COMPARATIVE STUDY BETWEEN HAMSTRING VERSUS BONE PATELLA TENDON AUTOGRAFT TO ASSESS THE FUNCTIONAL OUTCOME OF ARTHROSCOPIC RECONSTRUCTION OF ACL

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CERTIFICATE

This is to certify that the dissertation entitled **"COMPARATIVE STUDY BETWEEN HAMSTRING VERSUS BONE PATELLA TENDON AUTOGRAFT TO ASSESS THE FUNCTIONAL OUTCOME OF ARTHROSCOPIC RECONSTRUCTION OF ACL"** is a bonafide original work of **Dr.J.MANOJ**, in partial fulfilment of the requirements for M.S.Branch–II (Orthopaedics) Examination of the Tamil Nadu Dr. M.G.R. Medical University to be held in APRIL 2018 under my guidance and supervision in 2017-18.

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DECLARATION

I, **Dr.J.MANOJ** solemnly declare that dissertation titled, **"COMPARATIVE STUDY BETWEEN HAMSTRING VERSUS BONE PATELLA TENDON AUTOGRAFT TO ASSESS THE FUNCTIONAL OUTCOME OF ARTHROSCOPIC RECONSTRUCTION OF ACL"** is a bonafide work done by me at Govt. Stanley Medical College & Hospital during 2015-2018 under the guidance and supervision of my Unit Chief. **Dr. M. Antony Vimal Raj, M.S.ortho,** Professor and Unit Chief Department of Orthopaedic Surgery Govt . Stanley Medical College, Chennai – 600 001.

The dissertation is submitted to Tamil Nadu Dr. M.G.R. Medical University, towards partial fulfilment of requirement for the award of **M.S. Ortho,** Examination to be held in April 2018.

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Date : **(Dr. J. MANOJ)**

WORD OF GRATITUDE

I place on record my deepest sense of gratitude and indebtedness to

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Professor and Unit Chief

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URKUND

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http://orthofracs.com/adult/elective/knee/knee-ligament-injuries.html

Instances where selected sources appear:

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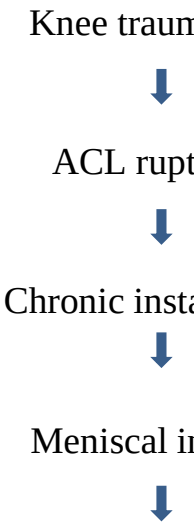
INTRODUCTION

Anterior cruciate ligament (ACL) Reconstruction have undergone series of evolution over the past 30 years to improve the biomechanics of knee joint. In 1970's surgery was done to repair the torn ends of the ligaments. After that, repair of ACL using autografts was done in 1980's using arthrotomy (open procedure). In recent times, ACL reconstruction using autografts using arthroscopic procedure is universally accepted treatment for ACL injuries. ACL injury rate is around 60 per 1,00,000 people per year[1], with increase in sports activity this number is likely to go up. In recent years with recent advances in arthroscopic ACL reconstruction it is noted that 90% of athletes have chance of returning to their pre injury level of sports activity.



This is the cascade studied by Donald . c. fithian[2] and proposed by Daniel et.al This concludes that without ACL reconstruction, there will be premature increase in incidence of osteoarthritis knee. Recent studies suggested that 15-40% of ACL injuries are associated with meniscal injuries[3]. In reconstruction of ACL the meniscal injury can be prevented, which leads to avoidance of chondral damage and eventually leads to minimizing the occurrence of arthritis in knee joint. Historically most surgeons prefer autograft more than allograft. The reasons behind it are

1. Less risk of disease transmission
2. Biologically favourable.
3. Better chance of incorporation

But they have a disadvantage of donor site morbidity. However because of more advantages autograft are generally preferred for ACL reconstruction. The current concept of ACL reconstruction is Transportal anatomic ACL reconstruction.

However there is a new found interest in some centers doing double bundle reconstruction, particularly in sports personnel which is much more technically demanding and with technical advancement in computer-assisted navigation and fluoroscopic placement of tunnels, results have improved in a great way. 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 could 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 done ACL reconstruction for 20 cases 10, were done with hamstring graft 10 cases were done with bone patella tendon graft. I like to compare the functional outcome of these 2 grafts by using IKDC subjective knee evaluation score.

AIM OF THE STUDY

Comparative study between Hamstring versus Bone Patella Tendon Autograft to assess the functional outcome of Arthroscopic Reconstruction of ACL done at Govt. Stanley Medical College and Hospital Chennai , from period of JUNE 2015 to MAY 2017.

REVIEW OF LITERATURE

- In 1895 , Mayo Robson[4] was the first person to surgically repair ACL using direct end to end suturing.

- In 1917, Heygroves [5,6] did open reconstruction of ACL using ilio tibial band through tibial and femoral tunnels.

- In 1920 Eugene Bircher[7] was the 1st person to perform arthroscopy in knee joint. He did it to diagnose Tuberculosis.

- 1936, Campbell [8] used a bone patella tendon graft for ACL reconstruction.

- 1939, Macey [9] used semitenidinosus graft for ACL reconstruction.

- 1950s-1960s the period in which arthroscopic ACL reconstruction became popular and many surgical modifications developed during this period.

- 1956, Augustine [10] described ACL reconstruction using semitendinosus graft through tibial tunnel.

- 1958 O’Donoghue [11] described about unhappy triad of knee. which includes rupture of ACL, medial collateral ligament and tear of the medial meniscus. He also emphasized about Hey groves technique.

- 1963 Jones [12] described a method of using patella tendon with a block of patella and tibial tuberosity for ACL reconstruction.

- In 1970 Dr. O'Connor[13] and Dr. Shahriaree41 began experimenting with ways to excise fragments of menisci 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.

- In 1972 Galway [14] described the pivot shift test of knee. 1980s saw the emergence of prosthetic ligaments.

- 1992 Thorn Rosenberg developed a fixation device which locked itself on the lateral femoral condyle called as Endo Button.

- 2002 MJ. Fiedman developed a 4 standard hamstring graft for ACL reconstruction.

- Now in 2012 we mark the 4th decade of arthroscopic surgeries and still many techniques and implants are developing in this field.

ANATOMY

EMBRYOLOGY

ACL arises from Blastoma of Fetus and begins its condensation in about 6 to 7 Weeks [15]. At that time it was found as condensation of mesenchyme that was located in intercondylar space in embryos which was 20mm long. In study conducted by O'Rahilly found out there is a distinct appearance of ACL as 2 bundles in embryo as in adults.

MICRO ANATOMY

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. Bundles of collagen fibrils makes 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

ACL is also called as "cranial cruciate ligament" as it is located in front of PCL. It is an "intra articular extrasynovial ligament". It has multifascicular structure with each fascicles run spirally or directly about

its long axis towards femur and tibia. These fascicles contain blood vessels [16]. ACL composed of 2 discrete bundles namely :

1. Anteromedial Bundle
2. Postero lateral Bundle

These 2 bundles are named by the respective insertion in the tibia. The Antero Medial bundle takes origin from proximal part of lateral femoral condyle and attaches to antero medial aspect of tibia. The Postero lateral bundle originates from distal part and inserts into the lateral aspect of tibia. ACL attaches to tibia not as a single cord but as a collection of fascicles so that making its surface area of insertion larger. The cross sectional area of ACL is around 36-44mm square. While cross sectional area as its insertion is between 113-136mm square [17,18] . This makes its insertional area 3-3.5mm times larger than the mid substance area. Insertion sites of ACL are divided into 4 zones:

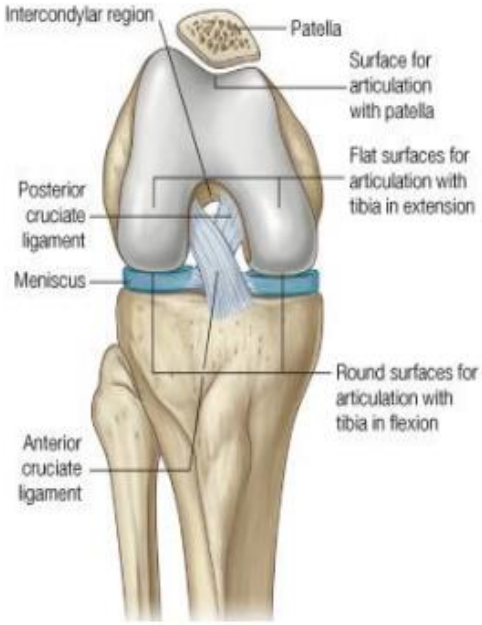
Zone I - Ligament tissue (Collagen)

