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Comparision of different modalities of treatment for ACL tear

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Abstract
Introduction: Knee joint derangement has a phenomenal growth in modern times owing to the immense expansion of industrial development, heavy vehicular traffic with increase in the number of accidents and enormous progress in sports-athletics. The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. Hamstring autografts have gained popularity for anterior cruciate ligament (ACL) reconstruction in recent years primarily due to significantly decreased postoperative pain and morbidity, allowing easier rehabilitation, compared with patellar tendon auto-grafts. The current study is aimed to compare different modalities of treatment of ACL injuries-arthroscopically, open procedure, mini open and pullout suturing
Aim: To compare different modalities of treatment of ACL injuries-arthroscopically, open procedure, mini open and pullout suturing.
Materials and Methods: This was a prospective study where all young and middle aged patients presenting with knee complaints and history of trauma to the knee in the Orthopaedics emergency and out patient department were evaluated by a thorough general and local clinical examination of the knee. The patients were included as per the specified inclusion criteria. The patients were treated using different modalities of treatment of ACL injuries-arthroscopically, open procedure, mini open and pullout suturing. The Post operative assessment was done by Lysholm Knee Score scale.
Results and Discussion: In our study 52% of the patients who were treated with semitendinosus graft gave Excellent results on Lysholm Grading Scale and 55% of the patients who were operated with Quadriceps graft showed Excellent Grading on Lysholm Scale which means there is no statistical difference between outcome of ACL reconstruction and type of graft used. Also there is no significant statistical difference between type of Bundle And outcome according to Lysholm Grading as 55% of those treated with Single Bundle showed excellent results while 44% of those treated with double bundle showed excellent outcome according to Lysholm grading.
Conclusion: Arthroscopic repair in ACL tear shows definitely better results with better outcome as compared to open repair of ACL tear.

Keywords: Modalities, anterior cruciate ligament, open procedure

Introduction

Knee joint derangement has a phenomenal growth in modern times owing to the immense expansion of industrial development, heavy vehicular traffic with increase in the number of accidents and enormous progress in sports-athletics.

The knee joint is the largest articulation in the body. It is most commonly injured because of its anatomic structure, its exposure to external forces and functional demands placed on it.

Increase in number of two wheelers with congested roads, inadequate traffic sense and driving under the influence of alcohol leads to rise in the number of accidents. Increased athletic participation, both competitive and recreational without adequate training has made internal derangement of knee more common. It is also seen in army professionals during physical training.

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. The ACL is the primary restraint to the anterior translation of the tibia but its function is much more than that of a simple checkrein. Along with the PCL, the ACL determines the blend of gliding and sliding between the tibia and femur that characterizes normal knee kinematics [3, 4]. In general, the incidence of ACL injury is higher in people who participate in contact sports, such as basketball, football and hockey.

However, ACL injuries are very commonly seen with road traffic two wheelers accidents. This injury has received a great deal of attention from orthopedic surgeons over the past decades, and is one of the most commonly performed surgeries in the field of Arthroscopy. Hamstring autografts have gained popularity for anterior cruciate ligament (ACL) reconstruction in recent years primarily due to significantly decreased postoperative pain and morbidity, allowing easier rehabilitation, compared with patellar tendon auto-grafts. However, two recently published meta-analyses comparing these two kinds of auto-grafts suggested increased laxity with hamstring reconstruction [1, 2].

The current study is aimed to compare different modalities of treatment of ACL injuries-arthroscopically, open procedure, mini open and pullout suturing. Several studies compared different modern methods of treatment of ACL injuries. Interpreting these studies is difficult because several variables are usually involved, such as graft source, graft construct, or fixation method.

Aim: To compare different modalities of treatment of ACL injuries-arthroscopically, open procedure, mini open and pullout suturing.

Materials and methods

The prospective study was conducted in civil hospital Ahmedabad, Gujarat. All young and middle aged patients presenting with knee complaints and history of trauma to the knee in the Orthopaedics emergency and out patient department of civil hospital, Ahmedabad were evaluated by a thorough general and local clinical examination of the knee. In a relaxed patient and in supine position, the uninjured knee was examined first to establish reference values after which the affected knee was examined and all patients were examined and operated by a single arthroscopic surgeon.

The following specific tests were performed for diagnosing anterior cruciate ligament insufficiency:

1. Lachman test
2. Anterior drawer test
3. Lateral pivot shift maneuver

Injuries to the associated structures were assessed by performing the following clinical tests:-

1. Valgus/ Varus stress test (for collateral ligaments)
2. McMurray‟s test (for menisci& joint line tenderness)
3. Posterior drawer test (for posterior cruciate ligament)
4. Reverse pivot shift test (for Posterolateralcomplex)

Routine skiagram of both knees in standing position in antero-posterior view and lateral view of the affected knee were taken and lateral view in 45 degree of flexion of the affected knee was also done. MRI of the knee was done in cases with equivocal clinical findings. Diagnostic arthroscopic examination of the knees was used as last resort for symptoms suggesting anterior cruciate ligament insufficiency.

