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Orthopaedics

STUDY ON FUNCTIONAL OUTCOME WITH VARIOUS GRAFT FIXATION OPTIONS IN ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract:

Background: Anterior Cruciate ligament reconstruction (ACLR) is one of the most commonly performed surgery in orthopaedics nowadays. Results are dependent upon an early postoperative physical therapy program that stresses early motion. Early rehabilitation demands rigid intraoperative mechanical fixation of the graft since therapy begins prior to biologic incorporation of the graft in the bone tunnels. Regardless of the graft substitute chosen, many methods of fixation are available. The "best" fixation technique depends upon several factors including graft choice and surgeon comfort..

Objective: The study was done to evaluate the functional outcome of arthroscopic ACL reconstruction using hamstring graft fixed with various modes of fixation.

Materials And Methods: This study was conducted in department of orthopaedics of Govt. Mohan Kumaramangalam Medical college and hospital. 30 cases with anterior cruciate ligament tear were treated with arthroscopic reconstruction with quadrupled semitendinosus and gracilis graft using various graft fixation options like both femoral and tibial side aperture fixation (10 cases),both sides suspensory fixation (10 cases) and Hybrid fixation (10 cases) with endobutton on the femoral side and interference screws on the tibal side. Patients were assessed for the functional outcome using Tegner Lysholm score.

Results: Patients who underwent Hybrid fixation using endobutton on the femoral side and interference screw on the tibial side had better fuctional outcome using Tegner Lysholm score.

Conclusion: Hybrid fixation using endobutton on the femoral side and interference screw on the tibial side provides secure fixation and better functional outcome when compared to other methods of fixation.

Key words: *Anterior cruciate ligament,quadrupled semitendinosus and gracilis graft.*

Introduction

ACL reconstruction (ACLR) is one of the most commonly performed surgery in orthopaedics nowadays .The popularity of this procedure is based upon its ability to allow an individual to return to his/her pre injury level of activity that would otherwise not be possible. A critical component during reconstruction of a ligamentously unstable knee is an early rehabilitation protocol which stresses immediate full range of motion, strengthening, neuromuscular coordination, and early weight bearing. This protocol demands rigid fixation of the graft substitute in order to withstand the stresses of early rehabilitation. The graft and fixation links must provide rigid mechanical fixation from time zero until biologic incorporation of the graft into the bone tunnels. During this interval, the intraarticular portion of the graft as well as the portion within the bony tunnels undergoes tremendous biological activity and remains susceptible to injury. The knee must be protected while simultaneously achieving advances in range-of-motion, coordination, and strength. It is not clear when the graft becomes fully integrated into the bone tunnels, or even when it is safe to allow return to full activity, however Sharpey's fibers have been identified as early as 6 weeks in histological bone in bone models [3]. Therefore, a time interval of unknown duration exists between time zero (when graft fixation is the weakest link) and adequate biologic incorporation of the graft into the tunnel (when the graft substitute tissue becomes the weakest link of the construct). The duration of this period is unknown, but is longer for soft-tissue grafts than for grafts with bone plugs. During this interval, laboratory pullout studies demonstrate avulsion of the graft from the tunnel. However, as biologic incorporation is allowed to proceed, increasing failure strength is demonstrated with increasing time indicating histologic incorporation and a shift of the weak link from the graft-fixation-tunnel interface to the bone/ligament interface, then to the interstitial portion of the graft . During the postoperative period, the maximum loads to the graft substitute construct are provided by rehabilitation. These loads should be less than or equal to the graft fixation strength achieved in the operating room, at time zero. In cases where the surgeon is concerned about poor fixation, the rehabilitation program should be customized to the fixation. Fixation methods available today involve securing soft tissue or bone plugs within a bone tunnel via fixation within the tunnel or distally, on the cortex. Many such methods and implants are available to optimize graft fixation. Although laboratory studies demonstrate significant differences between various methods, excellent clinical results may be demonstrated with a wide range of options .

