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A retrospective study of patient outcomes in revision anterior cruciate ligament reconstruction in non- sportspersons

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Abstract

Background and Objective: The aim of the present study is to study the revision rate of primary ACL reconstruction and the functional outcomes following revision ACL reconstruction in the non-sportsperson population.

Materials and Methods: This is a retrospective and prospective observational study done between June 2020 to February 2021, at department of orthopaedics, Belagavi Institute of Medical sciences, Belagavi. 23 patients were included in the study who underwent Revision Anterior cruciate Ligament Reconstruction arthroscopically. All the patients, who were non-athletes were examined clinically and radiologically and treated accordingly.

Results: There was significant difference noted between the IKDC scores of the patients who underwent the revision surgery for either rupture of the graft or for excessive laxity of the graft. ($p < 0.05$)

Interpretation /Conclusion: Accurate tunnel placement is important to have good postoperative outcomes. The revision rates and successful outcomes were independent of the time interval between the start of symptoms and ACL reconstruction.

Keywords: revision anterior cruciate ligament

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.

Reconstruction of the anterior cruciate ligament (ACL) is one of the most common surgical procedures, with more than 200,000 ACL tears occurring annually. Although primary ACL reconstruction is a successful operation, success rates still range from 75% to 97%. Consequently, several thousand revision ACL reconstructions are performed annually and are unfortunately associated with inferior clinical outcomes when compared with primary reconstructions^[1].

Objectives

The aim of the present study is to study the revision rate of primary ACL reconstruction and the functional outcomes following revision ACL reconstruction in the non-sportsperson population.

Implants

In our study, we used biodegradable screws.

Biodegradable screws

These have fixation strength comparable to that of metal screws.

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The advantages of bio-screws are

- No removal is necessary
- No interference with radiological studies like MRI

The disadvantages are

- Risk of foreign body reactions
- Viscoplastic deformation which may weaken the fixation strength of the implant.

Portals in arthroscopy:

Adequate illumination, joint distension and proper positioning of portals for the entry of arthroscope and accessory instruments are important in arthroscopy. The precise placement of portals is necessary since improper placement results in inability to see the joint and difficulty to maneuver the instruments within the joint. If an arthroscope is forced through an improperly placed portal, not only may injury to the joint occur but also the instrument may be damaged.

The portal entry points should be precisely marked before joint distension. The outlines of the following bone and soft tissue landmarks are drawn – patella, patellar tendon, medial and lateral joint line, posterior contours of the medial and lateral condyles of the femur. The surgeon should mark the portals and landmarks before and after distension to ensure correct placement of portals.

It has been found in a study by Stetsin and Templin that knee arthroscopy with two portals had an earlier rehabilitation time and quicker return to activity compared to arthroscopy with three portals. This was because the vastusmedialisobliquus was violated when using three portals.

Standard portals: The standard portals include,

- anterolateral
- anteromedial
- superolateral
- posteromedial

Anterolateral portal

This is the portal most commonly used by the surgeons for diagnostic arthroscopy. Almost all the structures within the knee joint may be visualised through this portal except PCL and the anterior part of the lateral meniscus. The location of this portal is 1cm superior to the lateral joint line and 1cm lateral to the patellar tendon. The level of the portal should be approximately 1cm distal to the inferior pole of the patella. Injury to the anterior horn of the lateral meniscus may occur if the port is placed close to the joint line. If the port is placed too close to the patellar tendon, the scope may penetrate the fat pad resulting in difficult viewing and maneuvering of the scope within the joint.

Anteromedial portal

This portal is mainly used for additional visualisation of the lateral compartment and also for palpating the medial and compartment structures with the use of the probe. The portal is situated 1cm superior to the medial joint line, 1cm distal to the inferior pole of the patella and 1cm medial to the patellar tendon. The exact placement of the portal can be confined by placing a spiral needle percutaneously which is visualised via the anterolateral portal.

Posteromedial portal

The location of this portal is in a small triangular spot which is bound by the posteromedial edges of the femoral condyle and the tibia. This triangle is palpated with the knee in 90

degree of flexion before the joint is distended. The structures in the posteromedial compartment can be visualised via a 30 degree angled arthroscope inserted through this portal. The location of this portal is 1cm superior to the posteromedial joint line and 1cm posterior to the posteromedial margin of the femoral condyle. This part is mainly used for dealing with pathologies of the posterior horn of the menisci and posterior loose bodies that cannot be approached through the anterior portals.

Superolateral portal

This is mainly used for visualisation of the dynamics of the patellofemoral joint such as patellar tracking, patellar congruity when the knee is moved from extension to flexion. The location of this portal is 2.5cm above the superolateral border of the patella and lateral to the quadriceps tendon.

