# **Original Research Paper**

Orthopaedic

# ARTHROSCOPIC TRANSTIBIAL ANTERIOR CRUCIATE LIGAMENT **RECONSTRUCTION A SHORT TERM ANALYSIS OF FUNCTIONAL** OUTCOME

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#### AIM AND OBJECTIVE: ABSTRACT

To evaluate the functional outcome of Arthroscopic trans portal Anterior Cruciate Ligament Reconstruction using quadrupled hamstring graft with endobutton as femoral fixation device and interference screw as tibial fixation device.

# MATERIALS AND METHODS:

The prospective study of 30 patients treated with arthroscopic anterior cruciate ligament reconstruction with quadrupled hamstring graft with endobutton as the femoral fixation device between May 2015 and November 2016 at institute of orthopaedics, Meenakshi medical college,hospital&researchinstitute,kanchipuram.

# KEYWORDS :

# INTRODUCTION

Knee injuries are increasing and becoming more common due to exponential increase in road traffic accidents and more involvement in sports related activities by common people. In current scenario, knee injuries take orthopaedist to a plethora of diagnosis and management challenges which is not resolved even by modern understanding and technical improvements in science.

Anterior cruciate ligament injury is one of the most common injuries<sup>(1)</sup> around knee and poses quiet a lot management controversies. Anterior cruciate ligament has a pivot role in function and stability of the knee joint along with all other ligaments, being a prime stabilizer preventing the anterior translation of tibia over femur<sup>(2)</sup>. Along with this function anterior cruciate ligament also restricts valgus and rotational stress to some extent.

Acute anterior cruciate ligament injury causes sever hemarthrosis with pain and decreased range of motion. Anterior cruciate ligament injury is associated with meniscal injury and early onset of osteoarthritis. There is also a involuntary decrease in function and activity of anterior cruciate ligament deficient knee. Anterior cruciate ligament reconstruction allows return to pre injury levels even in athletes, delays development of early osteoarthritis<sup>(3)</sup> and reestablish the stability of the joint<sup>(4)</sup>.

Arthroscopic anterior cruciate ligament reconstruction has become the gold standard<sup>(5)</sup> in management of these injuries. Earlier extraarticular procedures and intra articular reconstructions by open arthrotomy were done but in current understanding of biomechanics and with current ornamentorium of instruments and implants many orthopaedic surgeons prefer a arthroscopic anterior cruciate ligament reconstruction. Also usage of soft tissue grafts is increasing in number than bone patellar tendon bone graft in recent times. Decreased post operative inflammation and possibility of early full range of movements makes arthroscopic reconstruction superior and more preferable than open procedures. However there are controversies regarding the ideal graft, ideal time and technique of reconstruction.

# **INCLUSION CRITERIA**

# Skeletally mature

- Clinical and MRI evidence of ACL tear, single bundle and double bundle tear
- Grade II and grade III injuries
- Willingness to participate in the study

# **EXCLUSION CRITERIA**

**Skeletally immature** •

- Gradelinjuries
- . Injuries less than 3 weeks
- Old patients with less demand .
- Associated fractures
- Associated posterior cruciate ligament tear, medial collateral • ligament, lateral collateral ligament injury
- **Signs of infection**
- **Prior knee surgery** •

#### INSTRUMENTATION

Many specialized instruments are required for arthroscopic anterior cruciate ligament reconstruction. An arthroscopic system which consist of

- **Television monitor** 1)
- 2) Camera
- 3) Light source and fibre optic light source cable
- 4) Arthroscope (30 degree)
- 5) Shaver system and hand piece
- Tourniquet set (Pneumatic) 6)

# Equipments needed for surgery are

- 2.4mm drill tip guide pins
- Trocar, canula, ACL probe
- . Meniscus punch
- 3.5 and 4.5 shaver blades •
- Tibial aiming guide
- Cannulated headed reamers (size 5mm to 10mm) •
  - Transtibial femoral ACL drill guide (usually 7 mm offset tip)
- Extra long 2.4 mm guide pin with suture eye (Beath type • auide pin)
- 4.5 mm cannulated reamer for passage of endobutton
- Depth gauge
- Sizing block
- Cannulated interference screws .