Therefore, the techniques that are employed depend greatly on surgeon ability/knowledge and graft selection. The ideal fixation technique provides rigid fixation (abundant strength and stiffness) at the anatomic footprint of the native ACL at the articular surface, provides no inflammatory response, facilitates biologic incorporation of the graft into the tunnel, and does not hinder future procedures or investigative techniques. Without a perfect fixation option, an exploration of advantages and disadvantages of available options is warranted.

Materials And Methods:

The study was conducted on 30 patients who undergone arthroscopic ACL reconstruction using quadruple hamstring tendon autograft at the Department of Orthopaedics, Govt. Mohan Kumaramangalam Medical College and Hospital,Salem between the period of Jan 2014 to Dec 2016.

Inclusion Criteria:

1) Age: 20 to 50 years
2) Complete anterior cruciate ligament tear confirmed clinically and radiologically on MRI.
3) Associated Meniscal injuries
4) Duration of injury more than 6 weeks.

Exclusion Criteria:

1) Age <20 years and > 50 years
2) Multiligamentous Injury
3) Previous ligamentous injury in the same knee joint.
4) Bilateral ACL injury.
5) Any other comorbid condition of the same knee joint such as osteoarthritis of knee, local infection etc.

A detailed general and physical examination was carried out followed by radiographic investigation.

Diagnosis:

History.

Physical examination.

Radiology: Roentgenogram and MRI.

History

Nature of injury.

Mechanism of injury.

Duration since injury.

Pain: onset, duration, location and the site of maximum pain.

Effusion: onset, duration.

Stiffness.

History of giving way (instability).

Locking.

Associated injuries.

Primary treatment if any.

Past medical illness if any.

3.2 Physical Examination

Gait.

Tenderness.

Effusion of the knee joint.

Wasting.

Range of movements.

Patellar tracking.

Signs of instability of the anterior cruciate ligament.

Anterior drawer test.

Lachman test.

Pivot shift test.

Tests for associated ligamentous injuries

Diagnostic arthroscopy before the graft harvesting to confirm the nature of ACL injury and associated injuries at the same setting as ACL reconstruction.

Steps of Surgery

1. Position of the Patient and Draping

2. Marking of the Landmarks

3. Diagnostic Arthroscopy

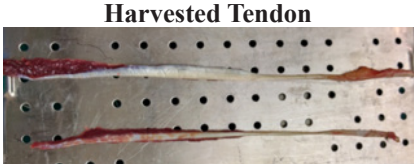
Diagnostic arthroscopy was done through standard medial and lateral parapatellar portals. Diagnosis was confirmed.

4. Harvesting of Graft

Semitendinosus harvest is accomplished with knee in 90 degrees of flexion. A 4-5 cm longitudinal incision is made over the pes tendon beginning 2-3 cms distal to the joint line and 1 cm-2 cm medial to the tibial tuberosity. The sartorius aponurosis is identified and semitendinosus tendon are palpated. The sartorius apponeurosis is incised in line with its fibers distal to underlining semitendinosus tendon. Using digital palpation the semitendinosus tendon is identified and with the help of right angled forceps isolated from the gracilis tendon. Connecting bands are carefully freed from semitendinosis tendon and harvested with tendon stripper. Same procedure is repeated for gracilis tendon. Inspection of superficial part of medial collateral ligament is carried out.

5. Graft Preparation

Harvested Tendon



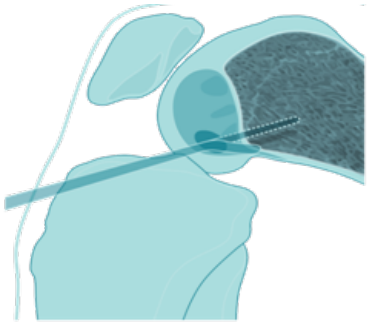
Prepared Graft

It is preformed on graft preparation board. Overall tendon length is measured. Each tendon ends are prepared with no.5 ethibond with whipstitch. The two graft are doubled over readymade endobutton and quadrupled graft diameter and length is determined. The graft is kept moist wrapped in a wet sponge to prevent dissecation.

6. Identification of the ACL Footprints

The scope was re-inserted and torn ACL substance was shaved off. The ACL footprint on tibial and femoral side was identified. Remnants of the ACL were preserved at the footprint sites as identification landmark for the graft insertion and also to help proprioceptive stimulation.

