A Prospective comparative Study of the

FUNCTIONAL OUTCOME OF ARTHROSCOPIC ACL RECONSTRUCTION Vs OPEN SINGLE INCISION ACL RECONSTRUCTION

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CERTIFICATE

This is to certify that **Dr. P. KANNAN,** Postgraduate student (2005-2008) in The Department of Orthopaedics, Government Kilpauk Medical College, Chennai has done this dissertation on **"A PROSPECTIVE COMPARATIVE STUDY OF THE FUNCTIONAL OUTCOME OF ARTHROSCOPIC ACL RECONSTRUCTION Vs OPEN SINGLE INCISION ACL RECONSTRUCTION"** under my guidance and supervision in partial fulfillment of the regulation laid down by the Tamilnadu Dr. M.G.R. Medical University, Chennai for M.S. (Orthopaedics) degree examination to be held on March 2008.

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CONTENTS

INTRODUCTION

ACL reconstruction is one of the more common procedure performed with an estimated 100,000 surgical reconstruction performed annually in United States[1]

In the 1980s orthopaedic sports medicine community focused on injury to ACL as major cause of athletic disability and open autograft ACL Reconstructions were thought to require post-surgical protracted immobilization resulted in joint stiffness and articular damage.

During the last 25 years, ACL has been one of the most studied structures in musculoskeletal system[4].

In recent times awareness of the ACL injuries are far reaching and people of all walks of life seek treatment for ACL deficiency indeed most of our patients are from sub-urbs and rural areas around Chennai with awareness and willingness towards ACL Reconstruction.

At International level Internet based review of NLM catalogue in 2005 for key word ACL resulted in 6383 hits, one of its highest signifying its importance[2].

Fate of ACL deficient knee is studied in detail by **Donal c. Fithian** and **'ACL injury cascade'** proposed by **Daniel et al**[3] as

The ACL Injury Cascade

ACL Disruption
↓
Knee Subluxation → Giving Way
↓
Meniscus Injury → Sports Disability
↓
Joint Arthrosis

And in effect produced increased incidence of premature OA of the knee; one another compelling reason for ACL Reconstruction is by **Anderson et al**[3] study which showed ACL Reconstruction lowered secondary meniscal tear rate from 27% to 3%.

Results of arthroscopic assisted ACL Reconstruction with BPTB graft by 18 different authors published from 1990-1998 reviewed by **Jeff. A Fox et al**[6] signified high short term stability rate, extremely high patient subjective satisfaction level and low post –op complication and BPTB graft as the choice by most surgeons especially at collegiate and professional level.

Prospective comparative study by various authors like **Marder et al, Aglilette et al, O Neil et al, Corry et al** [6] showed predictable short term results with few complications in BPTB graft and consistent finding of increased level of activity in patella tendon grafted patients and Quadriceps strength was greater with less tethering of extensor mechanism and accelerated rehabilitation in arthroscopic reconstructed patients.

Recent advances in arthroscopic instrumentation and surgical techniques in incorporating autologous graft and also with advances in both graft fixation and rehabilitation has made the olden days of ACL deficiency damaging a person's knee and his career are gone for sure.

The future direction of ACL Reconstruction are more towards anatomical reconstruction of both anteromedial and posterolateral bundles improving rotational stability is much more technically demanding and with technical advancement in computer-assisted navigation and fluoroscopy placement of tunnels, results have improved in a great way. As **J. C. Imbert**, suggest it is likely that ligament replacements will take the form of **"bio-implants"** produced with the aid of cell and tissue culture techniques. Perhaps, fresh lesions will be made to heal with gene therapy. Research along these lines is currently being conducted at Pittsburgh, US (F. Fu).

In our prospective study we have undertaken ACL Reconstruction with the gold standard BPTB graft the most studied graft through arthroscopy assisted reconstruction and assessed its functional outcome using **Lysholm knee score** and compared it with the study of open technique ACL Reconstruction done earlier in our Institute.

AIM

The aim of our prospective study is to assess the functional outcome of 18 cases of Arthroscopic ACL Reconstruction done over a period of 23 months (January 2006-November 2007) at The Department of Orthopaedics, Government Royapettah Hospital, Kilpauk Medical College, Chennai- 14 and compare it with 18 cases of ACL Reconstruction done by Open technique done earlier in our institution.

HISTORICAL REVIEW

One of the first anatomical descriptions is found in **Egyptian Papyrus Scroll**[2] dating back to as early as 3000 B.C. **Hippocratus**[2] 460- 370 B.C described subluxation of knee in relation to ACL.

Cladius Galen[2] 129 B.C was the first one to name it " **ligmenta genu cruciate"** and was the first to describe ACL as a support structure to the diarthroidal joint and emphasized its role as joint stabilizer and in restricting abnormal motion. **Mayo Robson** was the first man to repair ACL in the year 1895, by direct suturing[8].

Hey Groves[9,10] in 1917 reconstructed ACL, using a proximally based strip of iliotibial band, intraarticularly through femoral and tibial tunnels. This formed the basis of modern technique of intraarticular cruciate ligament reconstruction. **Alwyn Smith**[11] augmented this technique by reinforcing the medial side.

In the period 1920 to 1930, extraarticular stabilization of ACL deficient knee gained popularity.

Bennett[12] in 1926 described an extraarticular procedure of medial capsule plication and reinforcement with fascia. **Mauck**[13] in 1936, described an extraarticular procedure, he advanced the bony tibial attachment of medial collateral ligament distally.

1930s to 1940s saw the resurgence of intraarticular reconstruction of ACL In 1936 **Campbell[14],** used a distally based graft formed by the medial portion of the patella tendon, capsule and quadriceps tendon routed through femoral and tibial tunnels. Semitendinosus tendon graft was used for intraarticular reconstruction by **Macey[15]** in 1939.

1950s to 1960s This period formed the basis for modern ACL reconstruction.

In 1956 **Augustine[16]** described dynamic ACL reconstruction by routing semitendinosus tendon through back of the knee joint, forward through a tibial tunnel. He also emphasized on vigorous muscle strengthening.

O' Donoghue[17] in 1950 described about the "Unhappy triad" which includes rupture of ACL, medial collateral ligament and tear of the medial meniscus. He also emphasized about Hey groves technique.

Jones[18] in 1963 used the central third of patellar tendon with a attached patella bone block to reconstruct ACL. **Lam[19]** in 1968 modified this procedure, by placing the graft in more anatomical position. 1970s was the period during which instability tests and classification was introduced.

Galway[20] in 1972 described about pivot shift sign. **Slocum, Larson and Losee et al [21]** described the variation of pivot shift test.

Hughston et al[22] in 1976 presented standardized terminology and a classification system for knee ligament instabilities. The lachman test was described by **Torg et al**[23]**.** In 1976 **Franke**[24] used the patellar tendon with bone form tibia and patella as a free graft.

Mcmaster and Thompson et al[24] described a reconstructive procedure using the gracilis. **Ellison**[25] in 1979 described a dynamic transfer of iliotibial band, passed underneath the lateral collateral ligament.

1980s saw the refinement of both intraarticular and extraarticular reconstruction techniques.

Insall[26] described an intraarticular transfer using the anterior portion of the iliotibial band with attached bony block.

Clancy et al[27] **in 1982,** combined reconstruction of ACL with one third of patellar tendon and an extraarticular procedure, he also added biceps tendon transfer.

