The graft was fixed at the tibial and femoral side using titanium interference screw.

Diagnostic arthroscopy

Diagnostic arthroscopy was done first before harvesting the graft. In 900 of knee flexion, anterolateral port (viewing portal) is made using 11 blade at the level of inferior pole of patella just lateral to the patellar tendon. Then the scope is introduced and the knee is examined sequential manner of the following- suprapatellar pouch, patellofemoral joint, medial gutter, medial menisci, intercondylar notch, lateral menisci, lateral gutter posterolateral compartment. After all the pathologies have been recorded, the anteromedial(working) portal is then established. The associated pathologies are dealt accordingly such as portal/total meniscectomy for meniscal tear and loose body removal.

Hamstring graft harvest and graft preparation

A 3cm oblique skin incision is made starting 5cm below the medial joint line and 1cm medial to tibial tuberosity. The oblique incision is preferred because it gives a wider exposure of pes anserinus and there is less chance of injury to the infrapatellar branch of the saphenous nerve. It is planned to do the graft harvest and tibial tunnel drilling through the same incision.

The superior border of the pes anserinus is identified using the fingers. The superior border is lifted and fascia is incised. The tendon can be felt with fingers running from above downwards. The lowest one is felt is semitendinosus tendon. After the hamstring tendons are identified, the sartorius fascia is divided along the course of the tendon (gracilis and semitendinosus), taking care to preserve the deep layer containing the medial collateral ligament. With the help of right-angled artery forceps, the gracilis and then the semitendinosus is hooked out. The tendon ends were tied with double loop knot to aid the traction.

The knee is placed in 90 degrees of flexion and proximal dissection of the tendons were done using blunt dissection by finger still the musculotendinous junction thereby releasing adhesions and accessory bands, while continuous traction was being applied through the threads. The main band which connects the medial head of gastrocnemius usually cut with the help of scissors. It is confirmed that as the tendon id pulled distally, there should be no dimpling posteriorly over gastrocnemius.

The distal end of the tendon is freed with the scissors. Then the tendon stripper is advanced over the tendon in line with it maintaining firm, steady and gentle pressure and at the same time applying traction and holding the threads. If there is any resistance felt, then the stripper is withdrawn, adhesions removed and again the stripper is advanced removed and again the stripper is advanced and tendon harvested. The gracilis is usually more muscular appearing than the semitendinosus. The harvested graft is then placed on the graft master board. The tendons are removed of any residual muscle fibers with the help of blunt end of the blade.

The tendon ends are trimmed to achieve uniform size. A Bunnell's stich is placed at both ends of the tendons. Around 3-4cm of the both the ends of the tendons was stitched together. The 2 tendons are looped over a umbilical tape. The composite graft is then passed through the graft sizer. The diameter of the tunnel to be made is equal to the smallest sizing sleeve through which the quadrupled graft passed with minimum friction. The graft length to be placed inside the femoral tunnel is marked to ensure the correct placement of graft within the femoral tunnel while being viewed arthroscopically. The loop of the four graft is tied to the posts in the graft master board and pre tensioning is done by applying a pressure of about 15 pounds for around 15 minutes.

Intra articular preparation: m

The arthroscope was introduced via the anterolateral portal and joint cavity is visualized. The shaver blade is inserted through the anteromedial portal and the joint is debrided of ligamentum plicae, fat pads and synovial reflections that hinders through inspection of the tibial footprint for anterior cruciate ligament and medial surface of lateral femoral condyle. During the joint debridement, care should be taken to avoid injury to the intact PCL.

Notch preparation and Notchplasty

Then the visualization of intercondylar notch is done. The torn ACL may be viewed as a stump scarred to the PCL or the roof of the intercondylar notch or it may not extend till its attachment on the medial surface of lateral condyle. (Empty lateral wall sign). The residual ACL tissue is removed except the remnants on the tibial and femoral attachments. The femoral remnants will act as a landmark for positioning of guide pins making femoral tunnel while tibial remnants may serve as neurologically active envelop for the graft. The careful shaping and enlargement of intercondylar notch of the femur is called Notchplasty. The objective of this is to gain adequate exposure of the medial surface of lateral femoral condyle and to prevent the impingement of the graft against the roof/lateral wall. It is also important in cases of chronic ACL insufficiency in which osteophytes encroach into the notch.