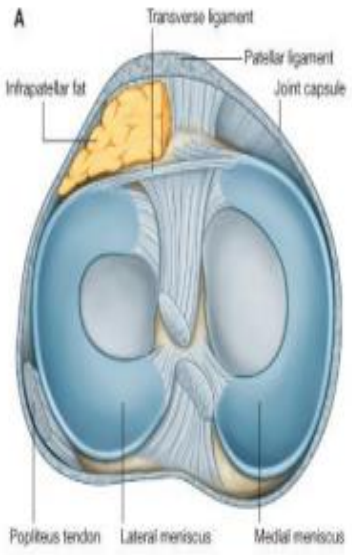
Zone II - Collagen blending with fibro cartilage

Zone III - Mineralized fibro cartilage

Zone IV - Subchondral bone


Intercondylar fossa
Anterior cruciate ligament
Posterior cruciate ligament
Fibular collateral ligament
Patella
Patellar ligament
Tendon of popliteus muscle
Infrapatellar fat
Lateral meniscus
Proximal tibiofibular joint


Intercondylar region
Patella
Surface for articulation with patella
Flat surfaces for articulation with tibia in extension
Posterior cruciate ligament
Meniscus
Round surfaces for articulation with tibia in flexion
Anterior cruciate ligament


A
Transverse ligament
Patellar ligament
Infrapatellar fat
Joint capsule
Popliteus tendon
Lateral meniscus
Medial meniscus


A
Vastus medialis muscle
Vastus lateralis muscle
Quadriceps femoris tendon
Iliotibial tract
Tibial collateral ligament
Fibular collateral ligament
Semitendinosus
Patellar ligament
Gracilis
Sartorius

BLOOD SUPPLY

Main blood supply is from Tibial intercondylar artery which is a branch of Middle Genicular Artery. It enters near the upper end of the ligament.

NERVE SUPPLY

Its main nerve supply is from posterior Auricular Nerve a branch of the tibial nerve.

BIOMECHANICS OF ACL

The average length of ACL is 4cm and average width is 11mm. The ligament is taut in full extension and most relaxed in 40-50 degree flexion [19] . In an intact knee ACL prevents anterior tibial translation. In extension anterior tibial translation is low with max of 2mm and this provides support while standing. In flexion when applying anterio posterior load Anterior tibial translation may increase up to 3mm while walking. When ACL is ruptured ATT is increased up to 10-15mm at 30 degree knee flexion.

To study the interaction of the cruciate ligaments with tibiofemoral joint a simplified two-dimensional, single degree of freedom "Crossed four-bar Linkage" moving in a single plane is commonly used. The model consists of two crossed rods that may be considered to be neutral fibres within the two cruciates that remains sometric during passive flexion and the two connecting bars that represents the line between the femoral (Bluemensaat‟s line) and tibial attachments. The "gliding" intersection of the crossed bars represents the instant centre of joint rotation. Thus, the intersection between these four bars can be used to describe the motion of both the tibial and femoral condyles as well as the posterior migration of tibio femoral contact points that occur with knee flexion.

MECHANISM OF FAILURE OF ACL

EXTERNAL ROTATION AND ABDUCTION WITH KNEE AT 90 DEGREES OF FLEXION

External rotation tears medial capsule, when abduction force is added to that it also results in MCL tear. Finally both forces are increased ACL tear occurs. So ACL tears only occurs when there is combined force of abduction and external rotation.

COMPLETE DISLOCATION OF KNEE JOINT

This occurs only in hyperextension. First, posterior capsule ruptures approximately at 30 degrees of hyperextension. On further hyperextension, then PCL ruptures first followed by ACL rupture.

DIRECT POSTERIOR FORCE AGAINST THE UPPER END OF TIBIA

This displaces tibia forward while knee is flexed and produces tear of ACL.

INTERNAL ROTATION OF TIBIA WHILE KNEE IS EXTENDED

The mechanism consists of that both Antero medial and Postero lateral bundle of ACL is taut when knee is extended and internally rotated. This may produce an isolated tear of ACL.

MATERIALS AND METHODS

In this prospective study we analysed 20 patients who were diagnosed to be having ACL tear and was treated with arthroscopic reconstruction of ACL out of which 10 cases were done using semitendinous graft and 10 cases by bone patellar tendon graft. The study was conducted in GOVT. Stanley Medical College And Hospital, Chennai from JUNE 2015 to MAY 2017 with minimum follow up of 4 months and maximum follow up of 12 months. All 20 cases were male.

INCLUSION CRITERIA:

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

All cases with only anterior cruciate ligament injuries irrespective of the mode of injury/duration/mechanism of injury/associated injuries of menisci were included in our study.

EXCLUSION CRITERIA:

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

Cases with multiple ligament injuries of the knee, Cases with bilateral ACL injuries and revision ACL reconstructions were excluded from the study.

CLASSIFICATION OF KNEE JOINT INSTABILITY RESULTING FROM LIGAMENT INJURY

ONE PLANE INSTABILITY (SIMPLY OR STRAIGHT)

1. One Plane Medial - MCL, ACL, Medial Capsular Ligament, Medial Portion of Posterior Capsule.

2. lateral- LCL, Illiotibial band, Popliteus Complex, Popliteo fibular ligament and ACL.

3. Posterior- PCL, Arcuate Ligament Complex, Posterior Oblique Ligament.

4. Anterior- ACL, lateral Capsular Ligament, Medial Capsular Ligament.

ROTATORY INSTABILITY

1. Antero Medial- MCL , Medial Capsular Ligament, ACL

2. Antero Lateral-Lateral Capsular Ligament, Arcuate Ligament, ACL.

3. Postero Medial – Posterior Oblique Ligament, MCL, PCL.

4. Postero Lateral- Poplietus Tendon , Arcuate Ligament, PCL.

COMBINED INSTABILITY

1. Antero Lateral- Antero Medial Rotatory

2. Antero Lateral- Postero Lateral Rotatory

3. Antero Medial- Postero Medial Rotatory

MANAGEMENT

Detailed history taking, Clinical examination, Radiological findings, they help in diagnosing IDK of knee. The most frequent type of injury that damage ACL are:

1. Excessive external rotation and valgus in flexed knee
2. Hyperextension with internal rotation of tibia.

- The initial symptom may be immediate collapse of knee and becomes extremely painful. and also the discomfort may also be trivial.
- Haemarthrosis at the time of injury is highly suggestive of ACL injury.
- Feeling of pop inside the knee during initial injury.
- Feeling of instability most common symptom 65% [20].
- knee pain the second most common symptom around 60% of cases.
- There may be locking episodes

CLINICAL EXAMINATION

The Clinical Examination Tests are

1. Lachman test
2. Anterior drawer test
3. Pivot shift test
4. Mcmurray test to rule out meniscal injury
5. Valgus or varus test

Sung-jae kim et al[21] found that in ACL deficient patient when examined under anaesthesia.

Anterior drawer is +ve in 79.6%

Lachmann +ve in 98.6%

Pivot shift in 89.8%

LACHMANN TEST

The patient in supine position with involved knee between full extension and 15 degrees of flexion. Then knee is stabilised with one hand then other hand is kept over tibia with thumb placed over tibial tuberosity and 4 fingers placed over popliteal fossa. The firm pressure is applied over tibia in posterior to anterior direction. The positive test indicates when there is a proprioceptive sensation or visual evidence of anterior translation of tibia. The anterior translation is characterised by "mushy" or "soft" end point. In contrast, "hard" end point indicates ACL is intact.

LACHMAN TEST

ANTERIOR DRAWER TEST:

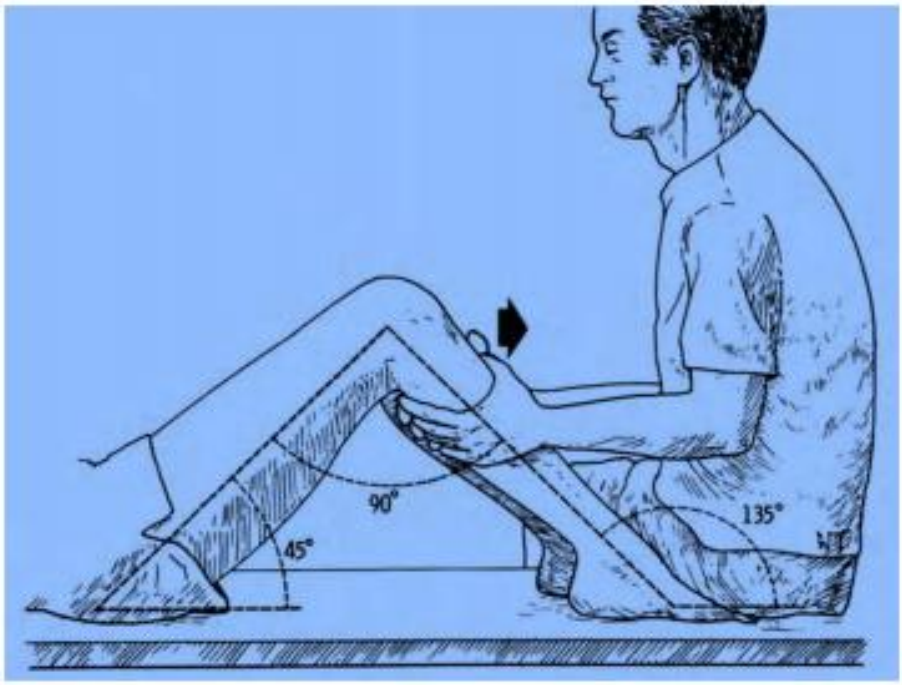
Patient in supine position, with hip flexed knee flexed 90 degrees with foot is fixed on table. The leg is externally rotated. Hands of the examiner are encircled over the upper end of tibia for relaxation of hamstrings.