Late 1980's saw the emergence of prosthetic ligament In 1983, **Rushton**[28] used carbon fibre ligament to augment reconstruction **Rodkey, Rubin and Paddu**[29], tested Dacron as a cruciate ligament substitute in 1987 **Bolton and Brickman**[30] developed polytetrafluroethylene (Gore-Tex) prosthetic ACL. In **1988, M. J. Friedman**[14] pioneered the use of an arthroscopically assisted four-

stranded hamstring autograft technique. He was followed, in **1993** (after the 1992 AAOS Annual Meeting in Boston), by **R. L. Larson, S. M. Howell**[19], **Tom Rosenberg**[40] (US), and **Leo Pinczewski**[35-38] (Sydney), who used the pes tendons (semitendinosus and gracilis) in three or four strands, with graft placement in a femoral socket**. Pinczewski** used an "all-inside" technique, with a special large (8 mm) round-headed interference screw, known as the RCI screw. Other leading-edge groups started using hamstring tendons, with different means of fixation. **Tom Rosenberg** devised fixation with the so-called Endo-Button that locked itself against the lateral aspect of the femoral condyle. **L. Paulos** used a polyethylene anchor; **G. Barrett,** a bone graft**; S. Howell and E. Wolf,** cross-pinning; **A. Staehelin,** biodegradable interference screws; **L. Johnson**, a staple; and others, screws and washers

ANATOMY OF ACL

EMBRYOLOGY

The anterior cruciate ligament itself appears as a condensation in the blastoma at about 6.5 weeks[31]. It begins as a ventral ligament and gradually invaginates with the formation of the intercondylar space. It appears well before joint cavitation and remains extrasynovial at all times. **Tena-Arregui et al[34]** performed arthroscopy on the knee of fetuses with a gestational age of 24 to 40 weeks. At these stages two main bundles were already detectable, but the bundles seemed more parallel when compared to the bundle orientation of the adult ACL.

MICROANATOMY

On the ultra structural level, ACL is composed of longitudinally oriented fibrils of mostly Type I collagen tissue ranging from 20 to 170 μm in diameter[31]. Bundles of collagen fibrils make up subfascicular units, which are surrounded by a thin band of loose connective tissue called the endotenon. Many subfasciculi are grouped together to make a collagen fasciculus. The fasciculus is surrounded by epitenon. Surrounding the entire ligament is the paratenon.

GROSS ANATOMY

The narrowest diameter of ACL occurs in the mid substance. The ACL is about 31 to 35mm in length and 31.3 mm^2 in cross section. The synovial membrane covers the ACL; though intraarticular it is extra synovial. Based on its insertion to the tibia, it is divided into three bundles. (1) Anteromedial bundle,(2) Intermediate bundle and (3) Posterolateral bundle

FEMORAL ATTACHMENT

Originates from the posteromedial aspect of the intercondylar notch on the lateral femoral condyle. This is a circular area of 113mm^2 in average, as described by Harner and Co-workers.

TIBIAL ATTACHMENT

The ACL fibres fan out as they approach their tibial insertion, just medial to the attachment of the anterior horn of lateral meniscus. The insertion site is more oval, with an average area of 136mm^2. Insertion sites of ACL are marked by transition of ligament tissue merging into bone, divided into 4 zones[32]

Zone I - Ligament tissue (Collagen)

Zone II - Collagen blending with fibro cartilage

Zone III - Mineralized fibro cartilage

Zone IV - Subchondral bone

BLOOD SUPPLY

Mainly from the middle genicular artery, which leaves the popliteal artery and directly pierces the posterior capsule, branches from the artery form a periligamentous plexus within the synovial sheath; inferior, medial and lateral genicular arteries also contribute through the fat pad.

The osseous attachment of ACL contributes little to vascularity[33].

NERVE SUPPLY

By the posterior articular nerve a branch of the tibial nerve.

ARTHROSCOPIC ANATOMY

a. 7mm from the anterior margin of PCL INSERTION is found to be center of postero-lateral fibers
b. Anterior horn of lateral meniscus described to be center of antero-medial fibers.

BIOMECHANICS OF THE KNEE

ACL plays an important role in biomechanics of knee during daily activities by controlling anterior tibial translation, as well as tibial rotation

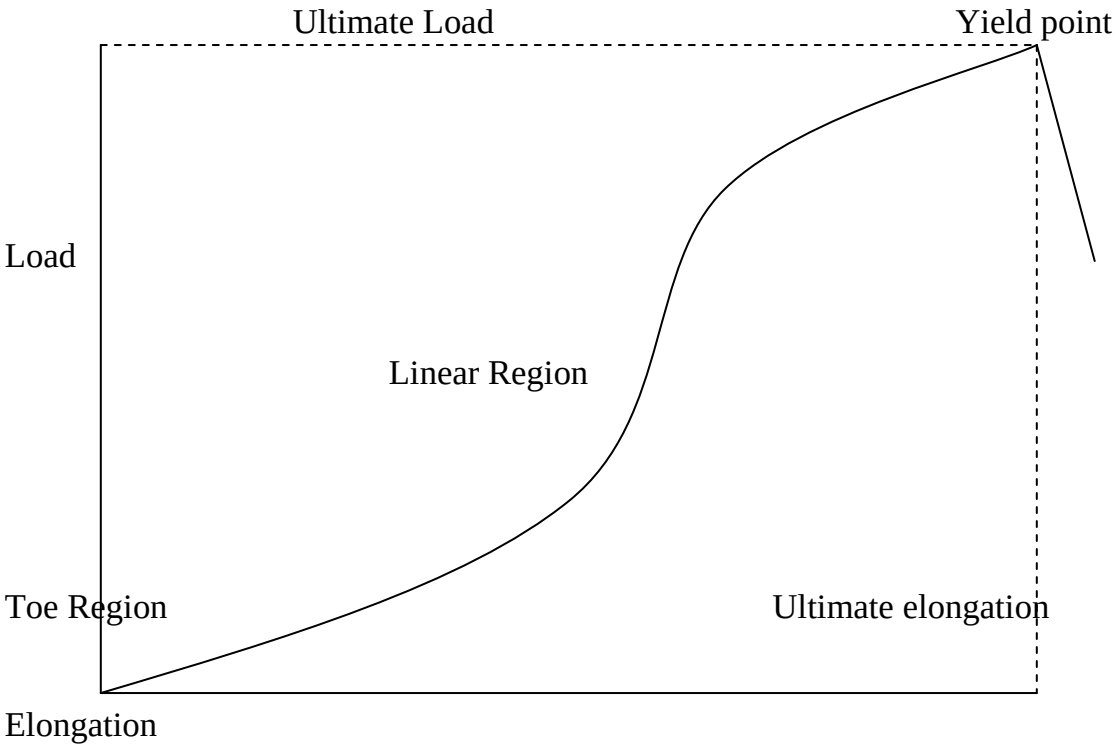
The major complication of the neglected ACL are instability, secondary meniscal injury and early osteoarthritis according to **Thomas p.andriacchi**[35] results primarily due to shift of load from load bearing areas to unconditioned region of cartilage leading to premature breakdown and rapid thinning out cartilage when compared with normal knee and is more pronounced towards medial compartment. The need for normal biomechanics paves way towards understanding the pivotal role of ACL in knee. The function and the biomechanics of ACL can be understood only in conjunction with the entire knee joint which comprises of three independent articulations, one between patella and femur and the remaining two between the lateral and medial tibial and femoral condyles[36].

STRUCTURAL PROPERTIES OF THE BONE LIGAMENT BONE COMPLEX

Initially, title load is required to elongate the ligament. The toe region of the curve characterizes this. The toe region is followed by a second, high stiffness linear region where significantly larger loads are required for continued, elongation, here all collagen fibres are straightened. If loading continues past the

yield point, until which maximum plastic deformation has taken place, the ligament ruptures.

This is described by a load-deformation curve.



MECHANICAL PROPERTIES DURING MUSCLE ACTIVITY

It has been shown that the introduction of muscle activity substantially alters the kinematics of the knee.

QUADRICEPS

The quadriceps muscle forces, causes, strain level in ACL, Largest strain occurs between 5° and 40° of knee flexion.

HAMSTRINGS

The hamstrings negate the increased strains in the ACL caused by quadriceps activity[37].

FUNCTIONS

The ACL holds a key position along with other ligaments in the stability of the knee joint. The function of ligaments as primary and secondary restraint was introduced by butle.

- Primary restraint to the anterior translation of the tibia in relation to the femur.
- Secondary restraint to internal rotation in the non-weight bearing and weight-bearing knee, particularly in full extension.
- Secondary restraint to external rotation and varus-valgus angulations, particularly under weight bearing condition.