The notch is usually depended by 2-3cm starting anteriorly on the anterior surface of the intercondylar notch 2-3cm superior to the margin. The direction of depending of the notch should be anterolateral. It is also important to deepen the anterior roof of the notch to avoid impingement of the graft in full extension. The anteromedial side of the notch to is not deepened unless there is presence of osteophytes. The notchplasty should be limited to

the anterior intercondylar notch and to avoid excess lateral notchplasty so as to avoid lateralization of femoral graft attachment site.

Femoral tunnel preparation: the ACL footprint is visualized on the medial surface of the lateral femoral condyle in 90 degrees of knee flexion and the entry point is marked. Then with the femoral offset aimer device inserted through the anteromedial port, the entry point is drilled with guide wire in 120-degree flexion. The drilling is continued till the tip of the guide wire emerges on the lateral side of the distal thigh at the level of epicondyle of femur.

Then using 4.5 mm canulated drill bit, the femoral tunnel was made by drilling both the near and far cortices. Then the length of the tunnel was measured using the depth guage. Then the femoral tunnel was reamed with a reamer corresponding to the diameter of the graft. The reaming was stopped 15-20mm from the lateral cortex depending on the length of the graft. After the femoral tunnel is made, the beath pin with ethibond at its end was passed via the femoral tunnel to aid in easy passage of prepared graft.

Tibial tunnel preparation: the tibial tunnel is made with the help of the tibial guide. With the knee in 70-90 degrees of knee flexion, the tip of the tibial guide is placed 2-3mm anterior to the (posterior margin of) anterior horn of the lateral menisci and slightly medial to midline of the ACL tibial attachment area. Then the tibial tunnel is made by reaming over the guide pin using cannulated drill bit with diameter equal to diameter of the graft. The edges of the tunnel are smoothened using shaver leaving the remnants at the site of ACL tibial attachment site for better proprioception.

Graft preparation, passage and fixation: after the graft has been prepared, it is mounted to fixed loop endobutton. The threads of fixed loop endobutton are then attached to ethibond suture at the end of the tibial tunnel, and is pulled into the knee under direct arthroscopic visualization. It is then pulled out of the femoral tunnel using the 2 threads till the flip of the endobutton is felt on the femoral condyle. Then cyclical tensioning of the graft is done by repeated knee flexion and extension with sustained pull on the graft via tibial tunnel. Then the arthroscopic visualization of the graft is done to look for any signs of graft impingements, alignments then tibial side of the graft is fixed with interference screw of appropriate length. The ports and the graft harvest site wound are closed in layers. Sterile compressive dressing is applied.

Post-operative management

In the immediate post-operative period, immobilization in the knee brace and limb elevation was done. IV antibiotics were given for 3 days. Wound was inspected on POD 2, 5 and 7. Suture were removed on POD 12. Rehabilitation was started from day 1.

Stage 1(0-2 weeks)- patella mobilization, SLR without extension lag, quadriceps sets, prone/ standing hamstring curls, passive extension, prone hangs, pillow under heals, wall slide, sitting slide, partial weight bearing, sleep in brace with extension.

Stage 2(2-4 weeks)- motion control brace, progress ROM by 120 degrees, progress SLR, prone/ standing curls with weights. Full weight bearing, wall sits 45 degrees, etc

Stage 3(4-10 weeks)- progress to full ROM by 6 weeks, begin lunges

Stage 4(12-16 weeks)- continue flexibility exercises, quadriceps strengthening, sports specific fitness

Stage 5(16-18 weeks)- plyometric program with shuttle, mini trampoline if quadriceps strength 65%, no effusion, stable knee. Begin jogging

Stage 6(5-6 months)- sports specific drills, agility training.

Stage 7(>6 months)- return to sports if, motion>130 degrees, hamstring>90%, quadriceps > 85%, sports specific agility training.

Evaluation: all patients were subjected to post-operative AP and lateral radiographs to determine and position of both the interference screws. Patients were followed at 6th week, 6 months and 1 year and functional outcomes assessed.

IKDC and Lysholm knee scoring scale were used for evaluation of patients. Maximum score is 100. Based on the outcome scores they were divided into excellent (95-100), good (84-94), fair (64-83) and poor (<64)

Statistical analysis: the results are expressed as mean and range values for continuous data, number and percentage for categorical data. A p-value of 0.05 or less was considered statistically significant.

RESULTS

500 cases of arthroscopic ACL reconstruction were regularly followed for an average period of 18 months in JJM Medical College, Davanagere.

