International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(3): 139-144

www.orthopaper.com
Received: 25-05-2018
Accepted: 26-06-2018

J Thiyageswaran
Department of Orthopaedics, Meenakshi Medical College Hospital and Research Institute, Enathur, Kancheepuram, Tamil Nadu, India

Waseem Ansari
Department of Orthopaedics, Meenakshi Medical College Hospital and Research Institute, Enathur, Kancheepuram, Tamil Nadu, India

K Arul Vignesh
Department of Orthopaedics, Meenakshi Medical College Hospital and Research Institute, Enathur, Kancheepuram, Tamil Nadu, India

MC Aravind
Department of Orthopaedics, Meenakshi Medical College Hospital and Research Institute, Enathur, Kancheepuram, Tamil Nadu, India

Correspondence
J Thiyageswaran
Department of Orthopaedics, Meenakshi Medical College Hospital and Research Institute, Enathur, Kancheepuram, Tamil Nadu, India

Comparative outcome analysis of arthroscopic transportal and transtibial ACL reconstruction with quadrupled or tripled hamstring graft

J Thiyageswaran, Waseem Ansari, K Arul Vignesh and MC Aravind

DOI: https://doi.org/10.22271/ortho.2018.v4.i3c.25

Abstract
Background: 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.
Aim and objective: To compare the functional outcome analysis of arthroscopic transportal and transtibial ACL reconstruction with quadrupled or tripled hamstring graft done at Meenakshi Medical College, Enathur, Kanchipuram.
Materials & Methods: A prospective study of 60 cases of arthroscopy assisted transportal and transtibial anterior cruciate ligament reconstruction with quadrupled hamstring tendon graft using endobutton as the femoral fixation device is followed for 6 months to 1.5 years. The mean follow up is 10.5 months. All patients are evaluated with Lysholm & Gillquist scoring.
Result: Functional result according to Lysholm & Gillquist score in Tranportal was found to be good in 80%, fair in 13.3%, poor in 6.7% and in Transtibial was found to be good in 73.3%, fair in 16.7%, poor in 10%. Poor outcome occurs due to development of complications and old age & medical illness.
Conclusion: The technique of trans portal quadrupled semi tendinosus 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. Lysholm & Gillquist score is good score to evaluate.

Keywords: Outcome analysis, arthroscopic transportal, transtibial ACL reconstruction, quadrupled, tripled hamstring Graft

Introduction
The anterior cruciate ligament (ACL) is one of the most frequently injured structures of the knee joint [1]. Anterior cruciate ligament has a pivot role in function and stability of the knee joint along with all other ligaments, function as the primary restraint against anterior tibial translation, ACL disruption inevitably causes alterations in knee kinematics which are most likely to result in secondary degenerative changes and long-term functional impairment [2, 3]. As the ACL fails to heal in a manner that would restore normal knee kinematics, reconstructive techniques have been emphasized for patients who desire restoration of knee function and stability as well as return to high-level physical performance [4] and in effect produced increased incidence of premature OA of the knee. One another compelling reason for ACL Reconstruction is by Anderson study which showed that early ACL reconstruction lowered secondary Meniscal tear rate from 27% to 3%. There is also an 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 and reestablish the stability of the joint [4].
Arthroscopic anterior cruciate ligament reconstruction has become the gold standard in management of these injuries. Earlier extra articular 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. The current concept of ACL reconstruction is Transportal anatomic ACL reconstruction. However there is a new found interest in some centers doing double bundle reconstruction, particularly in sports personnel

which is much more technically demanding and with technical advancement in computer-assisted navigation and fluoroscopic placement of tunnels, results have improved in a great way. 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 [5].

Materials and Method

Inclusion Criteria

- Skeletally mature
- Clinical and MRI evidence of ACL tear, single bundle and double bundle tear.
- Grade 2 and 3 injuries.
- Willingness to participate in the study.

Exclusion Criteria

- Skeletally immature.
- Grade 1 injuries.
- 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.

Implants

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 option in tibia are interference 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 used to flip the endobutton. Endobutton was stronger than RCI screw and BIO screw in withstanding cyclical loads and has a greater advantage of not lacerating the soft tissue graft.

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 screw 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 graft have shown comparable results with that of interference screw fixation of bone patellar tendon bonegraft.