MECHANISM OF ACL INJURY

Typical mechanism of injury is rapid but awkward stop and lateral movements, ACL tears in as short as 70 milliseconds following awkward landing. The exact point of ACL failure is just prior to gross valgus[38].

ACL injuries are common secondary to sports injury, RTA, fall etc.

Various forces that lead to ACL rupture are

- External rotation and abduction on a knee at 90° of flexion.
- Complete dislocation of knee.
- A Direct posterior force against the upper end of the tibia.
- Internal rotation of tibia, while the knee is extended.

CLINICAL EVALUATION

Detailed history taking and clinical examination will aid in diagnosing IDK especially ACL deficiency immensely. Histories regarding the actual chronology of events, aided with specific questions regarding mechanism of injury are assessed.

The methodical history includes

- Mode of violence
- Feeling of “pop” inside the knee during injury
- Ability to weight bear/continue play after injury / fall
- Haemarthrosis – highly suggestive of ACL injury
- Nature of treatment like aspiration, immobilization duration etc
- History of pain in knee second common symptom in 61%patients
- History of instability - giving way during level walking, climbing stairs is the most common symptom 65%, according to **pattee et al**[39]
- Clicking during range of movements
- Locking episodes- degree of locking fixed/variable and unlocking mechanism
- Specific expectancy for repair are elaborated.

CLINICAL EXAMINATION

Thorough examination of the knee is done, which includes, inspection, palpation, and instability tests.

Sung-jae kim (1995) et al[40], found in his study of proved ACL deficient patients examined under anesthesia positive for anterior drawer 79.6%, lachman in 98.6%and pivot shift in 89.8%. Thus lachman is most sensitive, pivot also has high sensitivity but is influenced by other factors

Denny t.t.lie(2007)et al[41], showed persistence of pivot shift in reconstructed patients and reliability and usefulness of in vivo pivot shift in assessing kinematics of knee after surgery regarding time-dependent changes influenced by graft tension and surrounding soft tissue healing

LACHMAN TEST

The Lachman test can be useful if the knee is swollen and painful. The patient is placed supine on the examining table with the involved extremity to the examiners side. The involved extremity is positioned in slight external rotation and the knee between full extension and 15 degrees of flexion; the femur is stabilized with one hand, and firm pressure is applied to the posterior aspect of the proximal tibia, which is lifted forward in an attempt to translate it anteriorly. The position of the examiners hands is important in doing the test properly. One hand should

firmly stabilize the femur while the other grips the proximal tibia in such a manner that the thumb his on the anteromedial joint margin. When the palm and the fingers apply an anteriorly directed lifting force, anterior translation of the tibia in relation to the femur can be palpated by the thumb. Anterior translation of the tibia associated with a soft or a mushy end point indicates a positive test.

ANTERIOR DRAWER TEST

Patient in supine position, hip flexed to 45° and knee in 90° flexion with foot placed on tabletop. The patient's foot is sat on to stabilize it and both hands are placed behind the knee to feel relaxation of the hamstrings. The proximal part of the leg is repeatedly pulled and pushed anteriorly and posteriorly noting the movement of tibia on femur. The test is done in three positions of rotation as (i) tibia in neutral, (ii) in 30° of external rotation and with (iii) 30° of internal rotation. The degree of displacement is each position of rotation is recorded and compared with normal knee. Anterior Drawer's sign 6 to 8 mm greater than the opposite knee indicates a torn ACL.

PIVOT SHIFT TEST

Seiji Kubo et al[42], found this clinically very useful and repetitive measurements give data regarding time dependent change in knee kinematics. It is used to assess the "rotational" component of instability associated with an ACL

injury. A positive test result is pathgnomonic of ACL deficiency. The test described by Galway and associates, is based on the subluxation and reduction of the lateral compartment as the knee moves from extension to flexion in patients with an ACL deficient knee. With the knee in extension, the lateral tibial plateau subluxes anteriorly in relation to the lateral femur. A valgus stress is placed on the tibia, as the knee in slowly flexed. At approximately 30° of flexion, the lateral tibial plateau will reduce suddenly, and the abruptness of reduction is noted. The test result is grade O (normal) if no shift is present, grade1 if there is smooth glide during reduction, grade 2 if the tibia is noted to "jump" back into the reduced position, and grade 3 if there is a transient locking of the tibia in the subluxed position before reduction. The accuracy of the test in limited while the patient is awake because of guarding and muscle splinting but improves dramatically with patient under anesthesia**. Nogalski and bach** noted a sensitivity of pivot shift test of only 24% while the patient was awake, which improved to 92% with the patient under anaesthesia, we consider the results of the pivot shift test with the patient under anaesthesia the most important diagnostic element in the assessment of the functional status of the native ACL or ACL graft.

Valgus or Varus stress test,McMurray's test – rule out associated meniscal injuries.With good history and examination, most of the time ACL injury can be diagnosed

ARTHROMETRIC EVALUATION OF THE KNEE

A standard of >3 mm difference on KT1000 testing signifies disrupted ACL *(injured – minus normal difference should be <3mmat 89N and maximums manual force)*, it is an adjunct to the lachman test in assessing anterior translation is the use of instrumented laxity testing. The most commonly used arthrometer is the KT1000. The arthrometer provides an objective measurement of anterior translation of the tibia that supplements the lachman test. The arthrometer is placed in alignment with the joint line, and with two sensor pads on the patella and tibial tubercle, knee is flexed to 30°; anterior force is applied with help of handle, the maximal translation is noted in mm.It is particularly useful in the examination of acute patients and obese patients. It can be also used as a diagnostic tool to assess ACL integrity as a part of follow-up examination after ACL reconstruction. The results of KT1000 and its sibling KT2000 have been noted to be reliable and accurate, but **Tashman et al**[43] (2004) showed restoration of anterior stability measured by KT1000 may not indicate rotational instability

OTHER INVESTIGATIONS

X-ray of the knee: To rule out bony avulsion associated osteochondral fractures, segond's fracture, etc. A true lateral view with knee at 30°of flexion, patella lies between the lines from physeal scar of distal femur and Blumenstaat's line (inter condylar roof) inferiorly and hence patella alta or baja can be determined

MRI OF THE KNEE

–Recent advances as 3-D gradient enable early and chronic cartilage damage with direct signs

Sensitivity is about 92-94%

Specificity is about 95-100%

Saggittal images are most useful in ACL fibre orientation and both attachments

Coronal view shows ACL orientation as “hand in pocket”

Axial view is useful in assessing ACL and PCL in the notch bone contusion, para articular fluid collection and joint capsule

MRI is not accurate in differentiating complete from partial tear or chronic tears.

NORMAL ACL APPEARANCE IN MRI

-Taut with straight anterior margin in saggital view,in knee in extension . If the knee flexed fibres are lax with curved course,

-On mid saggital view ACL is oriented nearly parallel to Blumensaat’s line inclining about 55° from tibial plateau.

INJURED ACL APPEAR

Poor or non-visualization of the ACL on sagittal image.

Amorphous edematous mass with focally increased signal on T_2 weighted image.

Irregular contour with wavy redundant fibres.

INDIRECT SIGNS

Posterior translation of femoral condyles relative to posterior margin of tibia of 7 mm or greater.

Abnormal orientation of fibres in intercondylar notch,failure to parallel its roof in mid saggital views

Buckling of PCL.

Meniscal injuries are present in 41% to 68% more of lateralMeniscus

Takeshi kanamiya et al[45], showed high intensity of ACL graft is caused by Impingement and not indicative of instability

L.Elmans et al[46]showed MRI on par with surgical findings

Byoung hyun et al[44], found Oblique axial images more useful than coronal and sagital slices in evaluating integrity of reconstructed ACL and sufficiency of Notchplasty to prevent impingement.

COUNSELLING

Forms the important part of our protocol, patients are instructed that surgery is to be perceived as a process and not an end event and there is a strict post op regime to be followed to get results.