Optional portals: The optional portals include

- Posterolateral portal
- Proximal midpatellar lateral and medial portals
- Accessory far medial and lateral portal
- Central transpatellar tendon (Gillquist) portal

Examination under anaesthesia and patient positioning

All the patients in our study were operated under spinal anaesthesia in supine position. The following tests were done under anaesthesia – anterior drawer test, posterior drawer test, Lachman test and pivot shift test. A pneumatic tourniquet is applied which is positioned in the upper thigh after soft padding. The limb is scrubbed from the ankle upto the tourniquet. The patient is positioned supine and the knee joint is placed slightly away from the distal breakpoint of the standard operating table. The uninvolved limb is placed in a well-leg support. In all the cases, prophylactic antibiotic usually 1 Gram Cefixime is given pre-operatively before inflation of the tourniquet. The limb is held upright to exsanguinate the limb before inflation of the tourniquet.

Surgical technique

The technique of single bundle ACL reconstruction was done with one tibial tunnel and one femoral tunnel with their centres corresponding to the centre of the native ACL tibial and femoral attachment sites respectively. The femoral tunnel was made using the anteromedial portal thereby creating an anatomic femoral tunnel position.

The graft was fixed at the tibial and femoral side using bioscrews.

Diagnostic Arthroscopy

Before the harvesting of graft, diagnostic arthroscopy was done first. In 90 degrees 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 knee is examined in a sequential manner of the following:

- Suprapatellar pouch
- Patellofemoral joint
- Medial gutter
- Medial meniscus
- Intercondylar notch
- Lateral meniscus
- 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 partial / total meniscectomy for meniscal tears and loose body removal.

Showing various structure of knee when viewed arthroscopically through various portals during diagnostic arthroscopy

- Suprapatellar pouch
- Patellofemoral articulation
- Normal medial parapatellarplica
- Posteromedial compartment
- Posteromedial compartment when seen through posteromedial portal, which is made after completion of routine examination if complete posteromedial view is unsatisfactory
- Medial meniscus and medial compartment
- Cruciate ligament with fatty synovium covering PCL
- Lateral meniscus and lateral compartment
- View of posterior horn of lateral meniscus and popliteal tendon through hiatus

Hamstring graft harvest and graft preparation

A 3cm oblique skin incision is made starting 5 cm below the medial joint line and 1 cm medial to the tibial tuberosity. The oblique incision is preferred because it gives a wider exposure of pesanserinus 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 pesanserinus is identified using the fingers. This superior border is lifted and fascia incised. The tendons can be felt with fingers running from above downwards. The lowest one felt is the semitendinosus tendon.

After the hamstring tendons are identified, the sartorius fascia is divided along the course of the tendons (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 are hooked out. The tendon ends were tied with double loop knot to aid in traction.

The knee is placed in 90 degrees of flexion and proximal dissection of the tendons were done using blunt dissection by fingers till 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 is usually cut with the help of scissors. It is confirmed that as the tendon is pulled distally, there should be no dimpling posteriorly over the gastrocnemius.

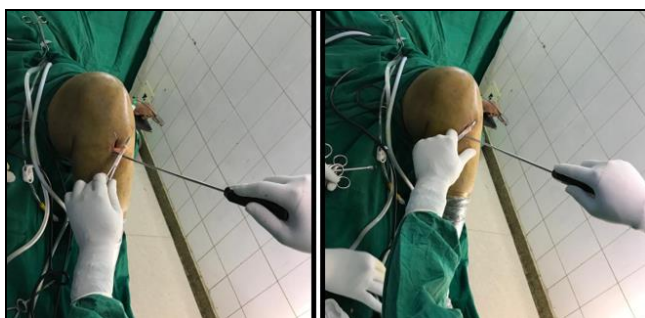


Fig 1: Stripping of the tendons with the help of tendon stripper

The distal end of the tendon is freed with the scissors. Then a tendon stripper is advanced over the tendon in line with it

maintaining firm, steady and gentle pressure and at the same time applying traction by holding the threads. If there is any resistance felt, then the stripper is withdrawn, adhesions removed and again the stripper is advanced and tendon harvested. The harvested graft is then placed on Graftmaster board. The tendons are removed of any residual muscle fibres with the help of blunt end of the blade.

The tendon ends are trimmed to achieve uniform size. A whipstitch is placed at both ends of the tendons. Around 3-4 cm of both the ends of the tendon were stitched together. The two tendons are looped over an 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 tripled graft passed with minimum friction. The graft length to be placed inside the femoral tunnel is marked to ensure correct placement of graft within the femoral tunnel while being viewed arthroscopically. The loop of the four strand graft is tied to the posts in the graft master board and pretensioning is done by applying a pressure of about 15 pounds for around fifteen minutes.