Inclusion criteria

The following patients were included

1. Clinical / radiological / arthroscopic evidence of anterior cruciate ligament insufficiency which is symptomatic even after conservative therapy of adequate duration.
2. Young and middle aged, active, motivated patients with future interest in professional / recreational sports or who are involved in vigorous activities, unwilling to change their active life style.
3. A normal contra lateral knee.
4. Associated with medial or lateral meniscus tear may or may not requiring treatment.
5. The acute inflammatory phase of the injury has subsided and full range of motion and good quadriceps strength has been regained with no extensor lag(usually after 4-6 weeks of injury).

Exclusion criteria

The following patients were not included in the study.

1. Patients with bilateral ACL tear.
2. Patients with associated fractures of lower limb and spine.
3. Patients with any other associated ligament injuries of the Knee(complete tear of posterior cruciate ligament, medial and lateral collateral ligament requiring treatment)
4. Patients who underwent ACL reconstruction of both the knees and those with open physis.
5. Patients with articular cartilage lesion exceeding grade.

Mechanism of injury

ACL and PCL injuries are significant events that can occur with virtually any mechanism of injury, if the force is sufficient to cause permanent deformation. As a rule ligaments can stretch to 10-25% of the usual resting length.

Mechanism of injury can either be direct or indirect. Palmer described four mechanisms of injury to the ligament [5].

1. Abduction, Flexion and Internal rotation of femur on tibia.
2. Abduction, Flexion and External rotation of femur on tibia.
3. Hyperextension.
4. Antero-posterior displacement.

Abduction, flexion and internal rotation is the commonest mechanism and if the injury is sever it can result in the “O‟ Donoghue” triad [6] i.e. an injury to ACL, MCL and medial meniscus. Hyperextension is the second most common mechanism of injury to the ACL. Disagreements still exist about the incidence of isolated tears. No single ligament can be disrupted without sustaining some degree of injury to the other supporting structures. The injury to the supporting structure may be minimal and may heal with conservative measures leaving what is apparently and isolated injury of the ACL on clinical examination.

Clinical evaluation of ACL injuries

Despite advances in the technology the main stay in the proper diagnosis and treatment remains the ability to accurately evaluate the patient‟s complaints and perform a thorough clinical examination.

The typical history of an ACL rupture is:

- History of twisting or hyperextension injury
- Pop in the knee at the time of injury
- Inability to continue the previous activity.

De Haven [7], Noyes *et al* have indicated that the ACL is injured in approximately 70% of all knees with acute haemarthrosis. Development of post – traumatic effusion occurs within the first 12-24 hours. Patient with chronic ACL tears present with swelling of the knee with or without effusion, history of giving way, recurrent falls and locking.

Pre operative period

A single dose of a third generation cephalosporin (ceftriaxone; 1 gm) / amoxicillin + clavulanic acid combinations was administered intravenous about ½ hr prior to procedure.

The affected limb was marked pre-operatively.

Patient Preparation

After giving the anesthesia (spinal, epidural or general) patient was placed in supine position on the operating table. The affected knee was examined, doing the relevant clinical tests, now under anaesthesia, to confirm anterior cruciate ligament insufficiency. Pneumatic tourniquet was applied to the operative leg after the limb was exsanguinated. The affected leg was then secured with lateral thigh post, which allows the movement from full extension to full flexion, the foot was also secured and supported. Tibial tubercle, patella, the medial and lateral borders of the patellar tendon and the medial and lateral joint lines were identified and marked.

Types of grafts

There are various types of grafts:

1. Auto grafts
2. Allo grafts
3. Synthetic materials

1. Auto grafts:	2. Allo grafts:
Semitendinosus tendon	Patellar tendon
Gracilis tendon	Semitendinosus
Patella tendon	tendon
	Quadriceps
Quadriceps tendon	tendon
Achillis tendon	Tibialis anterior
Iliotibial band	tendon

- Plantaris tendon
- Tibialis posterior tendon

Allo Graft and Synthetic Graft are not available in India.