7. Femoral Tunnel Drilling by Medial Portal (Anatomic Femoral Tunnel) Technique

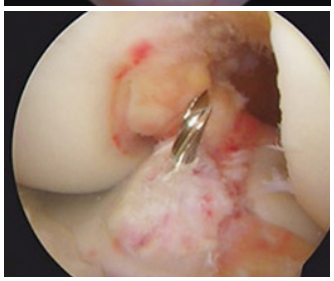


With knee in 90 degrees flexion, an additional medial portal was created about 2/3rd medially across above the

medial meniscus. A spinal needle was used to determine the exact location and to avoid accidental insertion of the medial meniscus.

Knee was then flexed maximally to > 120 degrees with leg on the operating table. This femoral tunnel is made via femoral aimer through anteromedial portal technique with a Endoscopic reamer. Depth of the femoral tunnel is measured and appropriate loop size of Endobutton is selected. The femoral tunnel was then over drilled with required diameter femoral drill. 10 mm additional length apart from femoral tunnel graft length was drilled with the same diameter femoral drill for allowing flipping of Endobutton.

8. Tibial Tunnel Drilling



The tibial footprint identified and an ACL tibial jig with an angle set to 55 degrees was used to pass a guide wire up to the medial tibial metaphysis into the joint. The tunnel was enlarged with an appropriate reamer.

9. Graft Loading and Passage

A No. 5 ethibond leading suture loop was passed through the medial portal in to femoral tunnel laterally. This retrieved out of the tibial tunnel. The prepared graft was loaded with appropriate Endobutton, the leading and trailing sutures and was passed over the No. 5 Ethibond suture.

10. Femoral side fixation Endobutton

Graft was fixed on the femoral side by endobutton/interference screws,.

11. Tibial Side Fixation Suture Disc

Titanium Interference Screws

Bio Screws

The tibial side fixation was performed with an interference screw that was passed up to the tibial tunnel with knee in 15 degrees of flexion with a posterior drawer given for applying tension distally. The size of the interference screw was generally 1 mm more than the diameter of the tibial tunnel in case of bioscrew whereas in case of titanium screws it is equal to that of diameter of tibial tunnel.

Excess graft coming out of the tibial tunnel was excised.

12. Postoperative Protocol

A long knee brace was applied over a padded compression dressing. Patient was subsequently discharged on 3rd post-operative day. Suture removal was done on post-operative day 12 if the wound was healthy. Patient was asked to follow up on 2nd, 4th and 6th post-operative months. We followed accelerated ACL rehabilitation protocol[2].

Pre-operative and post-operative scoring according to Tegner–Lysholm scoring system was done and records maintained[5].

Pre-Operative Tegner–Lysholm scoring

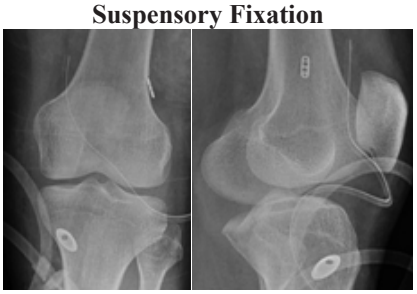
Knee Score	No.of Patients
Excellent	Nil
Good	Nil
Fair	17
Poor	13

Post-Operative Tegner–Lysholm scoring

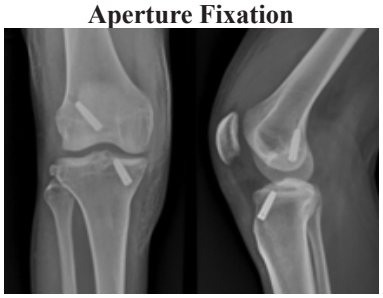
Knee Score	No. of Patients	Patients Who Underwent Aperture Fixation	Patients Who Underwent Suspensory Fixation	Patients Who Underwent Hybrid Fixation
Excellent	24	6	8	10
Good	6	4	2	Nil
Fair	Nil	Nil	Nil	Nil
Poor	Nil	Nil	Nil	Nil

Patients who had hybrid method of fixation returned to preinjury level of activity earlier when compared to other method of fixation.