PHYSIOTHERAPY

Quadriceps and Hamstring strengthening exercise are started, as soon as, the patient is diagnosed to have an ACL deficiency

TYPES OF GRAFT FOR ACL RECONSTRUCTION

According to **Suzane l. miller**[47] (2002) An ideal graft for Anterior Cruciate ligament reconstruction should reproduce the complex anatomy of the ACL, provide the same biomechanical properties as the native ACL, permit strong and secure fixation, promote rapid biologic incorporation and minimize donor site morbidity.

1. AUTOGRAFT:

Graft taken from one's own body.

Bone patella tendon bone graft (BPTB GRAFT),

Quadrupled semitendinosus / gracilis tendons graft (HAMSTRING GRAFT) & Quadriceps tendon with or without proximal patella bone plug are used For ACL Reconstruction .

Patellar Tendon

Pros:

Strongest graft considering its the initial fixation. This is due to the fact that there is bone on each end of the graft that is going into a tunnel in the bone. Physicians have the most experience with using this type of graft. Early return to full athletic participation is quicker (5-6 months).

Cons:

More post-operative pain. Increased chance for patellar tendonitis, Increased chance for a patella fracture, ,Pain and discomfort with kneeling, Extra incision

Hamstring

Pros:

Minimal post-operative pain, Easier rehabilitation, Quicker return to Activities of Daily Living (ADL), Smaller incision

Cons:

Fixation is not as strong initially ,Hamstring weakness

2.ALLOGRAFTS:

Pros:

No harvest morbidity, Faster return to Activities of Daily Living (ADL), Least painful post-operatively, Smaller incision

Cons:

Potential risk of viral transmission. (AIDS, hepatitis).

The chance of AIDS infection from donor graft tissue is 1 in 1.8 Million. Slower return to full athletic activities (6-7 months).

The greatest disadvantage is slower biological incorporation.

The advantages of allograft are no donor site morbidity, because it is from a cadaver, any tissue size specification can be met, reduced operating time, reduced pain and early recovery. Selecting the appropriate graft for ACL reconstruction depends on surgeon's experience, tissue availability, patient activity level and desires.

S.l.miller et al[47], preferred BPTB graft in high demand individuals as choice and allograft for older individuals above 45 years age and those with arthritis and those who do not want their own tissue used and understands pros and cons of allograft

John.A.Feagin et al[48]**,(**1997)showed BPTB graft has better results than hamstring graft if secondary restraints are compromised and also stiffer BPTB graft is preferred in chronic deficiency of ACL.

Freddric.H.Fu et al[49]**,** major advantages of BPTB graft is early R.O.M and controlled endurance & strengthening exercises are better with BPTB graft during post op period.

GRAFT FIXATION

Post operative rehabilitation programs places higher demands on initial graft fixation as it is the weakest link till the graft gets incorporated and is critical during the earlier rehabilitation. Secure graft fixation is essential for the success of any ACL reconstruction. Attainment of rigid graft fixation minimizes or prevents failure or elongation during cyclic loading at the graft fixation sites prior to biological incorporation. Selecting a fixation device depends on the graft used for ACL reconstruction.

BPTB graft:

The fixation devices used for bone patella tendon bone graft are.

Interference screws.

Sutures tied over a button

Suture post

Bio-absorbable screws are gaining popularity as Interference screw fixation for both tibial and femoral tunnel is commonly used, because of higher stiffness and higher ultimate failure load.

Gladstone et al[67] describe that the advantage of their absorption over time facilitates revision if necessary. The screws are replaced with bone as they are

absorbed if not by fibrous tissue which has equal strength as to a metal interference screw.

2. HAMSTRING GRAFT

The various fixation devices used are:

Staples

Screw post and washer

Endo button

Transfix implant used as a cross pin fixation.

Interference screws-poor results.

Tibial fixation can be done with suture post techniques or spiked washer

Strengths of various types of Grafts:

	Ultimate Strength (N)	**Stiffness (N/mm)**	**Cross sec area (mm^2)**
Intact ACL	2160	242	44
B-PT-B	2376	812	32
Quadrupled Hamstring	4108	776	53
Quad Tendon	2352	463	62
Tibials anterior	3412	344	38
Tibialis Posterior	3391	302	48

HISTORY ARTHROSCOPY

Medical endoscopies began in the early 1800s by **Bozzini**. In 1918, **Prof Kenji Takagi**[66] of Tokyo University did the first arthroscopy. It was done in a cadaver knee with a cystoscope.

2000 marks the end of the third decade of arthroscopic surgery, although pioneering work in the field began as early as the 1920s with the work of Dr. **Eugene Bircher**[66] was the first to perform and publish the first arthroscopy on live patients. To begin with, it was used to diagnose tuberculosis, which was more prevalent in those days. Since then the developments in arthroscopy have become many fold

Arthroscopic surgery was begun by a Japanese surgeon **Masaki Watanabe, MD; Dr. O'Connor and Dr. Shahriaree**[66] began experimenting with ways to excise fragments of menisci in the early 1970s. Dr. O'Connor paved the way for arthroscopic surgery and did more to pioneer and develop the techniques of arthroscopic meniscectomy than any other person in North America Together both doctors fashioned the first operating arthroscope and helped to generate and produce the first high-quality color intraarticular photography. **Dr. O'Connor wrote the first book under the title, 'The Arthroscopy'.** Dr. Shahriaree has written three books on arthroscopic surgery titled "The Arthroscopic Surgery".

INSTRUMENTS AND EQUIPMENTS

1. ARTHROSCOPE

It is an optical instrument, which can transmit light. It consists of a rod –lens system surrounded by multiple light conducting glass fibril.

Depending on the angle of inclination, which is the angle between the axis of the arthroscope and a line perpendicular to the surface of the lens, there are 3 types of arthroscopes as 30°, 70° and 90° arthroscopes.

2. FIBEROPTIC LIGHT SOURCE

It consist of a tungsten, halogen, or a xenon arc light source that produces 300 to 350 watts and the fiber optic cable consists of a bundle of specially prepared glass fibers encased in protective sheath. One end of the fiber optic cable is attached to the light source and the other end to the arthroscope.

3. TELEVISION CAMERA

It is a small, solid-state camera, which can be sterilized and connected directly to the arthroscope.

4. TELEVISION

Used to view the output from the camera and for recording.

5. BASIC ARTHROSCOPIC HAND INSTRUMENTS

Probe

Arthroscopic basket forceps

Arthroscopic grasping forceps.

All these instruments except television and light source is sterilized by ethylene oxide gas or formalin gas.

PORTALS

Key to success in arthroscopy is the placement of portals.

STANDARD PORTALS

Antero-lateral (AL)

Antero-medial (AM)

Postero-medial (PM)

Supero-lateral (SL)

OPTIONAL PORTALS

Posterolateral portal

Proximal midpatellar portal

Central transpatellar tendon portal

Once inside the knee

The following compartments are viewed methodically.

Suprapatellar pouch and patellofemoral joint

Medial gutter

Medial compartment the intercodylar notch – ACL is visualized here.

Posteromedial compartment

Lateral compartment

Lateral gutter and posterolateral compartment

We confirm our diagnosis and deal with associated meniscal injuries with arthroscopy, before ACL reconstruction.

ARTHROSCOPIC ACL RECONSTRUCTION

PRE OP ASSESSMENT

Careful assessment is critical to the success of the procedure. Wasiiewski et al[68], showed Excessive swelling, poor range of movements or weak quadriceps tone are implicated in poorer outcomes. Surgery to be delayed until minimal swelling, full extension of knee and active quadriceps function are possible. This may take 4 to 6 weeks studies indicate this can be critical in reducing post op arthro fibrosis

EXAMINATION UNDER ANAESTHESIA

Lachman, pivot shift and complete knee examination done including valgus/ varus stress tests, and the anterior and posterior drawers are performed.

The procedure requires additional instruments, apart from the normal orthopaedic instruments.