Intra-articular preparation

The arthroscope was introduced via the anterolateral portal and joint cavity visualized. The shaver blade is inserted through the anteromedial portal and the joint is debrided of ligamentummplicae, fat pads and synovial reflections that hinder a thorough inspection of the tibial footprint of the ACL and medial surface of the lateral femoral condyle. During the joint debridement, care should be taken to avoid injury to the intact PCL.

Notch preparation and Notchplasty

Then the visualisation of the 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 the lateral condyle (Empty lateral wall sign). The residual ACL tissues are removed except the remnants on the tibial and femoral attachment sites.

The femoral remnant will act as a landmark for the positioning of guide pins for making femoral tunnel while the tibial remnants may serve as neurologically active envelope for the graft, thereby having proprioceptive function after ACL reconstruction.

The careful shaping and enlargement of the 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 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.

Femoral tunnel preparation

The medial aspect of the lateral femoral condyle can be accessed through the anteriomedial portal or via a 2-incision technique. The center of the new femoral tunnel can be localized to the center of the footprint if native ligament footprint margins have been preserved. If these have been obliterated from the previous surgery, referencing of the intercondylar and bifurcate ridges can help to facilitate localization of the native femoral footprint.

With a medial portal technique, the knee should be hyperflexed to 120° before drilling the guide wire to allow for sufficient clearance from the medial femoral condyle and satisfactory graft obliquity.

The ACL footprint is visualised 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 a guide wire in 120 degrees of knee 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.

The femoral tunnel is reamed with a reamer corresponding to the diameter of the graft. The reaming is stopped 30mm from the lateral cortex depending on the length of the graft. Then using the 4 mm cannulated drill bit, the femoral tunnel is made by drilling both the near and far cortices. Afterwards, a beath pin with ethilon at its end is 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 jig (angle fixed to 55degrees). 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 lateral meniscus and slightly medial to the midline of the ACL tibial attachment area.

In the absence of significant tunnel expansion, this tunnel may be avoided by independent preparation of a new tunnel with divergent trajectory toward a more anterior anatomic position within the tibial ACL footprint. The ACL tibial footprint extends anteriorly to the intermeniscal ligament, which allows for a more anterior position of the new tibial tunnel.

The tibial tunnel is made by reaming over the guide pin using cannulated drill bit with diameter equal to the 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 passage and fixation

After the graft has been prepared, based on the length, the graft is tripled and both ends of the graft are sutured with number 5 ethibond.

The nonabsorbable suture already present within the joint is pulled out through tibial tunnel. Then the passing sutures for the ACL graft are passed through the suture loop and are taken out of the lateral thigh. With the help of these sutures, the graft is pulled via the tibial tunnel into the joint and then into the femoral tunnel. Once the estimated length of the graft is within the femoral tunnel, a guide wire is passed through the tunnel and graft is fixed with biodegradable screw.

Then cyclical tensioning of the graft is done by repeated knee flexion and extension (around 20 – 30 times) with sustained pull on the graft via the tibial tunnel. Then the arthroscopic visualisation of the graft is done to look for any signs of graft impingement, alignment, etc. The tibial side of the graft is fixed with interference screw (bioscrew) of appropriate length. The ports and the graft harvest site wound are closed in layers. Sterile compressive dressing is then applied. The limb is immobilised with the use of knee brace.

Results

Gender

Table: Gender Distribution

Gender	Frequency	percentage
Male	19	82.6
Female	4	17.4
Total	23	100%

In the study group, 19 patients were male (83%) and 4 patients were females (17%).

Mode of Injury

Table 2: Mode of injury distribution

Mode of Injury	Frequency	Percentage
RTA	13	56.6%
Self-Fall	10	43.4%
Total	23	100%

56% patients had come for revision surgery post road traffic accident and around 43% had a self-fall (falls at home or at work, non-sports, non RTA)

Age

Table 3: Age Distribution

Age	Frequency	Percentage
>35years	12	52.2%
<35years	11	47.8%
Total	23	100%

The mean age of patients was 35 years (range 28-44 years).

Side of Knee

Table 4: Side of knee distribution

Side	Frequency	Percentage
Right	14	60.9%
Left	9	39.1%
Total	23	100%

The right knee was involved in 61% of patients and the left knee in 39% of patients

Associated meniscal injury

Table 5: Distribution of meniscal Injury

Meniscal injury	Numbers
Medial	8
Lateral	5
Combined	3
Total	16

Meniscal tears were present in 16 patients out of 23, medial meniscal tears in 8, lateral meniscal tears in 5 and combined tears in 3 patients.