Standard Portals

- Antero-lateral(AL)
- Antero-medial(AM)
- Postero-medial(PM)
- Supero-lateral(SL)

Optional Portals

- Postero-lateral portal
- Proximal midpatellar portal
- Central transpatellar tendon portal.

Methods

Pre-Operative Work Up

Patients with ACL tear proven clinically wih above mentioned tests and radiologically with MRI are admitted in department of Orthopaedics and Traumatology. Routine investigations like hemoglobin, Total and Differential counts, Platelet count, ESR, Blood sugars, Renal parameters, Chest xray, ECG were taken and anesthetist assessment for regional and general anesthesia was done. Static and dynamic quadriceps exercise was taught to patient while awaiting surgery. Postoperative physiotherapy awareness will be given.

Anaesthesia and Patient Positioning

All patients are operated under spinal anesthesia. In supine position under anesthesia Anterior drawer test, Posterior drawer test, Lachmans test, pivot shift test are done. With patient supine and close to the edge of the bed and knees are flexed to 90 degrees and a removable side support is placed in the side of the table to support the ipsilateral thigh, a foot stopper is placed beneath the foot after flexing the knee to 90 degrees. In all the cases a pneumatic tourniquet is used which is placed in the upper thigh after soft padding. The limb is shaved around the knee joint and prepared with betadine pre-scrub. Limb is draped exposing the knee joint lower thigh and upper leg after painting the limb with betadine. A pre-operative antibiotic usually 1g cefuroxime is given before inflating the tourniquet and limb is held upright for 3 minutes to exsanguinate the limb before inflating the tourniquet.

Arthroscopic Approach

An anterolateral portal is established 1 cm lateral to the patellar tendon midway between the inferior pole of patella and the upper end of 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 visualizing Suprapatella pouch and patellofemoral joint, Lateral gutter, Intercondylar notch, Articuar surface of patella, Medial gutter and articular surface of femur and tibia, Medial gutter, Medial compartment-ACL visualized here, Posteromedial compartment, Lateral compartment, Lateral gutter and posterolateral compartment. 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 ed of the tibia. The meniscus are visualized and probed to reveal meniscal tear. Anterior cruciate ligament is probed to analyse the amount of tear [6, 7]. If unstable meniscal injuries are found they are treated with partial menisectomy and debridment depending on the site and type of the tear.

Graft Harvest and Preparation

Oblique incision of 2 to 3 cm is placed over the anteromedial aspect of tibia exactly over the site of pesanserinus 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 [8, 9]. 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.

Tendons insert in oblique fashion, and are more horizontal than vertical. The gracilis tendon insertion is superior to the semitendinosus tendon insertion, but both tendons converge at the pes anserine [10]. Alternatively, the tendons are exposed from their deep side if their insertions are sharply reflected off the tibia.

Then the tendons are whipstitch with 1 vicryl near their insertions and the tendons are detached from their insertions one by one as long as possible. Both tendons are mobilized and all tendinous slips are freed. Holding the vicryl tied to the tendon a closed tendon stripper is inserted. The stripper is carefully advanced with knee in 70 degree flexion and undue care is taken to prevent the amputation of the graft. 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 nonabsorbable number 2 suture materials (Ethibond). Manual tensioning of the tendon is done and the tendons are passed through the loop of the endobutton so that the tendons are quadrupled for reconstruction. The free ends of the combined gracilis semitendinosus tendons are again whip stitched with a 5 number ethibond. Then the graft size is measured with a sizer by pulling the graft through it and the graft is kept aside rolled in a moist cotton gauze pad.

Intraarticular Preparation

The scope 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 remnants 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.

Femoral Tunnel

The femoral tunnel is created by transtibial IN 30 cases technique in our study. The femoral offset guide in placed through the medial portal, and placed in the intercondylar notch at 1'O clock position for the left knee and 11'O clock position for the right knee [11]. The 7 mm offset aimer is placed so that it is placed over the posterior edge of the notch to avoid blow out and to leave at least 2mm of intact posterior cortex. If the graft diameter is greater than 10mm then the offset guide may need to be placed little more anteriorly to avoid posterior blow out. Having placed the aimer the long drill tip guide wire is drilled through the lateral femoral condyle to exit in the anterolateral aspect of the lower thigh. In 30 cases transportal technique was used to create femoral tunnels. femoral tunnels created at 2 o clock position for left knee and 10 o clock position for right knee

The intrarticular length of the graft is measured and the lateral femoral condyle is drilled with 4.5 mm reamer until the anterolateral cortex is breached to create a passing tunnel for the endobutton.