The examiner pulls the tibia forward noting the anterior translation of tibia. Anterior drawer sign is +ve when there is 6-8mm translation more than the opposite knee.

Grading of ACL instability (translation in cms)

0	normal laxity
1+	<5cm
2+	0.5-1cm
3+	1-1.5cm
4+	>1.5cm

ANTERIOR DRAWER TEST



PIVOT SHIFT TEST

The patient lies rotated 20 degrees from supine towards the unaffected side. The affected knee is flexed 70 degrees. The examiner applies valgus stress to knee and simultaneously internal rotation force is applied at ankle. Then the knee is brought from extension to flexion at about 30 degrees.

The lateral tibial plateau is subluxated anteriorly which is felt at a sudden slip or clunk. The test is graded as follows:

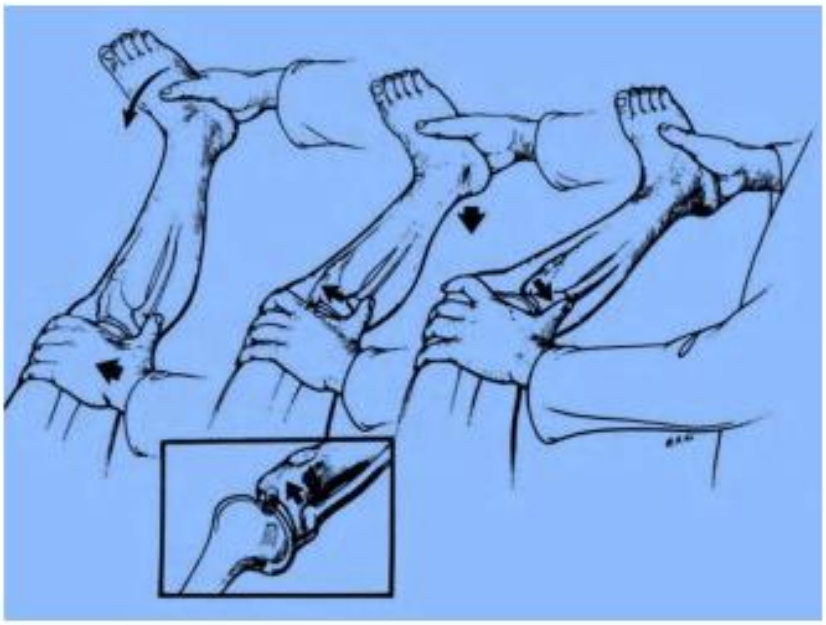
Grade 0 Normal(no shift is present)

Grade 1 Smooth and glide during reduction

Grade 2 There is sudden jumpback of tibia into reduced position.

Grade 3 Transient locking of tibia in subluxated position before reduction. The test's sensitivitiy improves dramatically when patient is examined under anaesthesia. The test is positive in only 24% of patients when awake which dramatically improves to 92% under anaesthesia.

PIVOT SHIFT TEST



OTHER INVESTIGATIONS

1. X-RAY OF KNEE

The plain radiograph is the first investigation to be done to rule out any bony pathology or associated injuries. It is used to rule out avulsion fracture of ACL insertion site and lateral capsular ligament “segond fracture”. This is commonly associated with ACL injury. It is used to identify any degenerative changes of knee.

2. MRI OF KNEE

The sensitivity of ACL tear goes upto 95% in MRI knee [22]. It forms an important diagnostic tool for diagnosing ACL tear. ACL tear shows discontinuous ligament in sagittal plane. In case of partial tear high signalled intensity within its substance in T2 weighted images.

MRI appearance

1. Discontinuity on non-visualisation in sagittal image
2. Irregular contour or wavy pattern of fibres
3. Kinking or bowing of normal taut PCL "Question Mark Sign"
4. Bony bruises

PHYSIOTHERAPY

Quadriceps and hamstring strengthening exercises are started as early as possible and are continued till surgery.

GRAFT SELECTION

An ideal graft selection should have the following characteristics

1. Same biomechanical properties
2. Promote rapid incorporation
3. Minimal donor site morbidity

Historically autografts are more preferred than allografts because of reduced disease transmission, superior mechanical property. The various autografts used are :

1. Bone Patellar Tendon Bone Graft
2. Hamstring Graft
3. Quadriceps Tendon
4. Tensor Fascia Lata

OPERATIVE TECHNIQUE

INSTRUMENTS AND EQUIPMENTS

ARTHROSCOPE

It is an optical instrument, the most important are diameter, angle of inclination and field of view. The angle of inclination is the angle between axis of arthroscope and surface of lens. It varies from 0 to 120 degrees. Arthroscope are available in 3 various viewing angles.

- 1.9mm Arthroscope – 65degree field of view
- 2.7mm Arthroscope - 90degree field of view
- 4mm Arthroscope – 115degree field of view

The wider the field of view, the easier it makes for the observers orientation.

TELEVISION CAMERAS:

The first to introduce television cameras in arthroscopy are Mcginty and Johnson. In modern days, cameras allow greater colour resolution and improved imaging quality. Nowadays, cableless arthroscopic systems are also available.

FIBRE OPTIC LIGHT SOURCE:

It has tungsten, halogen or xenon light source. It produces 300-350 W, and one end of fibre Optic cable is connected to light source and other end to Arthroscope.

ACCESSORY INSTRUMENTS :

- Probe
- Scissors
- Basket forceps
- Grasping forceps
- Knife blades
- Monitored shaving systems

IRRIGATION SYSTEMS :

Irrigation and distension of joint is very essential for arthroscopic procedure. It is maintained by ringer lactate solution, because it is physiologic and results in minimal synovial and articular surface damage. Shinjo et.al determined that ringer lactate solution is better in maintaining meniscal integrity than normal saline solution.

TOURNIQUET :

Tourniquet are always used in arthroscopic procedure. Contraindications are thrombophlebitis and peripheral vascular disease.

Advantages are

- Increased visibility
- No postoperative morbidity when used tourniquet used less than 90 minutes.

Disadvantages

- Blanching of synovium and ischemic damage to muscles and nerves when used more than 120 minutes.

ANESTHESIA :

Usually GA or spinal anesthesia given for arthroscopic reconstruction of ACL.

ACL INSTRUMENTS

- Tendon stripper – which is used to harvest semitendinosus tendon of appropriate sizes, which can be adapted to individual particulars of the patient.

- Measuring block – tendon preparation is complimented by measuring block for accurate dimensioning of the graft. Measuring block offers simple handling, joins equal and unequal diameters of the graft.

- Tibial guide- the unique tip design is what makes the tibial target guide special as it ensures secure positioning of the drill tunnel. In addition, the length of tibial drill tunnel can be defined in advance with the help of the target guide. the usual angle kept for drilling the tibial tunnel is from 145 to 155 degrees.