3. Synthetic grafts

Most commonly used grafts are:

- Trevira ligament
- Stryker ligament
- Profex ligament
- Carbon fiber prosthesis

Arthroscopy

Arthroscope is introduced and knee is examined systematically in the *'W* sequence, starting from the suprapatellar pouch, then the patellofemoral joint, medial gutter, medial meniscus, intercondylar notch, lateral meniscus and lateral gutter after making high anterolateral portal (Universal). Once all the pathologies are recorded a second anteromedial portal (working portal) is made at 1cm distal to inferior pole of patella just beside patellar tendon. All associated pathologies are dealt with appropriately like partial menisectomy for a meniscal tear that is unstable to probing, chondral defect shaving and removal of loose bodies. A torn ACL is usually visualized as failing to extend to its normal femoral attachment (emptynotch sign). The remaining ACL tissue is removed using the basket forceps.

ACL Bundles

The anterior cruciate ligament is made of a tough, fibrous tissue that spans the knee joint, attaching to the femur (thigh bone) on top, and the tibia (shin bone) below. The ligament itself is made of thousands of individual fibers that together form the ACL. Some of these fibers are organized into distinct bundles. The normal ACL has two primary bundles of fibers.

These bundles are positioned closely together, in some patients with normal ACLs it can be difficult to discern distinct bundles. But we know there are two primary bundles, and each bundle is named for its location. The longer anteromedial bundle is positioned in front of the shorter posterolateral bundle.

Single Bundle ACL Surgery

Most ACL reconstruction surgeries are done using a single-bundle reconstruction. A single-bundle ACL reconstruction uses a tendon graft to replace the torn ACL. Unfortunately, ACL tears cannot be repaired, or sewn together, and a graft must be used to reconstruct the ligament.

When the ACL is reconstructed, the graft is placed in the position of the anteromedial bundle.

Grafts are held in place by making a hole in the bone called a tunnel. One tunnel is made in the femur and one in the tibia. The graft is held in the bone with a fixation device, often a screw.

Double Bundle ACL Surgery

Instead of placing just one larger graft, the double-bundle ACL reconstruction procedure uses two smaller grafts.

Therefore, there are essentially two ligament reconstructions, one for each bundle. The double-bundle procedure requires two additional bone tunnels to accommodate a second graft and one additional incision.

Open Procedure

The procedure uses a medial parapatellar incision extending from one inch distal to the patella to just distal to the tibial tubercle. After drilling of a femoral tunnel, the middle third of the patellar tendon is then incised throughout its length, with the incisions continuing proximally across the patella and into the quadriceps tendon. A saw is then used to cut a triangular block of bone from the superficial cortex of the patella in line with the longitudinal incisions. The articular surface of the patella is not breached. In this manner, a graft consisting of a bone block from the patella and the central one-third of the patellar tendon is created, which is still in continuity with the tibia through the tibial insertion of the patellar tendon. This graft is then passed through the femoral tunnel, embedding the patellar component of the graft within the femoral tunnel, when pulled taut patellar tendon and the skin incision are then closed. Jones reported on 11 patients who underwent this procedure with excellent clinical outcomes.

Criticism of the technique centered around the fact that because the graft was so short, the femoral tunnel had to be drilled at the anterior margin of the notch and not at the insertion of the native ACL. The technique was simple, however, and caused minimal surgical trauma and so gained widespread acceptance.

However after arthroscopic method it is now obsolete.

Mini-open ACL Reconstruction

The ACL reconstruction technique described in this article allows for easy visualization and access to the tibial plateau, intercondylar notch, and posterolateral wall of the femur. The ideal placement of tibial tunnel involves positioning the graft so that it is flush with the roof of the notch when the knee is in full extension. The femoral tunnel is placed posterior in the notch with 1 to 2 mm of bony bridge remaining. There is a straight-line placement of the graft between the tibia and femur with the knee in 30 degrees of flexion. When the graft is harvested from the contralateral knee, patient begin exercises immediately to stimulate to stimulate the graft donor site to regain size and strength. Rehabilitation for the ACL-reconstructed leg emphasizes the return of normal range of motion and limiting a hemarthrosis. This ACL reconstruction technique uses the realiable patellar tendon graft source that has been shown to

provide excellent stability, graft incorporation, and a good return of strength and function.

Pull out Suturing Method (In out in technique)

The modified Bunnell crisscross suture is accomplished with atleast one crossing of the suture within the tendon. Bring the needle out through the cut end of the tendon, and pass it through the tunnel in the bone and out the opposite side of the bone and the skin. Pass the needle through felt and a button, and tie it over the button. Pass the pull-out wire retrograde through the skin with needle.

Post operative assessment was done by Lysholm Knee Score scale [8].