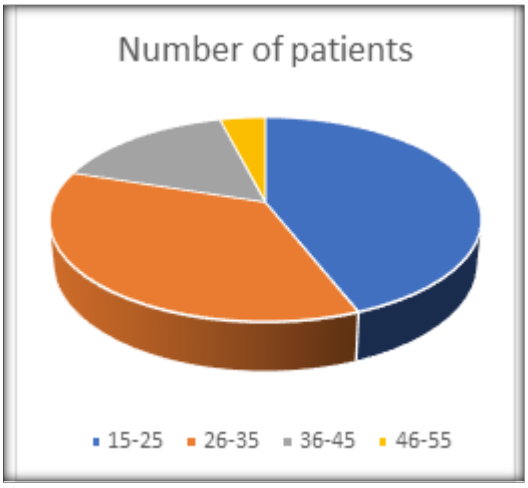

Figure 1: Age distribution of patients

In our study, majority belonged to the age group between 15-25 yrs i.e. 44% followed by 36% of patients in the 26-35 yrs of age. [Table 2]

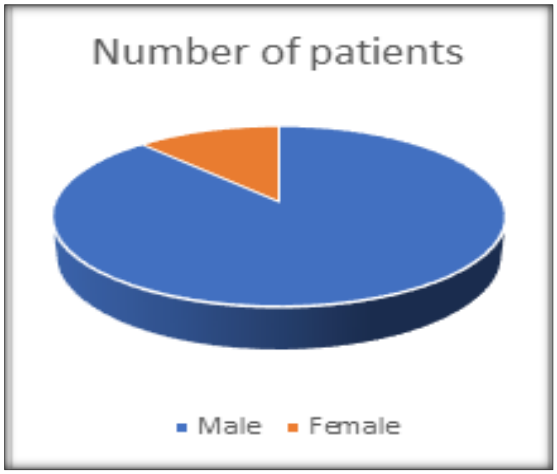

Figure 2: Sex Distribution of patients

Our study had male prepondence of 44 patients (88%) over females who were 4 (6%). [Table 3]

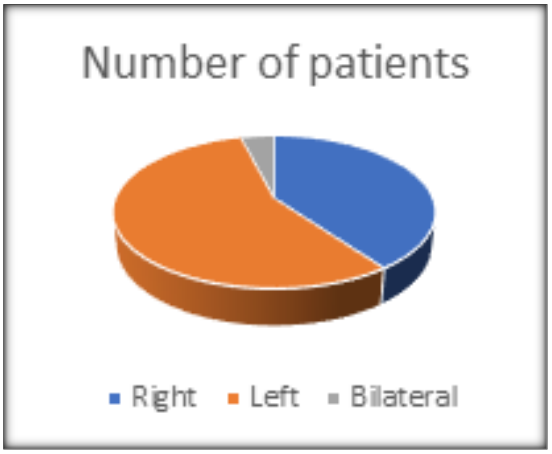

Figure 3: Side involvement

Out of 50 patients, 28 patients(56%) presented with left knee involvement, 20 patients (40%) presented with right knee involvement and 2 (4%) patient had bilateral ACL injury. [Table 4]

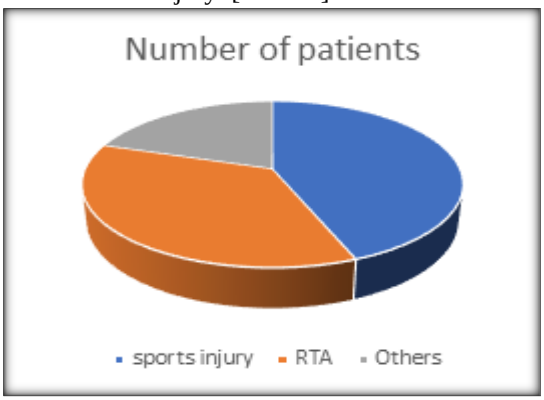

Figure 4: Mode of injury

Majority of the ACL injuries in our studies resulted from sports related injuries 22 patients (44%) out of which 36% were during volleyball followed by football and running injuries 54% patients each. RTA accounted for about 18 patients (36%) and 20% of the patients had other reasons. [Table 5]