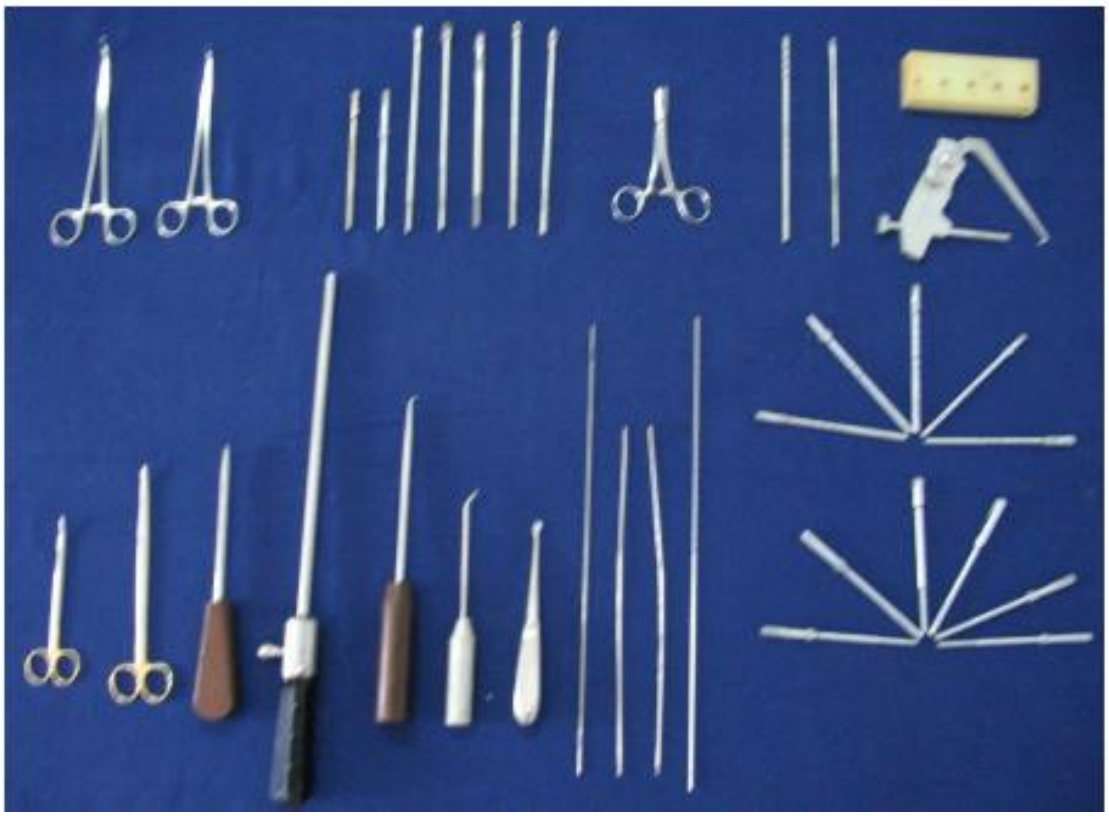
- Femoral guide – a range of different target guides with various offsets are available for use in positioning the femoral drill tunnel. These are selected depending on the diameter of the graft and applied in the `over the top' position.

- Drill bit- Following the anatomically correct positioning of the tunnels, they can then be enlarged to the required diameter with the help drill bit initially, then later drilled using various coring flower tipped drills according to the needed size of the tunnel.

- Other accessory instruments used are :

- Tendon hook, guide sleeve, tissue forceps, length gauge, collar burr, knot holder, screw driver, bone wedge chisel, mallet.

ARTHROSCOPIC INSTRUMENTS WITH DRILL BIT AND GUIDES



STANDARD ARTHROSCOPIC PORTALS :

Precise placement of portals are key to success in arthroscopy long with adequate light and distension of joint.

Standard portals used are

- Anterolateral portal
- Anteromedial portal
- Posteromedial portal
- Superolateral portal

OPTIONAL PORTALS :

- Posterolateral portal
- Proximal midpatellar medial and lateral portal
- Accessory Medial and Lateral portals
- Central Transpatellar Tendon Portal (GILLQUIST

The following are the compartments visualised following knee arthroscopy :

- Superopatellar Port and Patellofemoral joint
- Medial gutter
- Medial compartment
- Intercondylar notch
- Posteromedial compartment
- Lateral compartment
- Lateral gutter and Postero lateral compartment

PROCEDURE OF ACL RECONSTRUCTION

POSITION: Supine under Tourniquet Control

GRAFT HARVEST:

BONE PATELLAR TENDON :

Knee flexed 90degrees 4-6 cm Parapatellar incision starting from inferior pole of patella upto tibial tuberosity. Harvest 10mm wide graft or 1/3 rd of tendon using an oscillating saw , which runs 15degrees oblique to anterior cortex of patella. The cut should be 10*20mm long. 25mm long cuts made distally and tibial graft harvested.

HAMSTRING GRAFT :

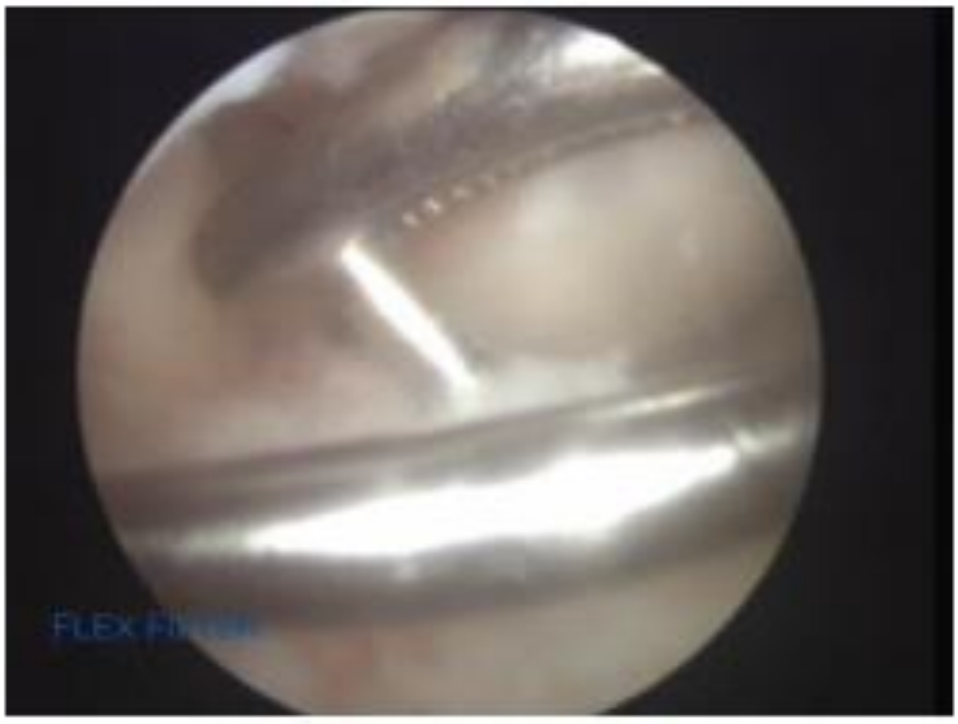
Make a 4cm incision anteromedially starting 4cm distal to joint line and 3cm medial to tibial tuberosity. Palpate gracilis tendon under semitendinous tendon with metzenaul scissors. Carry the dissection proximally upto thigh, with the curved hemostat dissect gracilis and semitendinosis tendon 3cm medial to insertion of tibia.

GRAFT PREPARATION:

Grafts harvested are placed carefully on previously prepared tables. Contour the grafts, so that it fits into appropriate trial ensuring the complete graft passage into trials.

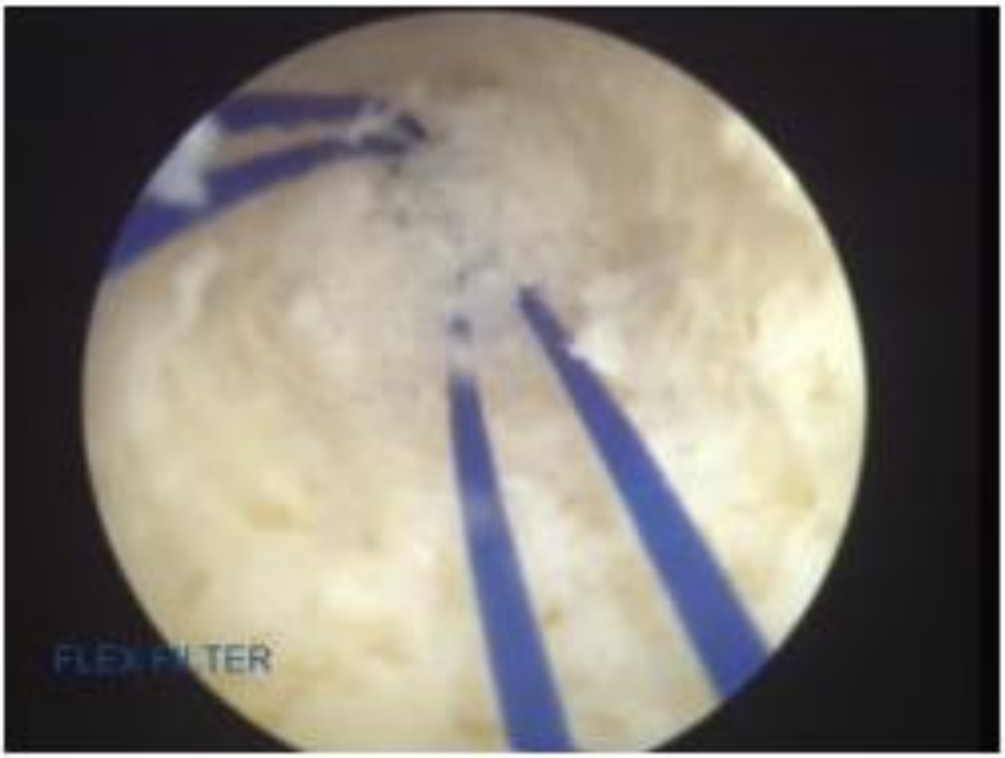
TIBIAL TUNNEL PLACEMENT:

Tibial tunnel is placed at 45 degrees sagittal angle just lateral to medial collateral ligament. The reference wire placement will be 7mm anterior to PCL insertion , 2-3mm anterior to ACL footprint . Then tibial tunnel is reamed with serial reamers.