Associated chondral injury

Table 6: Distribution of Chondral Injury

Chondral injury	Numbers
Medial femoral condyle (MFC)	7
Patella	4
Total	11

Chondral injuries were seen in 11 patients, in which medial femoral condyles were involved in 7 and patella in 4 patients.

Type of graft used

Table 7: Type of Graft Distribution

Type of graft	Frequency	Percentage
BPTB	11	47.8
HG	12	52.2
Total	23	100

The graft used in the initial index operation was Bone-Pattellar-Tendon bone (BPTB) in 11 patients and Hamstring (HG) in 12 patients.

Femoral Tunnel Placement

Table 8: Femoral Tunnel Placement Distribution

Femoral tunnel	Frequency	Percentage
Anterior	14	60.9%
Vertical	9	39.1%
Total	23	100%

The femoral tunnel was anteriorly placed in 61% patients and vertical in 39% patients.

Tibial Tunnel Placement

Table 9: Tibial Tunnel Placement Distribution

Tibial tunnel	Frequency	Percentage
Anterior	10	43.5%
Posterior	7	30.4%
Normal	6	26.1%
Total	23	100%

The tibial tunnel was aberrant in 74% patients. It was anteriorly placed in 10 patients and posterior in 7 patients.

Table 10: Comparison of preoperative and postoperative scores of outcome scores

Outcome score	Preoperative		Postoperative		p value
	Mean	SD	Mean	SD	
IKDC	37.24	9.91	74.29	7.75	0.00001
Lysholm	56.83	3.89	74.22	6.04	0.00001

The mean preoperative IKDC score was 37.24 (SD 9.91, Range 19.3 – 51.7). The mean postoperative IKDC score was 74.29 (SD 7.75, Range 54.9- 83.5). The change in IKDC scores was significant ($p < 0.00001$).

The mean Lysholm score preoperative was 56.83 and postoperative mean was 74.22 ($p < 0.00001$).

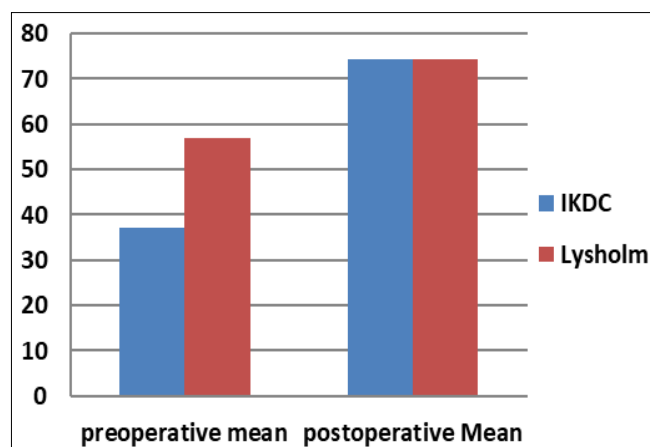


Fig 2: Outcome Scores

Table 11: Time interval between onset of symptoms and revision

Time interval	Preoperative IKDC score		Postoperative IKDC score		p Value
	Mean	SD	Mean	SD	
>1year	35.486	9.341	75.25	7.74	0.06
<1year	39.978	10.71	72.81	7.99	

There was no significant difference in the IKDC scores of patients who were symptomatic for a year or more than a year following the index surgery ($p = 0.06$).

Table 12: Comparison between types of graft and IKDC score

Type of graft	Preoperative IKDC score		Postoperative IKDC score		p Value
	Mean	SD	Mean	SD	
BPTB	38.027	10.57	75.927	7.049	0.214
HG	36.525	9.69	72.80	8.36	

There was no significant difference between patients who had undergone BPTB graft and hamstring graft at the index surgery ($p = 0.214$).

Table 13: Comparison between cause of failure of graft and IKDC score

Cause of failure of graft	Preoperative IKDC score		Postoperative IKDC score		p Value
	Mean	SD	Mean	SD	
Rupture	38.125	10.75	75.167	6.59	0.0001
Laxity	36.282	9.342	73.345	9.08	

There was significant difference noted between the IKDC scores of the patients who underwent the revision surgery for either rupture of the graft or for excessive laxity of the graft. ($p < 0.05$)

Conclusion

Accurate tunnel placement is important to have good postoperative outcomes. The revision rates and successful outcomes were independent of the time interval between the start of symptoms and ACL reconstruction. In our study, patient outcomes were better with acute re-rupture of the graft when compared to lax grafts. High incidence of meniscal and chondral injuries are also noted irrespective of mode of injury and activity levels of the patient.

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