INSTRUMENTS are

Tibial aimer

Femoral aimer

Cannulated reamers 7-10 sizes

Beath pin

Graft sizers

Tunnel notcher

OPERATIVE PROCEDURE

-Under spinal anaesthesia

-Under tourniquet control.

PATIENT POSITIONING

Supine with a side post just proximal to knee for valgus stress or with a Knee holder with the Foot of the bed dropped. Knee holder permits flexion of 80° to 90° with out assistance. A Mayo stand may be utilized for foot extension of foot if needed.

GRAFT HARVEST

Keep the knee in flexion an incision from lower pole of patella to tibial tubercle just medial to mid line, this avoids scar being directly over most prominent parts of patella& tibial tubercle.

Full thickness flap is raised to expose patellar tendon. Paratenon is identified, divided longitudinally and dissected off medially and laterally.

Width of tendon measured in midpoint. If it is less than 30 mm then a 9mm graft and if greater than 38mm, a 11mm graft harvested. Usually a 10mm graft harvested for most reconstruction

Knife should be penetrating adequately and the tendon is to be cut without skiving.

Tibial graft: - A 20-25mm long by 10 mm block harvested from tibial tubercle in a rectangular fashion with a depth of 5-10mm.

Patella Graft: - Depending on size of patella a 15 to 20 mm length and

5mm depth bone block is harvested; Hoffa's Fat pad attached to proximal part of tendon is dissected minimally.

Using 2mm drill bit drill, 2 proximal and 2 distal holes are made to insert sutures to assist in graft introduction, tensioning and fixation.

PORTALS

ANTERO LATERAL

Through the incision or through stab incision through skin about 1.5 cm above lateral joint line

ANTERO MEDIAL PORTAL

This can always be made with an aid of 18 – gauge spinal needle visualized arthroscopicaly for optimal placement and to avoid medial meniscus.

We prefer tendon harvest before arthroscopy

Firstly, as there is no extravasations of fluids harvest is easier,

Secondly paratenon is more easily defined and preserved,

Thirdly paratenon and fat pad breech can be closed before arthroscopy so that it aid in fluid pressure maintains inside the knee and

Fourthly an assistant can prepare the graft as notch preparation occurs.

Routine Arthroscopy performed; Meniscal Repair or Meniscectomy if any is done at this stage

Remaining ACL fibres are debrided and tibial foot print outline is left to help with tibial tunnel placement.

Lateral wall and roof preparation done for intercondylar notch and is cleared off all debris.

TIBIAL TUNNEL PLACEMENT

Tibial tunnel largely dictates femoral tunnel placement.

An 'L' shaped periosteal flap is raised on Antero medial tibia just medial to tibial tubercle about 4 cm below & 1- 1.5cm medial to medial joint line. ACL Tibial guide is inserted through Antero medial portal its tip placed on the tibial foot print of ACL.

Morgan et al[51] showed center of ACL insertion about 7.1 mm to anterior edge of PCL at 90° of flexion.

Jackson and Gasser[52] clinically confirmed saggitaly a point 7 mm anterior to PCL anterior margin is ideal to avoid Graft- Roof impingement. The average angle of Tibial tunnel is 70° to tibial plateau in coronal plane.

W**olf peterson**[2] describe the two land marks used for tibial tunnel placement in all arthroscopic technique as

a) 7mm from the anterior margin of PCL INSERTION is found to be center of postero-lateral fibers

b Anterior horn of lateral meniscus described to be center of antero-medial fibers.

ACL Tibial Guide is placed over ACL footprint that is on upslope of tibial spine just lateral to edge of articular surface of medial tibial plateau, the angle of the guide is about 45°.

Drill the guide wire under arthroscopy visualization.

Ream over the guide wire serially

FEMORAL TUNNEL

Femoral Aimer with 7° offset is used the Tongue of it is positioned “Over the Top” Knee may have to be extended slightly to get the tongue over the top.

Guide wire is inserted through the aimer, flower top reamers are used over Guide wire and an incomplete Tunnel of about 32 –40mm depth is drilled.

GRAFT PASSAGE

Graft is sized with sizers .

The appropriately sized graft is passed through BEATH PIN (along wire with an eye at one end).

Always hyper flex the knee exit the pin laterally. With knee back to about 80-90° of flexion, pull the graft into the knee, with the help of probe direct the leading graft into femoral tunnel with its cancellous surface facing anteriorly.

GRAFT FIXATION

The graft is secured with “METAL INTERFERNCE SCREWS”

FEMORAL FIXATION

Is done by interference screw through the antero medial portal,

The knee is hyper flexed to allow parallel placement of screw to graft by an anti rotation guide wire and interference screw at anterior interface and this may be aided by “Tunnel Notcher”.

The knee must be hyper flexed and an assistant should keep equal tension on both sides through sutures applied to the graft so that graft does not advance as the screw is inserted. The screw is inserted till it flush with the end of bone block

Look for impingement in full extension; lateral wall impingement is safely and easily addressed with curette. The ideal placement of tunnel is **10:30 A.M for right knee and 1:30 P.M for Left** by clock position to minimize impingement.

TIBIAL FIXATION:

The knee is cycled through full range for about 20 times (TENSIONING).

The knee is then brought to full extension, maximal manual tension is applied to tibial tunnel sutures appropriate interference screw at anterior interface

over cancellous bone of the graft with knee placed in 20-30° of flexion and a posterior draw applied to knee.

Lachman test performed and complete range of movements assessed. Anteromedial periosteal flap is closed. sub cute and skin are closed in layers with suture or staples. The ‘staples’ allow early motion and less risk of dehiscence

A Knee Immobiliser is applied in Full Extension

REHABILITATION AFTER ACL RECONSTRUCTION

The Science Of ACL Rehabilitation' by **BruceD.Beynnon,et al**[69],(2002)describe that there is evidence based from R C T that immediate weight bearing after reconstruction of ACL is beneficial as it lowers patello femoral pain without increased anterior knee laxity and resulted in better outcome in a endoscopicaly reconstructed one.

Feddric H.Fu et al's[49], analysis of outcome in a endoscopicaly reconstructed ACL substantiates the fact that Early R.O.M, and controlled Endurance programmes highly improved outcome and

David Fischeretal[53], observation of supervised home based Rehabilitation programme for arthroscopicaly reconstructed ACL substantiates its efficacy equivalent to clinic based one.

Rehabilitation after ACL (anterior cruciate ligament) reconstruction has drastically changed one over the last decade, with the adoption of a more aggressive approach, right from the first day after surgery. The aggressive rehabilitation after ACL rehabilitation is possible because of improved operative techniques, and also there are encouraging results of histological studies regarding early graft healing following aggressive rehabilitation program. The importance of

range-of-motion exercises, early weight bearing, an appropriate and balance exercises are explained well to the patients.

Dublajanin et al[54], description of arthroscopicaly reconstructed ACL group with aggressive rehabilitation clearly differed by range of motion ($p<0.005$), thigh circumference ($p<0.01$) and Lysholm test score ($p<0.01$), leg hop test ($p<0.05$), and Tegner test ($p<0.01$). The graft integrity was not compromised in any of these patients, nor did postoperative arthrofibrosis develop. This has undoubtedly revealed that early intensive rehabilitation approach leads to faster functional recovery without complications compared to conventional rehabilitation treatment.