# IMPLANTS

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The fixation options for soft tissue grafts in femur can be direct devices like interference screws and washers. The indirect devices like endobutton, femoral cross pins, suture discs and anchors are also available. Fixation options in tibia are interfernce screws, staples, screw and washer(Washerloc). We used endobutton for femoral fixation and titanium interference screws in the tibia.

# **ENDOBUTTON**

Endobutton is preferred by most of the surgeons nowadays. It ensures most of the graft in the tunnel. Endobutton has 4 holes of which central two holes are used to create the loop for quadrupling the graft. The peripheral two holes are for passing wires which are

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used to flip the endobutton. Endo button was stronger than RCI screw and bio screw in withstanding cyclical loads and has a greater advantage of not lacerating the soft tissue graft.

# EEE.

#### Endobutton

#### **INTERFERENCE SCREW**

Interference screws are direct fixation device which hold the graft to bone having inserted between the graft and the bone tunnel. These are made of variety of materials. Round contoured interference screws, bio absorbable interference screws, titanium interference screws are available. We used regular titanium interference screws. These interference screws which provide juxta articular fixation increase the stability of the knee joint than the implants which suspend the graft or fix the graft at the surface of the joint. However studies have proved that interference screws to be inferior to the endobutton and the bone mulch screw. One another concern was the laceration that interference screw can cause to the soft tissue graft. But in spite of the concerns interference screw fixation of soft tissue grafts have shown comparable results with that of interference screw fixation of bone patellar tendon bone grafts.



Interference screw

METHODS



#### Patient positioning

#### ARTHROSCOPIC PROCEDURE

An anterolateral portal is established 1 cm lateral to the patellar tendon midway between the inferior pole of the patella and the upper end of the tibia. Trocar and canula inserted with knee extended in to the suprapatellar pouch. Inflow of normal saline from 3 liter saline bottles is maintained through the TURP set. After adequate inflation of the joint space scope is introduced and a diagnostic arthroscopy is done visualising suprapatellar pouch, lateral gutter, intercondylar notch, articular surface of patella, medial gutter and articular surfaces of femur and tibia. An anteromedial portal or the working portal is established 1 cm medial to the patellar tendon midway between the inferior pole of patella and the upper end of the tibia. The meniscus are visualised and probed to reveal meniscal tears. Anterior cruciate ligament is probed to analyse the amount of tear. If unstable meniscal injuries are found they are treated with partial menisectomy and debridement depending on the site and type of the tear.

# **GRAFT HARVEST AND PREPARATION**

A 2 to 3 cm oblique incision is placed over the anteromedial aspect of tibia exactly over the pes anserinus which is identified by

palpating the semitendinosus and gracilis tendon by running the fingers from above downwards in the anteromedial aspect of the upper tibia. The tendons slip under the finger during this gentle palpation. Skin subcutaneous tissue is incised along the incision and blunt dissection is done to expose the sartorius fascia which is lifted up with a forceps and cut with a number 11 scalpel.

After incising the sartorius fascia the gracilis and semitendinosus tendons are indetified and localised using a right angle forceps. The tendons are freed from all soft tissue attachments in the anteromedial tibia and around their insertionsHolding the vicryl tied to the tendon a closed tendon stripper is inserted encircling the tendon and the tendon stripper is advanced with a minimal countertration. The stripper is advanced until the tendon muscle junction is cut and the tendon comes out through the incision.

The tendons are cleared of the muscle attachments and free ends of the tendons are stitched together with a running whip stitch 4 to 5 cm from the free ends with polybraided nonabsorbable number 2 suture material (Ethibond). Mannual tensioning of the tendon is done and the tendons are passed through the loop made in the endobutton with number 5 non-absorbable suture material (ethibond) or through the loop of the endobutton CL ultra so that the tendons are quadrupled for reconstruction. The free ends of the combined gracilis semitendinosus tendons are again whip stitched with a number 2 nonabsorbable suture material. Then the graft size is mesured with a sizer by pulling the graft through the sizer and the graft is kept aside rolled in a moist cotton gauze pad.