After reaming the lateral condyle the length of the femoral condyle is measured with a depth gauge. Having known the intra articular length of the graft and the whole length of the graft, the length of the graft to be in the femoral condyle can be desired and marked, which is usually the half the length of the remaining graft after subtracting the intraarticular length from the total length. Having known the length of the femoral condyle and the desired graft length in the femur, the loop length to be adjusted in the endobutton is calculated and the loop is created or a adequate length looped endobutton CL ultra is chosen. The femoral condyle is reamed with a appropriate size reamer as of the graft to a length of around 5 to 6 mm greater than the desired graft length for the turning radius of the endobutton. The tunnel is smoothened with a rasp or the shaver blade and the soft tissue interposition for the graft passage is removed adequately [12].

Tibial Tunnel

The tibial guide or the guide pin targeting tibial jig is used to create the tibial tunnel. The guide is set at 55 degree or by N+7rule where N is the effective length of the tendon. With the guide set in 55 degrees the tip of the guide pin is positioned in the ACL foot print in the posterior half. The guide can also be placed using various land marks like posterior rim of the anterior horn of the lateral meniscus, anterolateral part of the medial tibial intercond,ylar eminence,8 mm anterior to the posterior cruciate ligament, and posteromedial aspect of ACL foot print.

After establishing the proper position of the guide tip the guide pin sleeve is inserted and advanced to the anteromedial part of the tibia. The guide pin sleeve is flushed with the anteromedial cortex of the upper tibia midway between the tibial tuberosity and the posterior border of the proximal tibia. The guide pin sleeve is inserted and advanced through the incision made for harvesting the graft by retracting the skin edges. Before drilling the tibial tunnel the arm of the tibial guide is ensured to be parallel with the tibial plateau. Then the 2.4mm drill tip guide wire is drilled through the tibial cortex to exit intra articularly which is visualized with the arthroscope. When the 2.4 mm drill tip guide wire had been exactly placed intra articularly the tibial guide and the guide sleeve is removed. Serial reaming of the tibial tunnel over the guide pin is done with cannulated calibrated reamers up to the desired size of the graft. During all these drilling a small curved curette is placed intra articularly to prevent the tip of the guide pin or the reamers from damaging the articular surface of the joint. Once the tibial tunnel has been created the posterior end or the intra articular exit of the tibial tunnel is shaved of the soft tissues and bone particles from obstructing the graft passage. Even a sharp dissection can be used for this purpose and a rasp is used to smooth the tunnel walls for easy graft passage and to avoid graft damage.

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 anteromedial port and pulled through the tunnel and extracted along with the suture material in the lateral aspect of the distal thigh. The looped suture s visualized within joint and retrieved through the tibial tunnel with grasper. 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 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 [13].

Closure

Lachman's test is performed and the complete range of movements assessed. Anteromedial periosteal flap is closed and the remaining wound closed in layers with graft site 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

- Immobilization in knee braces and limb elevation immediate post operatively.
- Intravenous antibiotics for 3 days.
- Drain removal on 2ndPost operative day.
- Wound inspection on 2, 5, 7 Postoperative day.
- Suture removal on 12th Postoperative day.
- Gradual physical rehabilitation.
- Follow up at 4, 8 weeks and 3,6 months.

Rehabilitation

Post Operative Rehabilitation

Immediate weight bearing after acl reconstruction is beneficial as it lowers patello femoral pain without increased anterior knee laxity and resulted in better outcome.

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.

1st Postoperative day

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

0 – 2 Weeks

- Full knee extension ROM.
- 90 degrees knee flexion ROM.
- Strong QS/SLR without extension lag.
- Emphasize normal gait pattern.
- Passive, active, and active – assisted ROM knee flexion.
- Partial weight – bearing 50% to 75% with walker or weight-bearing totolerance 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.
- END OF 9 MONTHS;
- Return to sports;

Criteria

- Motion>130 deg
- Hamstrings>90% of normal strength.
- Quadriceps>85% of normal strength.
- Maintenance exercises are recommended 2-3 times per week

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 thereafter.

All patients are evaluated with Lysholm & Gillquist scoring.