FEMORAL TUNNEL PREPARATION:

Visualised from anteromedial portal a guide is placed just anterior to anteromedial bundle that is leaving 2mm of posterior wall and 5mm of femoral articular surface. Knee is flexed 120 degrees and flat blade reamer is used. If it is in desired position, ream a tunnel upto 30mm.



GRAFT PASSAGE:

The graft along with sutured loops with tails are passed which tails through the femoral tunnel and out through lateral thigh. Retrieve the loop through femoral tunnel. Flexible guide wire passed through medial portal and graft is passed through tibial tunnel such that 2cm of bone plugs remain in tibial and femoral tunnel for fixation of graft.

GRAFT FIXATION :

FEMORAL FIXATION :

Is done by interference screw/endobutton through the anterio 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 is flush with the end of the bone block. Look for impingement in full extension; lateral wall impingement is safely and easily addressed With a curette. The ideal placement of tunnel is in the foot print of the native ACL on femur which roughly corresponds to 9:30 ‘O clock for right knee and 1:30 ‘O clock position for left knee to minimize impingement.

TIBIAL FIXATION:

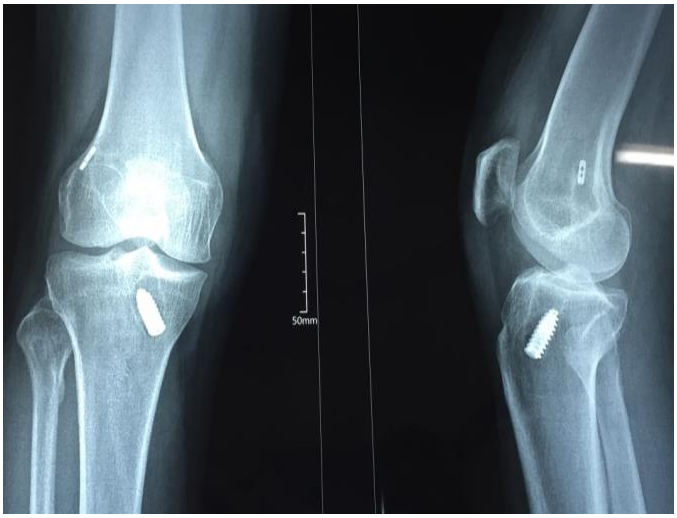
The knee is cycled through a full range of motion for about 20 times (TENSIONING). The knee is then brought to full extension, maximal manual tension applied to sutures of the graft appropriate sized interference screw applied at anterior interface of the graft with the knee placed in 20-30 of flexion for the initial purchase and in full extension as the screw advances.

BONE PATELLAR TENDON:

Graft is fixed with interference screw on the femoral side. Then knee is cycled through full range of motion for about 3 minutes(tensioning) and the knee is brought to full extension and interference screw is applied.

HAMSTRING :

For hamstring graft, the femoral side is fixed with endobutton and after tensioning for 3 minutes, tibial tunnel is fixed with interference screw.



CLOSURE :

Thorough wound wash given wound closed in layers and 14 sized suction drain is kept and compression dressing applied.

POST OP PROTOCOL:

REHABILITATION:

ZERO TO 2 WEEKS

- Patellar mobilisation (emphasize superior and inferior glides)
- Prone towel pulls
- Pillow under heel
- Edema control
- Sleep in brace locked in extension

2 WEEKS UP TO 6 MONTHS:

- Isometric Q exercises
- Exercise bike
- Roving exercises
- ROM 0 to 120 deg
- FWB without crutches

AFTER 6 MONTHS:

- Plyometric shuttle program
- Jump rope
- Jogging program

END OF 9 MONTHS;

Return to sports

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

OBSERVATION

This study comprised of 20 patients who were admitted in the department of Orthopaedics Govt. Stanley Medical College Hospital. The following are the observations and results Compiled at the end of the study.

Table No. 1

AGE WISE DISTRIBUTION (n=20)

S. No.	Age group (in years)	No. of cases	Percentage (%)
1	21-30	11	55
2	31-40	5	25
3	41-50	4	20

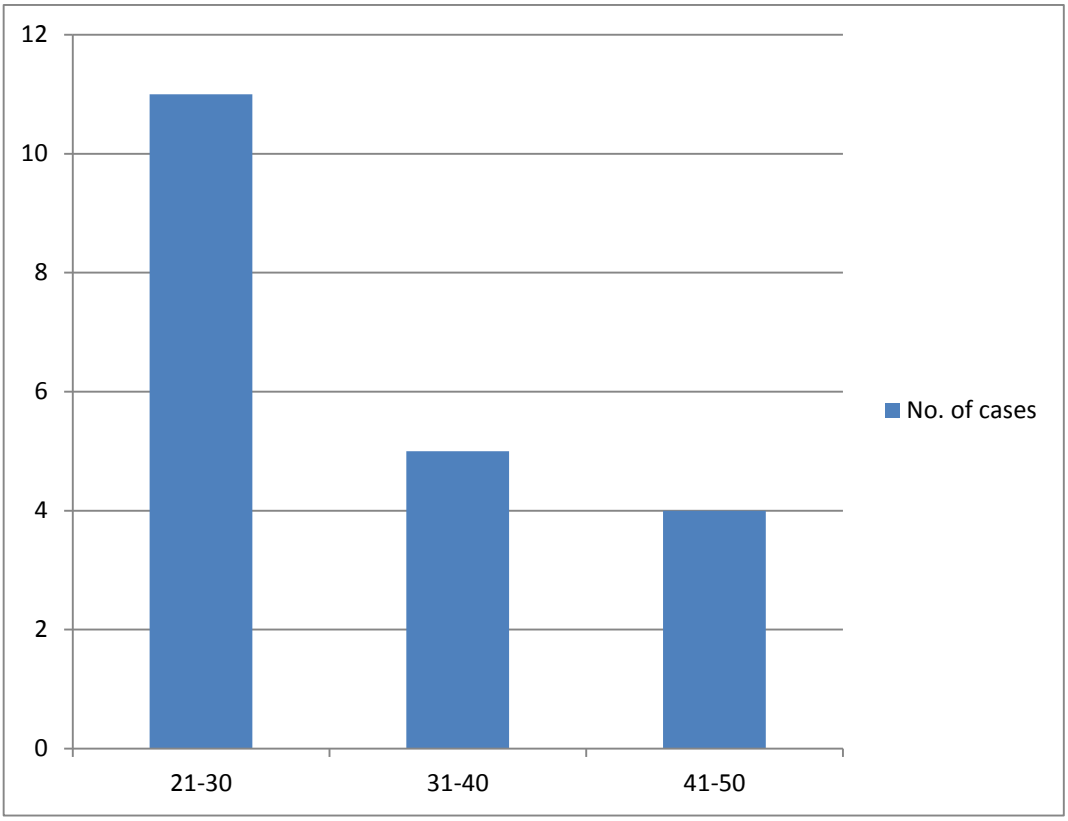


Table No. 2

SEX WISE DISTRIBUTION 9(n=20)

SEX		GROUP		Total
		GROUP HAM	GROUP BPT	
Male	Count	10	10	20
	% within Group	100.0%	100.0%	100.0%
Total	Count	10	10	20
	% within Group	100.0%	100.0%	100.0%

In my study all the patients were males (n=20).