Figure 13: Graft harvest

# INTRAARTICULAR PREPARATION

The arthroscope is introduced through the anterolateral portal and the 4.5 or 3.5 shaver blade is inserted through the anteromedial portal and the joint is debrided of the ligamentum plicae, some pad of fat and some synovial reflections which hinder a through visualization of the medial surface of lateral femoral condyle, the over the top position and the tibial foot print of the anterior cruciate ligament. The medial surface of the lateral femoral condyle is shaved of the native ACL remanents and the over the top position is identified without misinterpreting the students ridge. Then the ACL foot print in the tibia is prepared. Throughout this joint debridement undue care is taken to avoid injury to the native posterior cruciate ligament.

#### **GRAFT PASSAGE AND FIXATION**

In the peripheral holes of the endobutton two 5 number suture material is passed and taken through the eyelet of the guide pin so that it can used as a leading suture and as a toggle suture. The guide pin is passed through the tunnel and pulled through the tunnel and extracted along with the suture material in the anterolateral aspect of the distal thigh. The leading suture is pulled so that the graft is pulled through the tunnel headed by the end of the endobutton to which the leading suture is passed. The graft is pulled until the desired length of the graft is pulled in to the femoral condyle and the trailing suture is pulled to flip the endobutton. Once the endobutton is flipped and confirmed by arthroscope in the anterolateral aspect of the femur. The distal part of the graft is pulled down to seat the endobutton so that the femoral fixation is done. With manual tension to the distal graft the knee is taken through range of motion to cyclically tension the graft and to look for impingement. If there is impingement of the graft the notch is slightly enlarged to avoid impingement. After tensioning the graft the tibial site is fixed with appropriate size titanium interference screw and ensured endoscopically that the screw has not breached the articular surface.

#### CLOSURE

The wound is closed in layers after through wash. The portals are closed with single sutures with nonabsorbable suture material after placing a intraarticular suction drain. Sterile dressing applied over the wound and knee brace applied in extension after tourniquet is released. Post operative distal neurovascular deficits are checked for.

#### **POST OPERATIVE MANAGEMENT**

Immobilisation in knee brace and limb elevation immediate post operatively Intravenous antibiotics for 3 days Drain removal on 2<sup>nd</sup> Post operative day Wound inspection on 2, 5, 7 Post operative day.

Suture removal on 12<sup>th</sup> Postoperative day Gradual physical rehabilitation Follow up at 4,8 weeks and 3,6 months

# POST OPERATIVE REHABILITATION

The general post operative protocol for anterior cruciate ligament reconstruction is followed and progression of the rehabilitation is individualized for each patient. Emphasis on arthrofibrosis, joint contracture and joint laxity has been made.

**Goals:** Full range of motion (ROM), normal gait pattern, stability of the knee joint, pain free movement.

# 1<sup>st</sup> Postoperative day

Rest in extension in long knee brace Static quadriceps exercise Ankle and foot movement and limb elevation.

#### 0-2Weeks

Full knee extension ROM 90 degrees knee flexion ROM Strong QS/SLR without extention lag Emphasize normal gait pattern Passive, active, and active – assisted ROM knee flexion Partial weight – bearing 50% to 75% with walker or weight-bearing to tolerance with knee immobilizer with a walker

#### 2–4 weeks

Full extension to 120 degrees flexion Full weight bearing without Progress SLR with weights Walking, emphasis on normal gait.

# 4–10 Weeks

Progress to full ROM by 6 weeks Progress closed chain exercises Progress all the exercises

# 12-14 Weeks

Initiate full range knee extension exercises, light weight and high repetition. Initiate jogging program

#### 16–18 weeks

Isokinetic strength test for quadriceps and hamstrings Agility training and sport-specific training

#### EVALUATION

All the patients are subjected for post operative anteroposterior and lateral radiographs to determine the tunnel placement and position of endobutton in femur and interference screw in the tibia. Patients are followed at 4 weeks, 8 weeks, 3months, 6 months and once in 6 months there after.