Our protocol reflect this essence

PRE OPERATIVE PHASE

GOALS

Diminish swelling, inflammation and pain

Restore near normal ROM (extension at least)

Educate patient for surgery

Brace and rest the knee

EXERCISES

Ankle pumps

Passive extension to zero

Straight leg raises in flexion,abduction,adduction

Apply ice for pain

IMMEDIATE POST OP PHASE (DAY 1 TO 3 WEEKS)

GOALS

Restore full passive extension of knee

Diminish swelling and pain

Restore patella mobility

Improve knee flexion 90°by Day 5 and approximately 100° by Day-7

Reestablish quadriceps control

Restore independent ambulation

EXERCISES

Ankle pumps

Active and passive flexion exercises

Straight Leg Raises

Isometric quadriceps exercises

Hamstring stretches

Remove brace and ROM exercises 4 to 6 times a day

Weight bearing – with 2 crutches as tolerated with brace locked in extension

Patellar mobilization

Mini squats

Ice and elevation of leg with knee in extension

EARLY REHABILITATION PHASE (3 to 6 weeks)

CRITERIA TO ENTER PHASE-2

Ability to perform good quadriceps set and straight leg raises

Full passive knee extension

Passive ROM of 0° - 90°

Good patellar mobility

Minimal joint effusion

Independent ambulation

GOALS

Maintain full passive knee extension

Gradually Improve knee flexion

Muscle training

Restore proprioception

Patellar mobility

EXERCISES

Weight bearing as tolerated to discontinue crutches

Self-ROM stretching emphasis on full, passive R O M

Continue isometric quads

SLR

Leg press knee extension (90° to 40°)

Half squats (0° to 40°)

Weight shifts

Lateral and front step-ups

Front and side lunges

Hamstring curls

Passive ROM from 0° to 115°

Patellar mobilization

Well leg exercises

Cycling for ROM stimulus and endurance

Progressive resistance programs

Ice compression, elevation

CONTROLLED AMBULATION PHASE (6 to12 weeks)

CRITERIA TO ENTER PHASE-3

Active ROM from 0° to 115°

Quadriceps strength 60% of the normal side

Minimal or no joint effusion

No joint line or patello femoral pain.

GOALS

Restore full ROM (0° to 125°)

Improve lower extremity strength

Enhance proprioception , endurance ,balance

No immobiliser

Self-ROM 4 to 5 times using the other leg

EXERCISES

Progress isometric strengthening program

Knee extension (90° to 40°)

Hamstring curls

Hip abduction and adduction

Hip flexion and extension

Lateral and front step-ups

Front and side lunges

Wall squats

Toe calf raises

Proprioception drills

Cycling for ROM stimulus and endurance increase speed and gradient as tolerated

Continue balance

Continue stretching drills

Tread mill increase speed and gradient as tolerated

Start swimming but **no** “breast strokes”

EARLY SPORT TRAINING PHASE

CRITERIA TO ENTER PHASE-4 (from fourth month onwards)

ACTIVE ROM (0° to 125°)

Quadriceps strength 80% the normal side

No Pain / Effusion

EXERCISES

Jog/run on pavement tread mill

Normal skipping introduced

Lunges and hopping increased in intensity and frequency

Running acceleration and deceleration drills

Progress in slow turns, to tighter turns and cutting as tolerated

MATERIALS AND METHODS

Our study is a prospective study of 18 cases of Arthroscopic ACL reconstruction done, in the Department of Orthopedics, Government Royapettah Hospital, Kilpauk Medical College, and Chennai – 14. Our study was done over a period of 23 months, between (January 2006 to November 2007)

AGE DISTRIBUTION

Age group: 18-50 years, Mean age: 29.4 years

Age group of patients	No. Of patients	Percentage
10-20 yrs	3	16.66%
21-30 yrs	8	44.44%
31-40 yrs	5	27.77%
41-50 yrs	2	11.11%

SEX DISTRIBUTION

Sex	Number of patients	Percentage
Male	17	94.44%
Female	1	5.55%

In our study group majority were males with only a single female patient

MODE OF INJURY

Mode of injury	No. of patients	Percentage
Sports injuries	8	44.4%
RTA	6	33.3%
Fall	4	22.2%

SIDE OF INJURY

Side	No. of cases	Percentage
Left knee	7	38.88%
Right knee	11	61.11%

ASSOCIATED MENISCAL INJURIES IN 8 CASES

Meniscus injury	No. of cases	Percentage
Lateral	2	100%
Medial	0	0

Only two cases had associated meniscal tear and both were of lateral meniscus.

DURATION BETWEEN INJURY AND ACL RECONSTRUCTION

Duration in months	Number of cases
< 6 mon	11
6 – 12 mon	4
>12 mon	3

Our study also followed the protocol of open group as

ACL Reconstruction was done as early as 2 months post injury to as late as 23 months post injury.

Patients with clinically Lachman test, anterior drawers test, MRI or arthroscopy positive for ACL rupture were included in our study.

Patients with bony ACL avulsion, other associated fractures were excluded from our study.

The bone patella tendon bone auto graft was used for all the cases, for ACL reconstruction.

Interference screws were used for fixation

OBSERVATIONS

In our study group of 18 cases of Arthroscopic ACL reconstruction

Majority of the patients (8 cases) were in the age group between 21-30 years. With 11 patients in the 2nd and 3rd decade indicate active young people were most involved

Males were injured more commonly than females.

Sports injuries were the common cause of ACL injury closely followed by RTA.

RIGHT knee affected more than LEFT knee.

Lateral meniscus injuries, were associated with only 2 of our patients.

We had a case of wound dehiscence leading to delayed rehabilitation and there by resulted a lower score

RESULTS AND STASTICAL ANALYSIS

The outcome of our study was assessed using the Lysholm knee scoring system. It is both a subjective and objective scoring system.

It includes 8 parameters for which points are assigned; the only objective category is the thigh atrophy.

LYSHOLM KNEE SCORING SYSTEM

Parameter	Finding	Points
Limp	None	5
	Slight	3
	Periodical	3
	Severe and constant	0
Support	full support	5
	Requires stick or crutch	3
	Weight bearing impossible	0
Stair climbing	No problems	10
	Slightly impaired	6
	One step at a time	2
	Unable	0
Squatting	No problems	5
	Slightly impaired	4
	Not past 90 degrees	2
	Unable	0

Walking – instability	Never giving way Rarely during athletic or other severe exertion Frequently during athletic or other severe exertion Unable to participate because of instability Occasionally in daily activities Often in daily activities With every step	30 25 20 20 10 5 0
Walking pain	None Inconstant and slight during severe exercise Marked on giving way Marked during severe exertion Marked after walking more than 2 kilometers Marked after walking less than 2 kilometers Constant and severe	30 25 20 15 10 5 0
Walking swelling	None With giving way On severe exertion On ordinary exertion Constant	10 7 5 2 0
Atrophy of thigh Score =	None 1 -2 cm >2 cm	5 3 0
SUM (point for all of the parameters)		
Interpretation		

Minimum score: 0 Maximum score: 100 The higher the score, the better the function.	
Score	Outcome
98-100 93-97 82-92 66 -81 <=65	Excellent Good to excellent Fair to good Fair Poor

In our study a group of 18 cases are treated with Arthroscopic ACL reconstruction. The patients were followed up once fortnightly for 2 months, then once a month for 6 months, post operatively and once every three month thereafter. The maximum follow-up period in our study was 23 months and minimum follow up period was 6 months.

Full range of movements was achieved in 17 cases. . One case a known diabetic, had scar dehiscence and has not adhered to post op protocol and hence understandably has lower score all our patient were assessed with the lysholm knee scoring system.

The functional outcome, using the lysholm knee scoring scale in our study was found to be.

RESULTS

Outcome- Lysholm score	No. of patients	Percentage
Excellent	9	50%
Good-excellent	8	44.4%
Fair- good	0	0%
Fair	1	5.6%
Poor	0	0%

STASTICAL ANALYSIS

Group –1 The Arthroscopic ACL Reconstruction,

Group-2 The Open Trans Tibial reconstruction are compared for

1. **Age Criteria**

Group	Total cases (n)	Mean	Standard Deviation (S.D)	95% confidence limits of mean		SIGNIFICANCE
				LCL	UCL	
1	18	29.1666	8.7464	24.8171	33.5161	P = 0.3804
2	18	26.9444	6.0046	23.9584	29.9304	

95% Lower confidence limit of mean = mean minus (t multiplied by Standard Error) where Standard Error = S.D/$\sqrt{n}$

There is no significant difference in the age group distribution between the two groups making this study reliable, as the comparison is not affected by age distribution.