Appendix

Knee Scoring Scale of Lysholm & Gillquist

Limp

None - 05
Slight /periodic or both - 03
Constant or severe or both - 00

Support

None - 05
Cane or crutch - 02
Weight bearing impossible - 00

Locking

No locking or catching sensations - 15
Catching, but no locking sensations - 10
Locking –occasionally - 06
Locking –Frequently - 02
Locked on examination - 00

Instability / Giving Way

Never - 25
Rarely during athletic activity or any other heavy exertion - 20
Frequently during athletics or any other heavy 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
No problems - 05
Slightly impaired - 04
Knee flexion possible only up to 90 degrees - 02
Impossible - 00

Results

Observation

Total 60 cases of arthroscopy assisted transportal and 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, patients had injury in the right knee and patients had injury in the left knee.

Table 3: Side involved

Diagnosis	Patients	Percentage
Right	32	53.4
Left	28	46.6
Total	60	100.0

Mode of Injury

Mode Of Injury	Patients	Percentage
Sports	16	26.7
Fall	22	36.6
Rta	22	36.7
Total	60	100.0

Duration of Injury

Duration After Injury	Patients	Percentage
<6 Weeks	12	20
6 Weeks To 3 Months	10	16.6
3 -6 Months	14	23.4
6-12 Months	14	23.4
>12 Months	10	16.6
Total	60	100

Results

Outcome	Transportal	Transtibial
Good	80%	73.3%
Fair	13.3%	16.7%
Poor	6.7%	10%
Total	100%	100%

Conclusion

- The technique of trans portal quadrupled semi tendinosus 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.
- Endobutton did not seem to have any superiority of results when compared with the usage of a standard titanium RCI screw.

References

1. Butler DL, Noyes FR, Grood ES. Ligamentous restraints to anterior- posterior drawer in human knee. A biomechanical study. J Bone Joint Surg Am. 1980; 62:259-70.
2. Haimes JL, Wroble RR, Grood ES, Noyes FR. Role of medial struc-tures in the intact and anterior cruciate ligament deficient knee. Limits of motion in the human knee. Am J Sports Med. 1994; 22:402-409.
3. Satku K, Kumar VP, Ngoi SS. ACL injuries. To counsel or to oper-ate? J Bone Joint Surg Br. 1986; 68:458-61.
4. Howe, Johnson, Kaplan. ACL reconstruction using quadriceps patellar tendon graft. Part I. Long term follow up. Am J of Sports Med. 1991; 19:447-57.
5. Fu FH, Bennett CH, Ma CB. Current trends in anterior cruciate ligament reconstruction: Operative procedures and clinical correlation. Am J of Sports Med. 2000; 28:124-130.
6. Hey Groves EW. Operation for the repair of cruciate ligament. Lancet, 1917; 2:674-675.
7. Campbell WC. Repair of the ligaments of the knee: Report of an operation for the repair of the anterior cruciate ligament. Surg Gynecol Obstet. 1936; 62:964-968.
8. Kurosaka M, Yoshiya S, Andrish JT. Abiomechanical comparison of different surgical techniques of graft fixation in anterior cruciate ligament reconstruction Am. J Sports Med. 1987; 15:225-229.
9. Dyson L, Hamner MD. Hamstring Tendon Grafts for Reconstruction of the Anterior Cruciate Ligament: Biomechanical Evaluation of the Use of Multiple Strands and Tensioning Techniques. The Journal of Bone and Joint Surgery, Incorporated. 1999; 81-A:4.
10. Petteri Kousa MD, Teppo LN, Ja¨rvinen MD. PhD The Fixation Strength of Six Hamstring Tendon Graft Fixation Devices in Anterior Cruciate Ligament Reconstruction.
11. Rosenberg TD. Technique for endoscopic rnethod of ACL reconstruction Technical Bulletin. Mansfield. MA. Acufex Microsurgical, 1993.
12. Rubinstein RAJ, Shelbourne KD. Graft selection,

placement, fixation and tensioning for anterior cruciate ligament reconstruction. Operative Tech Sports Med. 1993; 1:10-15.
13. Harvey MBBS, FRCS (Tr & Orth), Thomas NP. BSc, FRCS (Hons), Fixation of the graft in reconstruction of the anterior cruciate ligament 10.1302/0301-620X.87B5.15803J Bone Joint Surg Br. 2005; 87-B(5):593-603.