All patients are evaluated with Lysholm & Gill	quist scoring.	
KNEE SCOKING SCALE OF LYSHOLM & GILL	QUIST	
Limp	05	
None Slight (govie die exheth	05	
Signt/periodic or both	03	
Constant or severe or both	00	
Support		
None	05	
Caneorcrutch	02	
Weight bearing impossible	00	
Treight Searing impossible	00	
Locking		
No locking or catching sensations	15	
Catching, but no locking sensations	10	
Locking - occasionally	06	
- Frequently	02	
Locked on examination	00	
Instability / Giving Way		
Never	25	
Rarely during athletic activity or any other he	avyexertion	
	,	20
Frequently during athletics or any other heav	vy exertion	
		15
Rarely in daily activities		10
Frequently in daily activities 05		
At every step		
	00	
Pain		
None	25	
Inconstant or slight during heavy exertion	20	
Marked during heavy exertion	15	
Slight during a walk >2 km	10	
Marked during a walk <2 km	05	
Constant	00	
Swelling		
None	10	
Mild on exertion	06	
Marked on exertion	02	
Constant	00	
Stair Climbing		
No problems	10	
Slightly impaired	06	
One step at a time	02	
Impossible	00	
Squatting		

SquattingNo problems05Slightly impaired04Knee flexion possible only up to 90 degrees02Impossible00

#### **OBSERVATION & RESULTS**

30 Cases of arthroscopy assisted transtibial Anterior cruciate ligament reconstruction with quadrupled hamstring tendon graft using endobutton as the femoral fixation device was followed for 6 months to 1.5 years. The mean follow up was 10.5 months

#### **SIDE INVOLVED**

In this study, 15 patients had injury in the right knee and 15 patients had injury in the left knee

#### Table 1: Side involved

SIDE INVOLVED	PATIENTS	PERCENTAGE
RIGHT	15	50
LEFT	15	50
TOTAL	30	100

#### **MODE OF INJURY**

MODE OF INJURY	PATIENTS	PERCENTAGE
SPORTS	3	10
FALL	14	47
RTA	13	43
TOTAL	30	100

# DURATION OF INJURY

DURATION AFTER INJURY	PATIENTS	PERCENTAGE
<6 WEEKS	6	20
6-3 MONTHS	5	17
3-6 MONTHS	7	23
6-12 MONTHS	7	23
>12 MONTHS	5	17
TOTAL	30	100

# OBSERVATION

- Greater number of our patients was seen in the younger age group of 20-40 years.
- Male preponderance was noticed in our study
- Left side and right side was equally affected.
- Road traffic accident was the most common cause accounting for ACL injury.
- Medial meniscus injury was involved more than the lateral meniscus.
- Most of the patients returned to their pre-functional level at 4 months.

# SCORING ANALYSIS

30 patients of arthroscopic acl reconstruction with quadrupled hamstring graft was followed for a minimum period of 6 months and maximum period of 1.5 years. All patients are evaluated with Lysholm and Gillquist scoring at the end of 6 months. The maximum score achieved was 100 and minimum score was 52. The scores were graded as

Outcome	Points
Good	84-100
Fair	65-84
Poor	<65

We compared our results with LYSHOLM and GILLQUIST study

Outcome	Lysholm and Guillquist study	Our study
Good	88%	83.3%
Fair	8%	10%
Poor	4%	6.6%

# GOOD RESULTS

In our study 25 patients had good results and the patients had no limp, were able to walk without support, there was no locking, except for a few with mild instability during athletics or heavy exertion. There was no pain or swelling of the knee joints. There was no difficulty in climbing stairs or squatting.

# FAIR RESULTS

3 of our patients had fair results with the following clinical findings. There was slight limping, occasional locking, with mild instability during daily activities. There was anterior pain and swelling on exertion. squatting and stair climbing were slightly impaired.

# POOR RESULTS

2 patients had poor results, with painful weight bearing. The patient walked with support, and felt the knee giving way in daily activities. There was constant swelling and pain of anterior knee joint. Squatting and climbing stairs was painful.

The above 2 patients with poor results had lachmans and anterior drawer test positive with restricted knee movements. These may be due to improper graft tension and in cooperation during postoperative rehabilitation.10f the 2 patients had infection and septic arthritis 10 days following which subsided with arthrotomy and joint lavage and antibiotics.

In 25 cases of good outcome 10 had extensor lag 5 - 10 degrees. These can be improved by doing notchplasty, placing the graft far much posteriorly on the lateral condyle, and vigorous postoperative rehabilitation to improve quadriceps weakness.