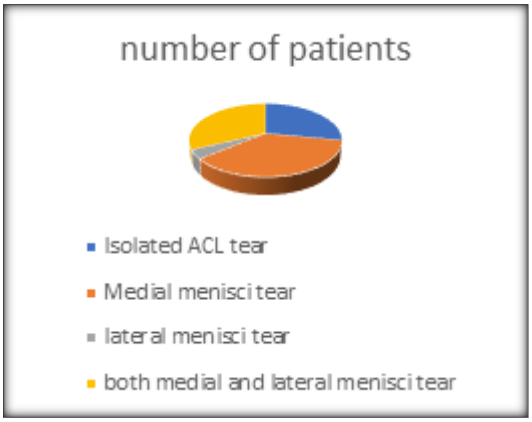

Figure 5: Associated Meniscal injuries

In our study, 36% patient had associated meniscal injuries. Most commonly, ACL injuries were associated with medial menisci injury. 32% of the patients had injuries had in both medial and lateral menisci. ACL injury associated lateral meniscal injury was seen in 2 patients. [Table 6]

Figure 6: Lysholm Knee Score

38 patients in our study and excellent results at the end of 6 months post operative follow up while 12 patients ended up with good functional outcome.
IKDC subjective score: there was statistical improvement in post op IKDC from pre op score of 45.74% to a post op score of 92.836% with a p value of <0.05 making it statistically significant.

Table 1: Age distribution of patients

Age	Number of patients	Percentage
15-25	22	44%
26-35	18	36%
36-45	8	16%
46-55	2	4%

Total	50	100%

Table 2: Sex Distribution of patients

Gender	Number of patients	Percentage
Male	44	88%
Female	6	6%
Total	50	100%

Table 3: Side involvement

Side involvement	Number of patients	Percentage
Right	20	40%
Left	28	56%
Bilateral	2	4%
Total	50	100%

Table 4: Mode of injury

Mode of injury	Number of patients	Percentage
sports injury	22	44%
RTA	18	36%
Others	10	20%
Total	50	100%

Table 5: Associated Meniscal injuries

Associated injuries	number of patients	Percentage
Isolated ACL tear	14	28%
Medial menisci tear	18	36%
lateral menisci tear	2	4%
both medial and lateral menisci tear	16	32%
total	50	100%

Table 6: Lysholm Knee Score

Result	Number of patients	Percentage
Excellent	38	76%
Good	12	24%
Fair	0	0
Poor	0	0
Total	50	100%

DISCUSSION

Anterior Cruciate Ligament injuries have become very common amongst sportsmen and people sustaining road traffic accidents necessitating surgical corrections. Arthroscopic ACL reconstruction have become the gold standard treatment of choice for injured ACL and is being extensively studies. The choice of the graft and implant has been a matter of great debate and the wide range of options to choose from, does not make it easy for surgeons. Bone – tendon- bone graft, hamstring graft, quadriceps graft, peroneus longus graft, various synthetic grafts are options available for grafting. Bone tendon bone grafts were being used extensively due to its high tensile load and rigid fixation at the bony tunnels. But post-operative complications like anterior knee pain, defect in extensor apparatus causing extensor lag, risk of patellar tendon rupture had led researchers to look for other graft options. Successful clinical outcomes following ACL reconstruction with a semitendinosus graft have been reported by many authors.[5] Hamstring grafts has advantages such as minimum donor site morbidity, no compromise of extensor apparatus, favorable elastic modulus and no incidence of anterior knee pain or problems while kneeling.

Semitendinosus has a strength of 75% of the native ACL while the gracilis tendon has about 49% of strength. When augmented with each other in a quadrupled graft, the semitendinosus-gracilis has more tensile load making it an ideal graft. Nowadays we have spectrum of implants to choose from for fixation of the grafts and a wide range of permutations and combinations have been studies. The choice of fixation of ACL reconstruction is still evolving and the current fixation device which has been widely used were endo button and bio composite interference screws which has helped to render an improved rehabilitation program post operatively.[6]

All patients in our study underwent arthroscopic ACL reconstruction with quadruples hamstring graft autograft from ipsilateral limb using fixed loop endobutton, cortical suspensory fixation method for femoral side and non-absorbable titanium interference screw, aperture fixation method for tibial side. Age distribution: the mean age of patients in our study was 28.76±8.65 yrs. The results of our study are comparable to the results of other studies such as one conducted by Siebold et al,[7] (mean age of 29 yrs), Specchiulli et al,[8] (mean age

of 27 yrs) and D. Chowdhary et al,[9] (mean age of 26.8yrs).