2. Sex distribution

Both the groups have 17 males and 1 female patients thus excluding gender bias

3. Associated injuries

Group 1 has 2 cases of lateral injuries where as group 2 has 6 lateral and 2 medial meniscal injuries

4) Side of injury

Group-1 has 11 cases of Right side and group-2 has 12 cases no significant difference noted

5) Degrees of R.O.M

The Post -Op R.O.M is compared between the groups using Fischer exact 2 tailed test used to evaluate as at least one expected value is <5 (row/column), Chi Square

could not be worked out; and the p – value is 0.3377 and is not significant statistically

6) Duration between injury and surgery

The time between the history of injury to the date of surgery is analysed p – Value =0.9301,did not show any statistical significance in our study

"As most of the variables did not differ statistically **the analysis is not influenced or biased** by them, thus making this comparison more **reliable"**

SCORE ANALYSIS

Groups	Number of patients	Mean	S.D	95%L.C.L	95% U.C.L
1	18	95.7777	5.2306	93.1766	98.3789
2	18	86.3888	22.4791	75.2102	97.5694

p – Value = 0.000177

Since the data did not follow normal distribution we applied "Mann-Whitney U test" for difference in medians and the resultant "p" **(**p – Value = 0.000177) is statistically very significant indicating arthroscopic ACL reconstruction has better outcome

DESCRIPTION OF TESTING PROCEDURE

A common research task is to compare the means of two populations (groups) by taking independent samples from each. This is sometimes referred to as a parallel-groups design. Perhaps the simplest comparison that we can make is between the means of the two populations. The mean represents the center of the population. If we can show that the mean of population A is different from that of population B, we can conclude that the populations are different. Other aspects of the two populations can (and should) also be considered, but the mean is usually the starting point

If assumptions about the other features of the two populations are met (such as that they are normally distributed and their variances are equal), the two-sample t test can be used to compare the means of random samples drawn from these two populations. If the normality assumption is violated but the distributions are still symmetric, the nonparametric Mann-Whitney U test, Kolmogorov-Smirnov Test For Different Distributions may be used instead.

Assumptions

The following assumptions are made when using the two-sample t test.

One of the reasons for the popularity of the t test is its robustness in the face of assumption violation. If an assumption is not met the significance levels and the power of the t test are unknown hence, we should take the appropriate steps to check the assumptions before we make important decisions based on these tests.

Two-Sample T Test Assumptions

The assumptions of the two-sample t test are:

1. The data are continuous (not discrete).
2. The data follow the normal probability distribution.
3. The variances of the two populations are equal
4. The two samples are independent. There is no relationship between the individuals in one sample as compared to the other (as there is in the paired t test).
5. Both samples are simple random samples from their respective populations. Each individual in the population has an equal probability of being selected in the sample.

If these assumptions are violated, the nonparametric Mann-Whitney U test may be used instead.

Mann-Whitney U Test Assumptions

The assumptions of the Mann-Whitney U test for difference in means are:

1. The variable of interest is continuous (not discrete). The measurement scale is at least ordinal.

2. The probability distributions of the two populations are identical, except for location. That is, the variances are equal.

3. The two samples are independent.

4. Both samples are simple random samples from their respective populations. Each individual in the population has an equal probability of being selected in the sample.

Software used for our study is - NCSS

DISCUSSION

Over the past several decades development in arthroscopic techniques and improvements in research have allowed ACL reconstruction to become one of the most successful techniques in sports medicine.

According to **John.w.Janregerito**[50] reasons for failures are due to (1)Errors in graft selection.(2)Errors in tunnel placements.(3)Errors in fixation(4)Improper post-op rehabilitation.(5)Failure to recognize secondary restraint instability as it may lead to graft failure due to stress.

Revision ACL reconstruction results are not as predictable as the primary one

Our study of Arthroscopic ACL Reconstruction is preferred over open method as indicated in the following scientific papers

a) According to **chirnarzadowRuchu et al**[55], arthroscopic ACL reconstruction resulted in smaller amount of blood loss and better ROM at least during the first three months.

b) C**ameron et al**[56] by their prospective randomized comparison of open vs arthroscopic ACL reconstruction recorded statistically significant advantages of arthroscopic ACL reconstruction in ROM at 1 month, thigh atrophy at 6 months

post op and cybex test (knee extension at 60° /sec) lay the foundation for our study.

Our knee scoring system "the Lysholm Knee score" has been accepted as standard score by various studies and the efficacy of its constituents are shown by **Boden moyer et al**[57], in their 26 months follow-up study showed patient's subjective rating are highly favorable and objective measure like pivot shift, ROM, thigh circumference and strength clearly favor arthroscopic ACL reconstruction than open method.

Our grading of functional outcome the Lysholm score includes both subjective rating and objective thigh circumference measure.

The use of "**The Gold Standard"** patella tendon auto graft for ACL reconstruction was the choice for our study was first described by **Jones** in 1963 and later popularized by **Clancy** in 1982.

Since then ACL reconstruction has rapidly evolved into an arthroscopic procedure with an expectation to return to all activities at pre- injury levels of performance. This has occurred by technological advances in arthroscopy, improved arthroscopic skills and better understanding of knee biomechanics with revolutionized rehabilitation programs.

The reasons for using BPTB graft are.

-Because of its increased initial strength and stiffness than normal ACL.

(168% strength and almost 4 times' stiffness of normal ACL[33]).

-Bone to bone union is more stable takes about 6-8 weeks, in case of hamstring graft it takes more time.

-BPTB graft has lesser incidence of laxity compared to hamstring graft.

But, the main problem of BPTB graft is the graft site morbidity and anterior knee pain.

BPTB grafts are consistently provided excellent stability and fixation with interference screw within the bone tunnel provides and initial pullout strength of 640 N.

The efficacy of Arthroscopic ACL Reconstruction using BPTB graft are shown by

a)Laffargue et al[58], show BPTB graft harvest morbidity is of short duration and highly reversible as arthroscopic ACL reconstruction allows faster rehabilitation.

b)Paulos LE,et al[59], show arthroscopic ACL reconstruction has better results by means of decreased operation time, morbidity thus offers predictable rehabilitation at least initially after surgery and suggested proper graft selection, improved instrumentation and precision in technique are paramount regarding results.

c)Dublajanin et al[54]description of arthroscopicaly reconstructed ACL group with aggressive rehabilitation clearly differed already after 6 weeks by range of motion ($p<0.005$), thigh circumference ($p<0.01$) and Lysholm test score ($p<0.01$), after 4 months in relation to one leg hop test ($p<0.05$), and after 6 months according to Tegner test ($p<0.01$). The graft integrity was not compromised in any of these patients, nor did postoperative arthrofibrosis develop. This has undoubtedly revealed that early intensive rehabilitation approach leads to faster functional recovery without complications compared to conventional rehabilitation treatment.

d)Veltri DM[60] says properly performed arthroscopic ACL reconstruction proved to be successful clinically in most acute and chronic deficiency patients

e)Results of arthroscopic assisted ACL Reconstruction with BPTB graft by 18 different authours published from 1990-1998 reviewed by **Jeff. A Fox et al**[6] signified high short terms stability rate extremely high patient subjective

satisfaction level and low post complication and BPTB graft as the choice by most surgeons especially at collegiate and professional level.

All these scientific literature substantiate our choice of Arthroscopic ACL Reconstruction with BPTB graft.

In our study we used a single incision technique harvesting ipsilateral BPTB graft preferably before arthroscopy with minimal fat pad dissection as it prevents hemorrhage and fibrosis postoperatively.

We prefer to leave the harvested tendon site open with only para-tenon approximation as indicated by the study of **Cercillo et al**[61], which showed thickening of patellar tendon in Toto when tendon gap is approximated with thickening of patellar tendon occurring not only in central third but also medial and lateral third are involved > 50%. On contrary the tendon gap left open patients only 25% of them had minimal scaring that to in middle third.

The graft is sized appropriately and fixed to the tunnel with an interference screw. This method of fixation has provide excellent intial fixation strength and allows desired bone to bone healing indicated by **Brand JJ et al, Kuroska et al**[63]

.