Table No. 3

SIDE WISE DISTRIBUTION

		SIDE	Group		Total
			Group HAM	Group BPT	
	RIGHT	Count	3	6	9
		% within GROUP	30.0%	60.0%	45.0%
	LEFT	Count	7	4	11
		% within GROUP	70.0%	40.0%	55.0%
Total		Count	10	10	20
		% within GROUP	100.0%	100.0%	100.0%

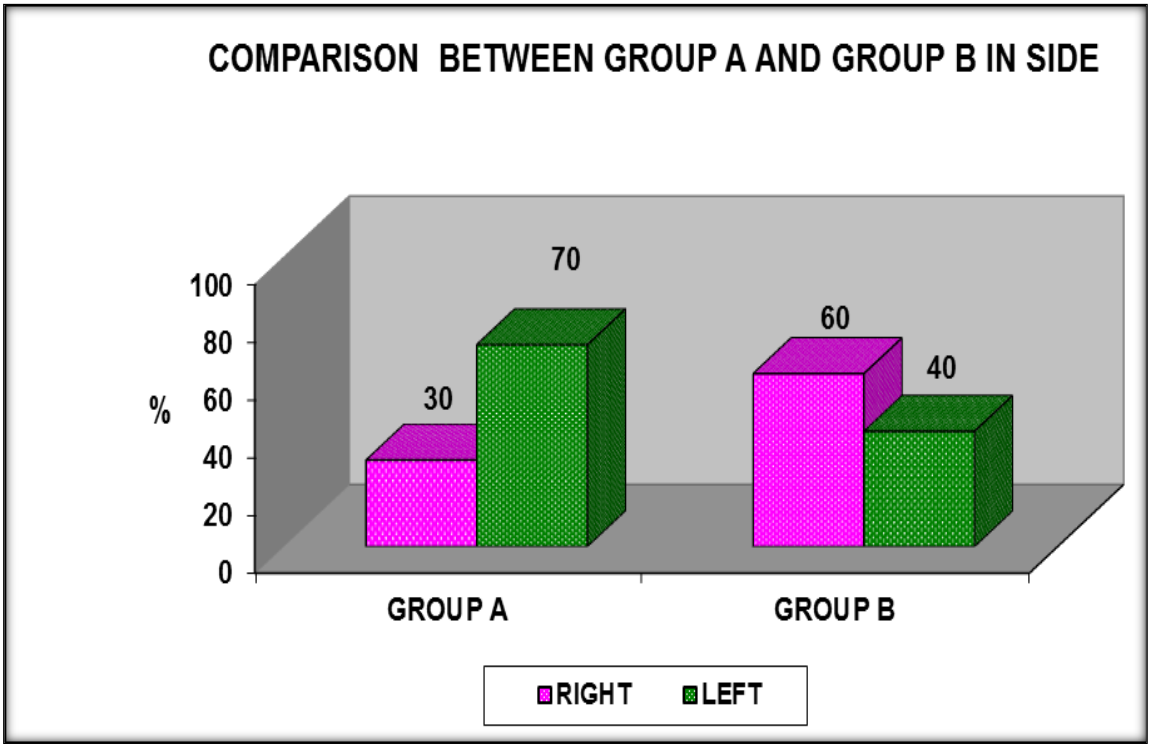


Table No. 4

MODE OF INJURY

MODE OF INJURY		GROUP		Total
		GROUP HAM	GROUP BPT	
RTA	Count	6	8	14
	% within GROUP	60.0%	80.0%	70.0%
SPORTS	Count	4	2	6
	% within GROUP	40.0%	20.0%	30.0%
Total	Count	10	10	20
	% within GROUP	100.0%	100.0%	100.0%

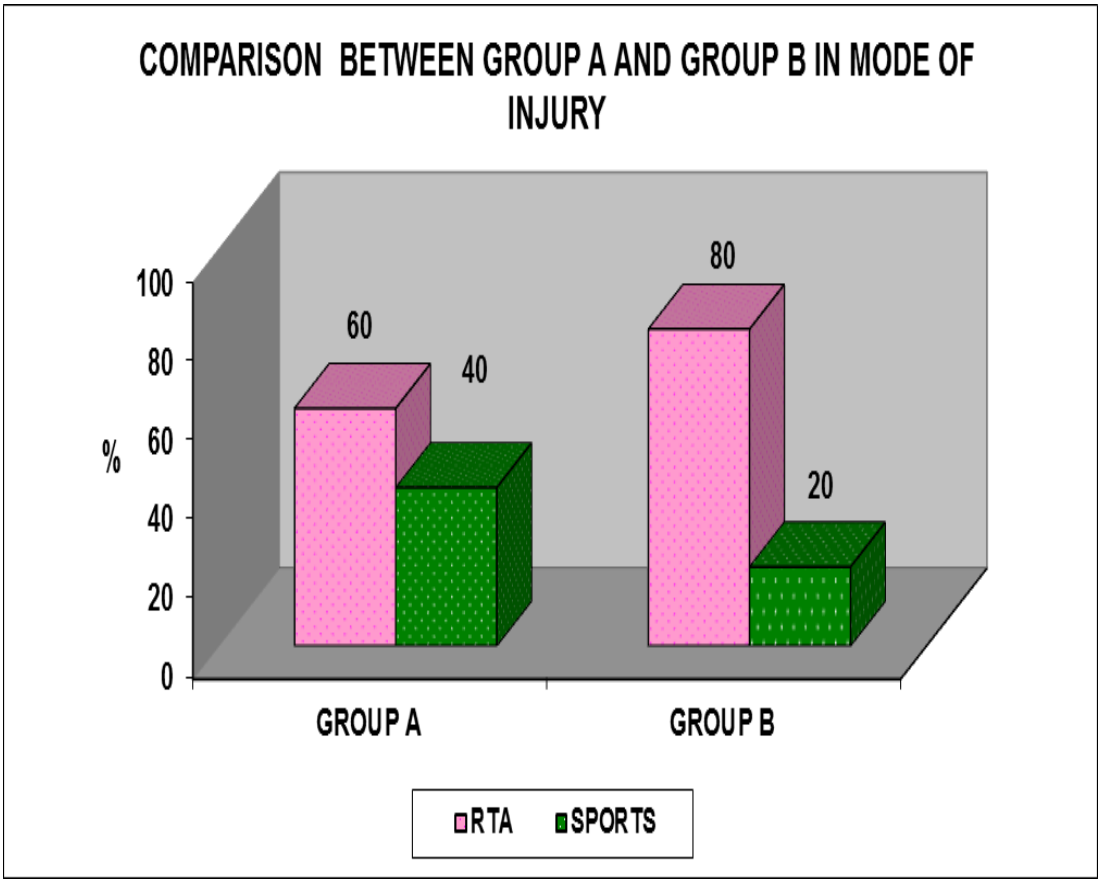


Table No. 5

ASSOCIATED INJURIES

ASSOCIATED INJURY		GROUP		Total
		Group HAM	Group BPT	
MMT	Count	3	1	4
	% within GROUP	30.0%	10.0%	20.0%
NIL	Count	7	9	16
	% within GROUP	70.0%	90.0%	80.0%
Total	Count	10	10	20
	% within GROUP	100.0%	100.0%	100.0%