# COMPLICATIONS

The most common complication proposed was premature amputation of the graft but we did not encounter such a problem in our study. One patient had post operative infection and patient presented on 10th post operative day with fever, pain and inability to move the limb. Septic arthritis was suspected and patient treated with open arthrotomy and joint debridement and antibiotics for 4 weeks and infection subsided.



Incidence of anterior cruciate ligament reconstruction had increased significantly in the past decade(36) owing to the increased number of road traffic accidents and more involvement in sports activities. Arthroscopic ACL reconstruction have become gold standard and open reconstruction have become almost obsolete nowadays.

The arhtroscopic procedure has the advantage of reduced morbidity, reduced incidence of patellofemoral adhesions, decreased anterior knee pain following reconstruction. Arthroscopic also has a techinal advantage of better visualisation of intraarticular structures and helps in accurate placement of tunnels. Cyril b Frank(37) reported that arthroscopic reconstruction have better functional outcome in short term but the outcomes are not significantly different in long term. Our study is to evaluate the functional outcome of arthroscopic single bundle ACL reconstruction with quadrupled Hamstring graft with transtibial technique using endobutton as femoral fixation device and titanium interference screw as tibial fixation device.

In our study fall and road traffic accidents predominated as the cause of injury accounting for 47% and 43% respectively. Sports injuries accounted for only 10% in contrary to all international studies. DW Lewis reported 58% meniscal injury associated ACL tear at presentation .Medial meniscus was involved more than the lateral meniscus in his study and he also proposed meniscal repair or resection did not alter the outcome and chondral lesions are a better predictor of funtional outcome. The graft choice was of great debate in the recent years. The graft options include bone patellar tendon bone graft, Hamstring graft, Quadriceps tendon graft, allograft, and synthetic grafts. Bone patellar tendon bone graft has been gold standard until recent past as many studies supported patellar tendon graft for its strength and direct bone to bone healing providing early stability. But recent development and advancement in soft tissue fixation devices studies have proven hamstring grafts to be superior in strength and avoiding extensor mechanism disruption<sup>(1)</sup>

In our study we used trans tibial single bundle reconstruction with quadrupled hamstring graft placing the femoral tunnel between 10 30 and 11'o clock position in the right knee and between 1'o clock and 1 30 position in the left knee. John Paul<sup>(51)</sup> proposed that placing graft at 10 30 position and 1 30 position in single bundle reconstruction reconstructs portions of anteromedial and posterolateral bundlesIn our study 83% good to excellent results were achieved,10% fair results and 6.6% poor results were documented. Lewis et al reported 81% good results in his review article which showed 19% patients had positive pivot shift post operatively. In our study 33% patients presented with 5 degree extensor lag, 16% had minimal anteroposterior laxity. Overall patient satisfaction was good in 27 patients. Riley J Williams<sup>(55)</sup> reported 8% extensor lag and 11% positive lachmans and positive pivot shiftSince our study was a short term follow up we could not comment about the arthritic changes post operatively. Fox et al reported 3 to 17% incidence of anterior knee pain, compared to 13% in our study, Apostolopoulos(58) reported 10% of anterior knee pain. Kurt Spindler<sup>(59)</sup> stated regular exercise can lead to increased outcomes in 2005. Our patients are put on home based phys iotheraphy programe insisting on knee flexion and quadriceps strengthening and mean flexion achieved was 135 degree.J A Grant<sup>(60)</sup> concluded that home based physiotheraphy is cost effective and not significantly inferior to supervised programmes. As overall conclusion several factors influence the functional outcome in arthroscopic ACL reconstruction. Factors like graft choice, graft fixation, tunnel placement and graft tensioning play a vital role in altering the final outcomes.

#### CONCLUSION

The technique of quadrupled semitendinosus autograft for ACL reconstruction using the Endobutton for femoral fixation and interference screws for tibial fixation has little morbidity, low reoperation rate and excellent clinical results With modern surgical and fixation devices, excellent clinical results can be obtained with quadrupled hamstring grafts The principles of surgical technique, graft fixation and postoperative rehabilitation are more important than the graft choice in anterior cruciate ligament reconstruction.

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