We tension the graft by doing about 20 cyclical movements. **Yoshiya et al**[62], showed the effect of cyclical movements of passive flexion and extension

produced a local elongation of the graft. Effect of preconditioning on the visco elastic response of BPTB graft is considered to be an important factor influencing the outcome.

We also used 20ml of 0.375% bupivacaine injection intra-articularly which reduced postoperative pain considerably as is shown by **Hall F Cheu etal and Karlsson et al[64],** is an effective method of post-operative pain relief, with no side effects or complications.

In our institute we have a set of 18 cases of ACL reconstructed by open method with mean age of 26.9 yrs assessed by Lysholm scoring system and in our study of 18 cases of arthroscopic ACL reconstruction the mean age is 29 .4 yrs. With 95%confidence limits there is no significant difference in the age group distribution between the two groups making this study reliable, as the comparison is not affected by age distribution.

As most of the variables did not differ statistically the analysis is not influenced or biased by them, thus making this comparison more reliable.

Both groups have majority cases in third decade with more number of younger people < 30yrs in arthroscopic ACL reconstruction group, which also has only 2 cases of meniscal injury both are lateral meniscus when compared to 8 cases in the open method group.

Our Rehabilitation programme is aggressive permitting early weight bearing and mobilization, where as in open group rehabilitation weight bearing is avoided for at least 6 weeks with slower rehabilitation programme.

Our results are excellent in 9 patients, good to excellent in 8 cases and fair in 1 case. The last one being a diabetic patient developed wound dehiscence and a delayed rehabilitation affected the outcome. On comparison with the Open trans tibial method of ACL Reconstruction, the data did not follow normal distribution so we applied "**Mann-Whitney U test**" for difference in medians and the resultant **"p"(p – Value = 0.000177)** is statistically very significant indicating arthroscopic ACL reconstruction has better outcome with p – Value comparable to literatures (ref.- Study by **Dublajanin et al**[54] has a p- value <0.01 in Lysholm test score comparison between arthroscopic and open method favouring arthroscopic reconstruction)

On summarizing our study of arthroscopic ACL Reconstruction with BPTB graft followed the principles like

1) BPTB harvested with minimal Hoffa's pad dissection
2) Leave the patella tendon harvest site open
3) Tibial tunnel made using a tibial guide with standard arthroscopic reference points.

4) Use of femoral aimer with 7^0 offset, over the top position used for placement.

5) Femoral side fixed first with interference screw.

6) Tensioning of graft done.

7) Intra-articular Bupivacaine injection.

8) Early and aggressive rehabilitation.

The comparative better result of arthroscopic ACL reconstruction group can be attributed to less post-op morbidity, combined with graft tensioning and usage of local anesthetic, early aggressive rehabilitation

Our comparative study shows that single incision arthroscopic ACL reconstruction has better functional outcome than open transtibial ACL reconstruction by Lysholm score (**p – Value = 0.000177**) with lesser postoperative complications and early return to activities of pre injury level.

CONCLUSION

We conclude that our short term results of our prospective study of Arthroscopic ACL reconstruction assessed in terms of the Lysholm knee scoring system has better functional outcome than open transtibial ACL reconstruction with lesser postoperative complications and early return to activities of pre injury level.

SL.NO	NAME	GROUP	AGE	AGE-CLASS	SEX	IP NO.	D.O.S	SIDE	follow-up	Other Injuries	R.O.M	SCORE	DOS
1	Jebaseelan	1	22	2	M	832265	13/01/06	(L)ACL	23months		O°- full flex	95	6
2	Dinesh	1	18	1	M	842102	5/5/2006	(L)ACL	18months		O°- full flex	98	3
3	Udaya Baskar	1	38	3	M	845039	12/6/2006	(L)ACL	17 months		O°- full flex	99	4
4	Chockalingam	1	38	3	M	844850	16/06/06	(R)ACL	17 months		O°- full flex	96	4
5	Rajaguru	1	19	1	M	846263	26/06/06	(R)ACL	17months		O°- full flex	99	3
6	Dinesh	1	33	3	M	847197	7/7/2006	(R)ACL	16months	Lat. Meniscus	O°- full flex	95	2
7	Selvaraj	1	50	4	M	842658	12/8/2006	(L)ACL	15 months		O°- full flex	96	3
8	Sasikumar	1	28	3	M	850558	21/08/06	(R)ACL	15 months		O°- full flex	99	4
9	Sasikumar	1	23	2	M	851372	30/08/06	(R)ACL	15 months		O°- full flex	96	14
10	Vijayalaxmi	1	30	2	F	851816	11/9/2006	(R)ACL	14 months		O°- full flex	98	4
11	Kannan	1	25	2	M	857654	13/11/06	(R)ACL	12months		O°- full flex	98	3
12	Manoj	1	18	1	M	861680	8/1/2007	(L)ACL	10months	Lat. Meniscus	O°- full flex	94	13
13	Keeran	1	34	3	M	862490	12/1/2007	(R)ACL	10 months		O°- full flex	98	8
14	Suresh	1	28	2	M	863932	5/2/2007	(R)ACL	9 months		O°- full flex	96	15
15	Jegan	1	30	2	M	867535	21/03/07	(R)ACL	8 months		O°- full flex	98	4
16	Chandrasekar	1	25	2	M	868863	9/4/2007	(R)ACL	7 months		O°- full flex	94	7
17	Abdul Kadar	1	42	4	M	877612	2/5/2007	(L)ACL	6 months		15°-100°	76	3
18	Velmurugan	1	24	2	M	877241	11/5/2007	(L)ACL	6 months		O°- full flex	99	6
1	Hari	2	22	2	M	771453	20/02/04	(L)ACL	25 months	Lat. Meniscus	O°- full flex	98	4
2	Shankar	2	24	2	M	774271	11/3/2004	(L)ACL	24 months		15°-100°	76	9
3	Paramasivam	2	36	3	M	782665	11/6/2004	(R)ACL	21 months		O°- full felx	92	3
4	Anitha	2	22	2	F	784989	12/7/2004	(L)ACL	20 months	Med. Meniscus	O°- full flex	93	4
5	Kalidass	2	31	3	M	789853	03/09/04	(R)ACL	18 months		O°full flex	93	3
6	Balakrishnan	2	25	2	M	793580	18/10/04	(R)ACL	17 months	Lat. Meniscus	O°- full flex	93	14
7	Nagaraj	2	43	4	M	796281	19/11/04	(R)ACL	16 months		10°-100°	74	8
8	Murugan	2	24	2	M	801482	21/01/05	(R)ACL	13 months	Lat. Meniscus	O°- full flex	94	2
9	Sekar	2	31	3	M	806224	18/03/05	(R)ACL	12 months		O°- full flex	93	3
10	Ashruff	2	23	2	M	808486	14/04/05	(R)ACL	11 months		O°- full flex	95	6
11	Anji	2	29	2	M	809787	2/5/2005	(R)ACL	10 months	Med. Meniscus	O°- full flex	93	5
12	Chandrasekar	2	25	2	M	810081	6/5/2005	(R)ACL	Traumatic rupture 3 weeks P.O			0	3
13	Ramaraj	2	19	1	M	810654	9/5/2005	(R)ACL	10 months		O°- full flex	95	4
14	Mohideen	2	24	2	M	818380	1/7/2005	(L)ACL	8 months	Lat. Meniscus	O°- full flex	98	5
15	Premkumar	2	23	2	M	822666	23/08/05	(R)ACL	7 months	Lat. Meniscus	O°- full flex	94	5
16	Sabarinathan	2	24	2	M	824400	14/09/05	(R)ACL	6 months	Lat. Meniscus	O°- full flex	93	9
17	Bharathidasan	2	26	2	M	825525	22/09/05	(L)ACL	6 months		5°- full flex	89	13
18	Domnic	2	34	3	M	825821	29/09/05	(L)ACL	6 months		O°- full flex	92	4

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OUTCOME