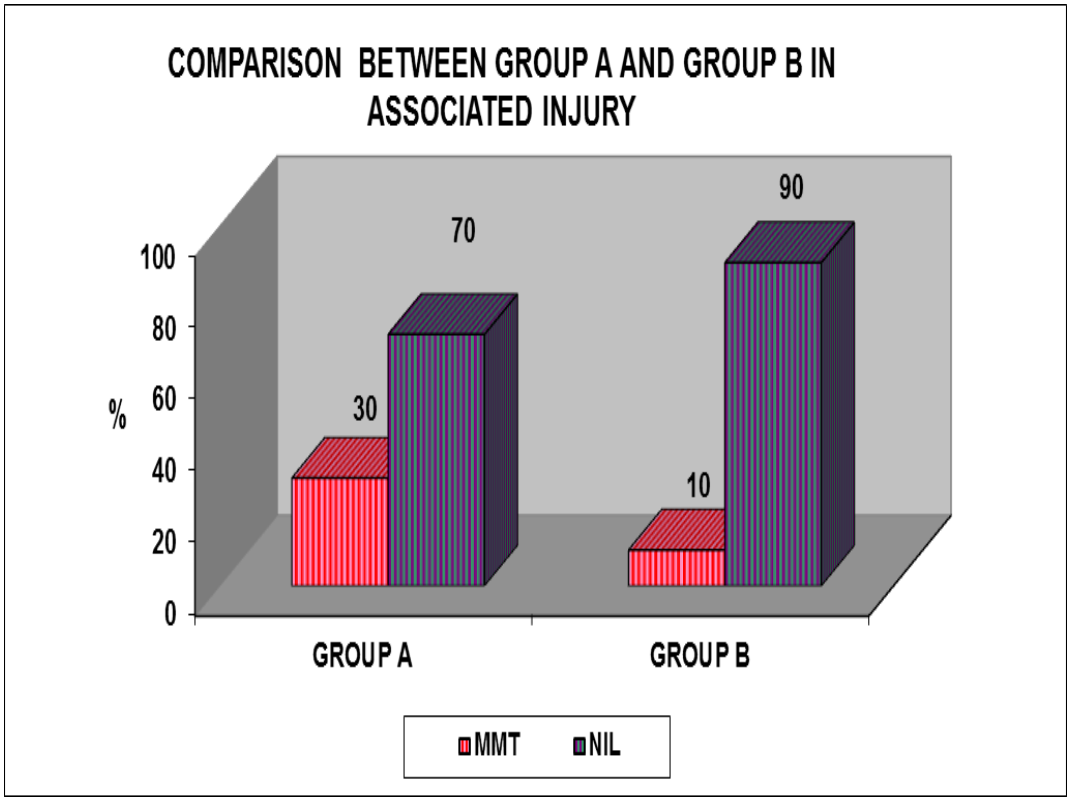


Table No. 6

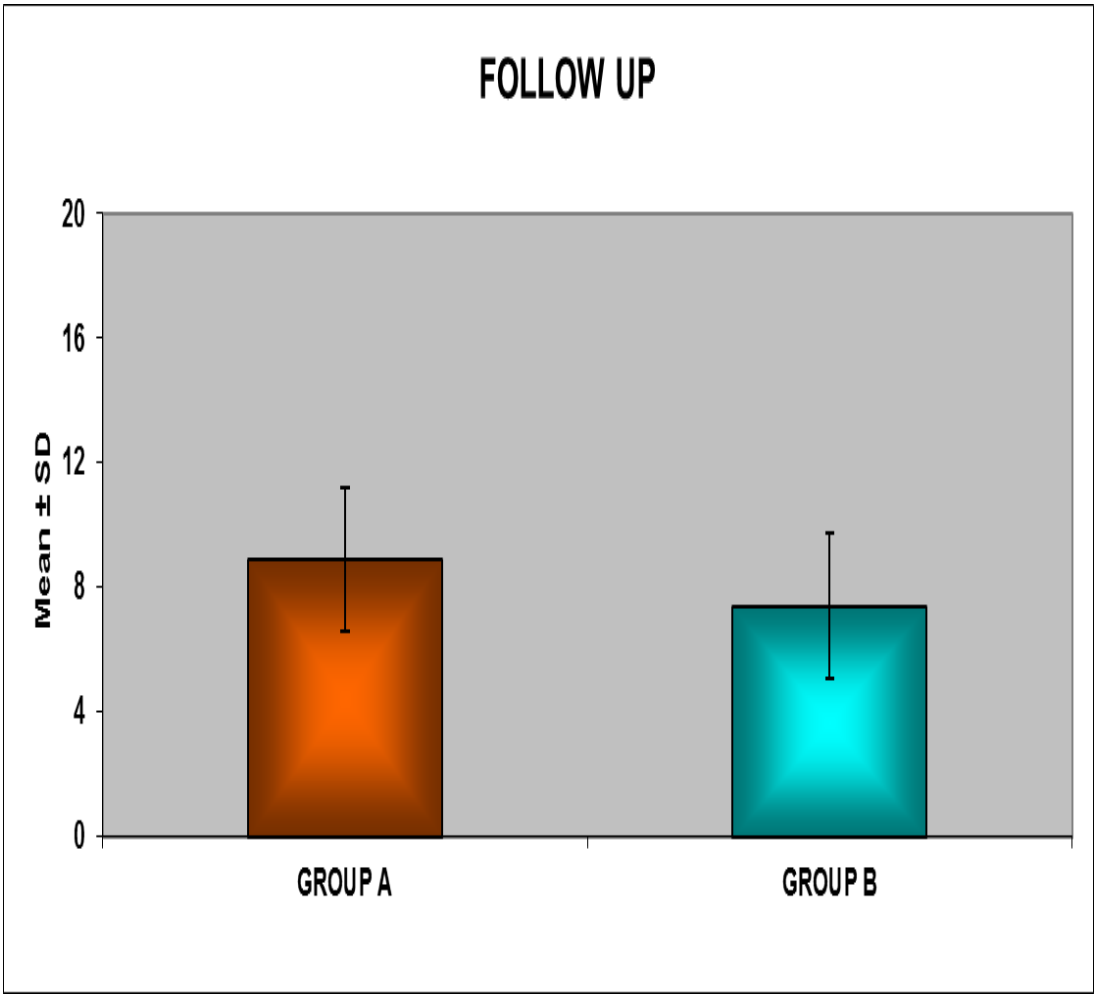
TIME SINCE INJURY

	Group	N	MEAN (Months)
TIME SINCE INJURY	GROUP HAM	10	7.40
	GROUP BPT	10	13.70

Table No. 7

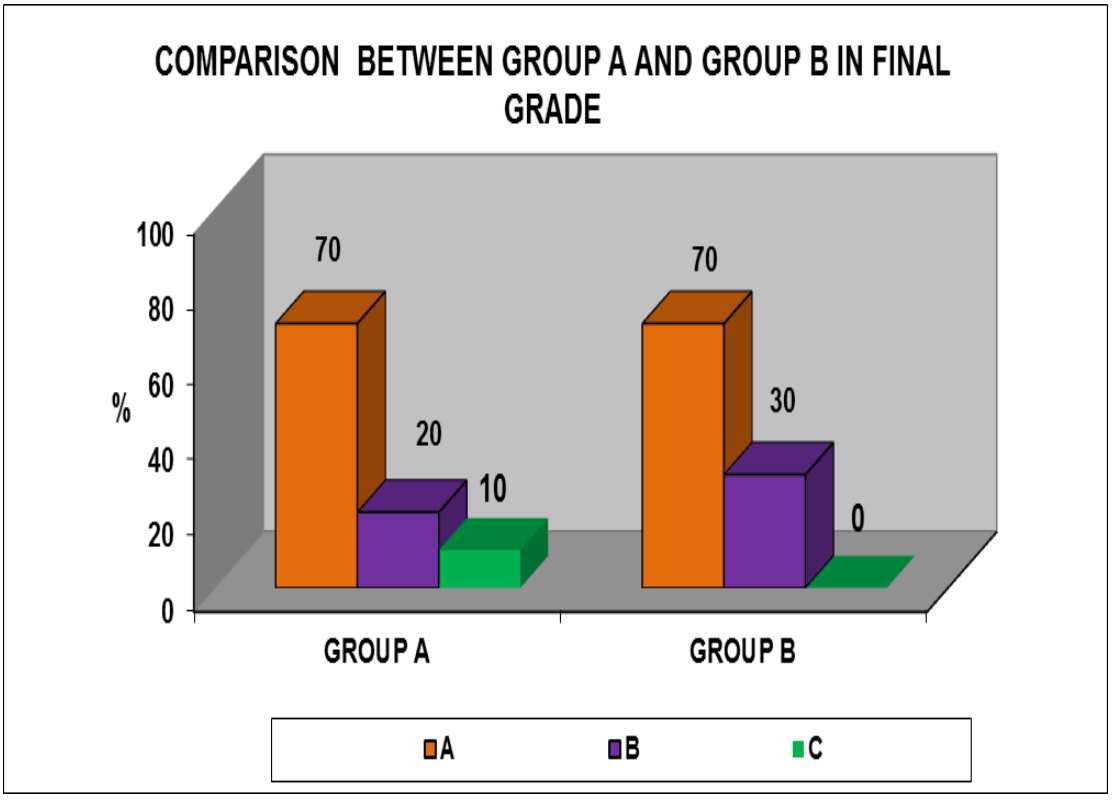
FOLLOW UP

	GROUP	N	Mean (Months)
FOLLOW UP	Group HAM	10	8.90
	Group BPT	10	7.40



FINAL GRADE * GROUP

			GROUP		Total
			Group HAM	Group BPT	
FINAL GRADE	A	Count	7	7	14
		% within GROUP	70.0%	70.0%	70.0%
	B	Count	2	3	5
		% within GROUP	20.0%	30.0%	25.0%
	C	Count	1	0	1
		% within GROUP	10.0%	.0%	5.0%
Total		Count	10	10	20
		% within GROUP	100.0%	100.0%	100.0%



DISCUSSION

The aim of ACL reconstruction procedure is to allow the patient to return to normal routine activity avoiding further meniscal damage and having normal knee function. The most commonly used grafts in ACL reconstruction are bone patellar tendon and hamstring graft. Each has its merits and demerits, in this study we compare the functional outcome of ACL reconstruction by using Hamstring graft(10), Bone Patellar Tendon(10) done in Government Stanley Medical College and Hospital from period of APRIL 2016 TO MAY 2017.