Results

1. Sex Distribution: In our study 76% were Male and 23% were females.
2. Mode of Trauma: In our study maximum patients were injured due to fall.
3. Type of Graft: In our study 65 out of 100 patients were treated with Semitendinosus and Semimembranosus graft while 35 of 100 were treated with Quadriceps graft.
4. Type Of bundle: In our data 62% were treated with Single Bundle Branch.
5. Type of graft and sex distribution: In our study out of 74 males 53 were treated with single bundle and out of 23 operated females 15 were treated with single bundle branch
6. Resultsscore used to evaluate association between post op outcome of ACL reconstruction and anterior laxity. so we have assessed functional outcome after ACL reconstruction by using Lysholm score scale.

In our study 52% of the patients who were treated with semitendinosus graft gave Excellent results on Lysholm Grading Scale and 55% of the patients who were operated with Quadriceps graft showed Excellent Grading on Lysholm Scale which means there is no statistical difference between outcome of ACL reconstruction and type of graft used.

Also there is no significant statistical difference between type of Bundle And outcome according to Lysholm Grading as 55% of those treated with Single Bundle showed excellent results while 44% of those treated with double bundle showed excellent outcome according to Lysholm grading.

When compared the results based on Pivot shift test following

	Pivot shift			
	Normal	**Clunk**	**Glide**	**Gross**
Quadriceps	31	2	3	1
Semitendinosus	50	3	4	2

Discussion

Anterior cruciate ligament is a common occurrence these days due to increased participation in sports and vehicular accidents. Arthroscopic reconstruction of ACL by either Intratunnel or Extratunnel fixation technique is a matter of debate. This study was undertaken to resolve this conflict.

Two meta-analyses have previously evaluated patient outcomes after ACL fixation [9, 10]. Unlike the report of Colvin *et al.* [9] In their review Ilahi *et al.* [10] included only 1 year of follow-up. In the following sections we discuss our findings regarding patient outcome scores, pivot-shift and anterior knee joint laxity tests and study limitations.

In our study 52% patients belonged to the age group of 30-45 years, showing that ACL tear is more common amongst young people who are more active as compared to old people.Results also showed that majority of the injuries were due to fall followed by road traffic accidents. There were 1% patients operated with each open, mini open surgery and the rest 98% operated with arthroscopic surgery.

Manual knee laxity test were performed in all cases of ACL injury. First it was performed in normal knee which was taken as standard of that patient than it was performed in injured side. It was recorded as +, ++, +++ (if positive) and negative.

Anterior Drawer Test, Lachman test and Pivot shift test were positive in all the patients. Briggs *et al.* [10] verified that the Lysholm Knee Scale and Tegner Activity Level scores were psychometrically strong with acceptable responsiveness after ACL treatment. This is why we required these surveys as part of our study inclusion criteria.

Lysholm score used to evaluate association between post op outcome of ACL reconstruction and anterior laxity. So we have assessed functional outcome after ACL reconstruction by using Lysholm score scale.

In our study 52% of the patients who were treated with semitendinosus graft gave Excellent results on Lysholm Grading Scale and 55% of the patients who were operated with Quadriceps graft showed Excellent Grading on Lysholm Scale which means there is no statistical difference between outcome of ACL reconstruction and type of graft used.

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	Pivot shift			
	Normal	Clunk	Glide	Gross
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Semitendinosus	50	3	4	2

According to our study 15% of those treated with Semitendinosus showed abnormal Pivot Shift Test while 16% of those treated with Quadriceps showed Abnormal Pivot Shift Test. This means there is no statistical difference between type of graft and outcome based on Pivot shift test. Similarly in our results we also found that there is no statistical difference between type of Bundle and outcome based on Pivot Shift Test

When compared according to ambulation no statistical difference was found based on type of graft or type of bundle and its outcome in ambulation as in our study 73% of those treated with Quadriceps were ambulatory without support while 78% of those treated with semitendinosus and semimembranosus graft were ambulatory without support similarly 65% of those treated with single bundle type of graft were Ambulatory without support while 83% of those treated with double bundle graft were ambulatory without support.

Conclusion

Biomechanical study suggests that ACL grafts fixed closer to the intra-articular aperture result in more stable constructs. Arthroscopic repair in ACL tear shows definitely better results with better outcome as compared to open repair of ACL tear. Inspite of availability of various grafts for repair of ACL tear no graft shows better result as compared to other as outcome of all

the grafts were similar on follow up. Return to daily activities was also found to be similar irrespective of the type of graft or technique of the graft. However early ambulation without support was achieved In arthroscopically operated double bundle graft as than single bundle graft. Outcome of the operation remains the same on long term irrespective of the technique used whether it is single or double bundle. Outcome of operation had better results with arthroscopically treated patients as compared to open or mini open technique. ACL avulsion injuries treated with any other techniques had similar results with that of Arthroscopic operated ACL avulsion. Arthroscopic technique has better results in terms of faster and better pain relief, better rehabilitation and decreased post op complications.

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