Side of Injury: Brown et al,[10] studies the incidence of the sidedness of the limb injury and sex incidence and stated that although their study pointed that females are more prone to this injury, the incidence is yet, more in males due to their increased exposure to work in a strenuous environment. They also hypothesized the limb sided ness have no influence in either during injury or the recovery period. However, in our study, 28 (56%) participants had injury on the left side and 20(40%) patient had injury on the right side with male preponderance. 2 people did have bilateral ACL tear.

Mode of Injury: D Chowdary et al,[9] in their study noted that 66.7% injuries caused by sporting activities, followed by motor vehicle accident accounted for 30.8%. studies conducted by Patond et al,[11] found sports activities to be predominant cause of ACL injuries. In our study 11(44%) were other modes of injury like skid and fall and atraumatic degenerations suggesting comparable modes of injuries.

Associated injuries: as per the study conducted by D W Lewis et al,[12] they found 58% of the patients undergoing ACL reconstruction had associated meniscal injuries and they also found that medial menisci injuries were more common. They also concluded that meniscal repair or removal did not affect the final outcome in their study. We found similar results in our study where 34(68%) of our study participants presented with medial meniscal injury at the time of presentation. 9(36%) of them had injuries in both menisci and 2(4%) of them had an isolated injury. 14 (28%) of our study participants did not have any associated injury. 14 patients with meniscal injury underwent partial meniscectomy while the remaining were treated conservatively. This did not seem to have a significant impact in the final functional outcome in our patients. Other ligament injuries such as MCL and PCL injuries were excluded in our study.

Functional outcome: the mean post-operative Lysholm score improved from pre-operative score of 48.56 to 96.56 in our study. The improvement in the mean pre-operative and post-operative Lysholm scores was statistically significant ($p<0.01$). At 1 year follow up, 80% had an excellent score while 40% had good score which was comparable to results in the studies conducted by E. Bourke et al,[13] who has a score of 93 and Williams et al,[14] who in their study had a post-operative Lysholm score of 91.

Fareed et al,[15] reported the results of a retrospective study on patients who underwent arthroscopic ACL reconstruction. The average follow up was 25.4 months. A satisfactory outcome was seen in 96%. Cooley et al,[16] in their study conducted that ACL reconstruction using quadrupled fold semitendinosus tendon autograft had about 85% of the patients according to Lysholm scoring fall into normal to near normal in their study. Gulick et al,[17] in 2002 studied on 57 patients and concluded that 84% of their patients returned into pre injury level of function.

Our study was comparable also comparable to the results of the following studies suggesting that ACL reconstruction with hamstring graft provides excellent functional outcome. Our study participants had a pre-operative IKDC score of 45.74±11.60%. when this was compared to the post-operative mean IKDC score of 92.83±5027% we found that the p value was <0.01, making statistically significant. This was comparable to many studies such as ones conducted by Kumar et al., Prasad et al., Aparajitha et al., as shown in the table below.

Complications: Judd et al,[18] reported that hamstring grafts were associated with the higher incidence of infection. Whilliam et al,[14] in their study of 2500 cases of ACL reconstruction, reported an infection rate of 0.3%. However, none of our patients had any form of infections. We do hypothesize that a larger sample size is required for assessment of such complication. Agiletti et al,[5] in their study found <5mm tibial translation in 20% of the knees in which the torn ACL was reconstructed with hamstring graft. In our study, anterior tibial translation was eliminated in all patients who were examined at a mean 10-month post operatively. 5(10%) in our study ended up in having pain at the graft site at the end of 6 months follow up out of which 2 of them were relived of it by the end of 12 months post operatively. 1 patient developed impending compartment syndrome post operatively treated with immediate fasciotomy and release of pressure. This could have been probably because of a capsular tear in which tear wasn't diagnosed on MRI.

CONCLUSION

From this study, we conclude that ACL injuries are common in younger age group individuals. Sports injuries are the most common modes of injury followed by road traffic accidents and other causes. Arthroscopy assisted ACL reconstruction using hamstring tendon auto graft provides a stable knee, reduces post-operative morbidity and enables early rehabilitation. Graft fixation using fixed loop endobutton will help the graft to facilitate graft tunnel healing and also maintain its strength until there is good graft to bone healing. The functional outcome is excellent to good and allows the patient to return to pre injury level of activity, allows the patient to squat, sit crossed leg and climb stairs without difficulty with the hamstring muscle graft. Thus, arthroscopic ACL reconstruction with quadrupled hamstring tendon autograft using fixed loop endobutton is an excellent treatment option for ACL deficient knees. High success rate has been achieved after this procedure with regard to functional recovery of the patient.

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