Suspensory Fixation

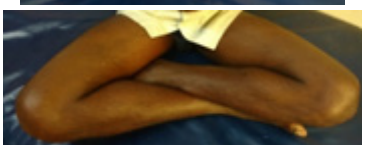


Aperture Fixation



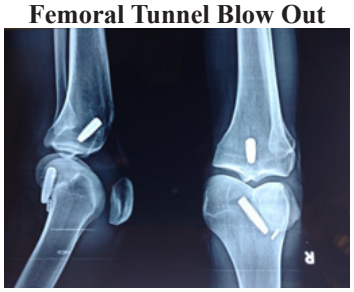
Hybrid Fixation

Functional Outcome-No Difficulty In Squatting,Sitting Cross Legged



Complications:

Femoral Tunnel Blow Out



Femoral tunnel blowout occured in two patients and two patients had numbness over the anteromedial aspect of leg and foot.Apart from that there where no major complications in our study.All patients returned to pre injury level of activity 6 months to 1 year after surgery.

Discussion:

Various fixation methods have been described for ACLR. They can be classified into aperture fixation and suspensory methods. The aperture fixation methods like the interference screws allows for early firm fixation and heal with tight bone-tendon interface[4]. The suspensory methods can be sub-classified into cortical, cancellous and cortio-cancellous suspension methods. The cortical suspensory method provides excellent fixation strength, but it has been associated with bungee cord effect and a windshield wiper effect due to the far fixation point from the articular surface. The cortico-cancellous suspension method like the cross pin fixation is said to have strong stability and stiffness due to its rigid fixation. Milano et al in a study comparing the biomechanical strength of different femoral fixation devices for ACLR with QHT graft concluded that the cortical-cancellous suspension fixation seemed to offer the best and most predictable results in terms of elongation, fixation strength, and stiffness.14 For both compression and suspension, cancellous fixation devices attained the weakest fixation. According to their design, cortical suspension devices showed a greatly variable mechanical behaviour.

Pioneered by Dr. Thomas Rosenberg and introduced around 1990, it was the first device specifically designed to hold soft tissue grafts like the hamstring tendons. It is

now the most widely used femoral fixation device for ACLR worldwide. Originally, a Dacron tape was used for connecting the button to the tendon. Since the last decade, this technique of using a dacron tape has been replaced with a continuous loop. This eliminates the need to tie knots and occasionally resulted in the failure of the knot. Due to its biomechanical properties and ease of fixation, EndoButton has now become the gold standard for fixation of soft tissue grafts on the femoral side[1]. Hamstring tendon grafts have become popular over the years due to less graft site morbidity compared to BPTB grafts, particularly in terms of reduced anterior knee pain and their easy accessibility wherein the graft harvesting and tibial tunnel fixation can be carried out with a single incision. They can be doubled, tripled, or quadrupled easily[2,3].

Chen et al, reported that ACLR using a quadrupled hamstring autograft had little graft site morbidity, low re-operation rate, and excellent clinical results. Most orthopedicians appear to favour a QHT[6] graft as it matches the native ACL in terms of strength, stiffness and other biomechanical parameters .Biomechanical studies done by Hamner et al, demonstrated the superior load to failure of the quadruple bundle graft (2,422 N ± 538) when compared with that of the patellar tendon graft (1,784 N ± 580)[5].

In our study we found a significant improvement in the functional outcome of the patients who underwent ACLR with QHT graft fixed with endobutton on the femoral side and interference screws on the tibial side. There was negative Lachman test and pivot-shift test at 2 year follow-up and these results are comparable to the results achieved by various other authors world-wide.

Conclusion:

Arthroscopic ACLR using QHT autograft fixed with hybrid fixation with endobutton on the femoral side and interference screws on the tibial side and an accelerated post-operative rehabilitation program has showed significant improvements in functional scores and helped the patient achieve an early pre-injury status.

The two year follow-up results of ACLR with QHT graft using EndoButton for femoral fixation and bioabsorbable /Titanium interference screw for tibial fixation are excellent when compared with other modalities of graft fixation.

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