1. AGE WISE DISTRIBUTION:

Most of the patients in this study were from second and third decade of life. Manage of the hamstring group is 31.5 and bone patellar tendon group is 30.1. the combined mean is about 30.8. this indicates that young and active people were most often involved.

Albert O Gee in his study concluded that ACL reconstruction which was done on patients less than 40 years of age had a better outcome.[23]

1. SEX DISTRIBUTION:

In this study, all patients(20) were males and no female patients were there in our study. However in study conducted by Munro. BJ has stated that girls involving in sports activity have 8 times more chance of suffering ACL injury than boys[24]. The reason which he has given was

- Narrower intercondylar notch and smaller ACL
- Wider pelvis
- More lax ligaments
- Slower reflex time
- Greater quadriceps/hamstring strength ratio
- Changes in Estrogen level
- Flat footed landing

However in comparing the outcome of the male and females after ACL reconstruction Ferrari JD has stated that outcomes are similar in both groups with equal chances of failure[25].

2. MODE OF INJURY:

In this study, the mode of injury of the patients were RTA and Sports injury. In this RTA accounts for about 70%(14) of total injury, were as Sports injury accounts for about 30%(6) of total injury. Chapell Et al suggested that ACL torn during sports activity are usually from non contact sports[26]. RTA is due to direct trauma to the knee or may be due to dashboard injury or fall from height with the twisting force

3. SIDE WISE DISTRIBUTION:

We have studied 20 cases of ACL tear, amongst the 10 cases operated by Hamstring graft, 3(30%) patients were found to have ACL tear on the right side and 7(70%) were found to have tear on left side. Amongst the 10 cases operated by bone patellar tendon, 6(60%) were found to have right sided tear and 4(40%) were found to have left sided tear.

4. ASSOCIATED INJURIES:

In this study, 3(15%) patients have associated medial meniscus tear and the remaining patients have isolated ACL tear. Of the three meniscal injury partial meniscectomy was done along with ACL reconstruction for these patients.

In a study conducted by Hagino T., the incidence of meniscal tear associated with injury is higher in chronic cases[27]. Early ACL reconstruction is recommended also for prevention of secondary meniscal tear.

5. TIME SINCE INJURY:

In this study, the minimum time taken for surgery is 2 months and maximum is 3 years after injury. In both the groups, the average time taken for surgery in Hamstring group is 7.40 months and average time taken for surgery in Bone patellar tendon group is 13.40 months. The mean average of both the groups were 10.4 months. In the study conducted by Hartmann, the ACL injury is a significant factor for developing secondary knee osteoarthritis[28]. The relative risk of osteoarthritis is doubled each year after ACL injury.

6. COMPLICATIONS:

The common complications encountered in Arthroscopic ACL reconstruction are:

- Persistent pain (most common)
- Instability
- Joint swelling
- Infection
- Stiff knee
- Deep venous thrombosis

In our study, superficial wound infection was seen in 1 case of bone patellar tendon which was treated with intra venous antibiotics and got settled. In 1 case of hamstring graft, implant got infected leading to screw pull out and the patient lost follow up.

In a study conducted by David N. Garras stated that early diagnosis of infection and appropriate treatment are necessary to prevent cartilage damage and Arthrofibrosis[29].

Three cases of bone patellar tendon had an anterior knee pain with mild joint effusion which is 30%. In 2001, Eriksson Et al published a comparison between two graft types and found no difference in incidents of anterior knee pain except on kneeling[30].

In one case of Hamstring graft, there is an extension lag of about 5 degrees. Out of 6 sportsmen who were operated, 4 persons have returned to their normal routine sports activity following ACL reconstruction.

7. FUNCTIONAL OUTCOME :

In the post operative functional outcome of bone patellar tendon and hamstring graft is measured by IKDC knee scoring. In this scoring we take various factors like Effusion, Passive motion deficit, Ligament examination which includes Lachmann, Pivot shift, AP translation and also took considerations on harvest site and X-ray findings.

Functional outcomes were normal in 7 cases of hamstring graft and nearly normal in about 2 cases and abnormal in 1 case. In bone patellar tendon, 7 cases were normal and 3 cases were nearly normal. There were no cases of severely abnormal in our studies and the significance between the two groups was not established.

Advantages of bone patellar tendon graft:

- Closest resemblance to torn are the length of both ACL and BPT are equal.
- Bone to bone healing is always better and considered to be strongest.

Advantages of hamstring graft:

- Small incision (less chances of infection)
- Less anterior knee pain
- Range of motion returns faster.

CONCLUSION

20 patients of ACL injury were studied. There were 10 patients operated with hamstring graft and 10 patients operated by bone patellar tendon graft. In the study we compared the functional outcome of bone patellar tendon graft and hamstring graft.

1. The claimed advantage of hamstring graft is that it has less donor site morbidity than bone patellar tendon , it is therefore associated with anterior knee pain and pain on kneeling .

2. The mechanical advantage rests with the bone patellar tendon as in previous studies the bone to bone integration is much better when compared to hamstring grafts . Micheal Hnues[31] stated in this study that the bone patellar tendon has higher post operative activity levels than hamstring grafts.

3. In our study there were same post operative protocol followed for both the sets of patients.

4. The p value between the two groups is not significant it is >0.05 , and therefore the functional outcome of these groups were similar in this study.

5. However a study with larger study group might yield a varying outcome .

CASE ILLUSTRATIONS

CASE 1

NAME OF THE PATIENT : **Mr. Satish**

AGE/ SEX : **26/M**

IP: NO : **1723652**

THE HISTORY : **2 yrs old injury/ sports (athletics) /right knee**

ANTERIOR DRAWER TEST : P**ositive**

THE LACHMAN TEST : **positive**

PLC INJURY : **nil**

PIVOT SHIFT TEST : **positive**

OSTEOCHONDRAL DAMAGE ; **nil**

ASSOCIATED MENISCAL INJURY : **nil**

ACTIVITY LEVEL OF THE PATIENT : **Moderate**

TYPE OF GRAFT : BONE PATELLAR TENDON

FIXATION : interference screws

FINAL OUTCOME : NORMAL **(A)**

PRE OP XRAY

MRI

Immediate Post Op Xray

Post Op Xray At 7 Months

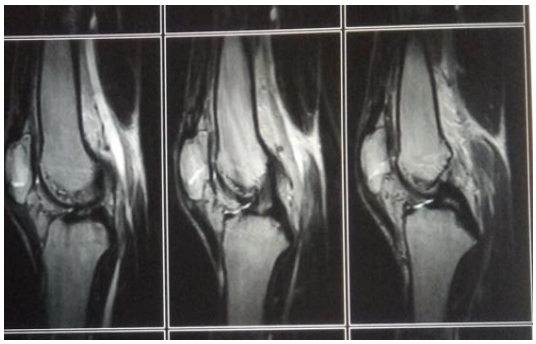
CLINICAL IMAGES

CASE 2

NAME OF THE PATIENT	:	**Mr. Silambarasan**
AGE/ SEX	:	**22/M**
IP: NO	:	**1734009**
THE HISTORY	:	**6 months old injury/ RTA /right knee**
ANTERIOR DRAWER TEST	:	**positive**
THE LACHMAN TEST	:	**positive**
PLC INJURY	:	**nil**
PIVOT SHIFT TEST	:	**positive**
OSTEOCHONDRAL DAMAGE	:	**nil**
ASSOCIATED MENISCAL INJURY	:	**MEDIAL MENISCUS**
ACTIVITY LEVEL OF THE PATIENT:		**Moderate**
TYPE OF GRAFT	**:**	**Bone Patellar Tendon With Partial Meniscectomy**
FIXATION	:	**interference screws**
FINAL OUTCOME	**:**	**NEARLY NORMAL (B)**

PRE OP XRAY

MRI



Immediate Post Op Xray

Post Op Xray At 5 Months

CLINICAL IMAGES

CASE 3

NAME OF THE PATIENT	:	**Mr. Jhonson**
AGE/ SEX	:	**27/M**
IP: NO	:	**1673119**
THE HISTORY	:	**2 months old injury/ sports(football) /left knee**
ANTERIOR DRAWER TEST	:	**positive**
THE LACHMAN TEST	:	**positive**
PLC INJURY	:	**nil**
PIVOT SHIFT TEST	:	**positive**
OSTEOCHONDRAL DAMAGE	:	**nil**
ASSOCIATED MENISCAL INJURY	:	**nil**
ACTIVITY LEVEL OF THE PATIENT	:	**Moderate**
TYPE OF GRAFT	:	**HAMSTRING GRAFT**
FIXATION	:	**interference screw with endobutton**
FINAL OUTCOME	:	**NORMAL (A)**

PRE OP XRAY

MRI

Immediate Post Op Xray

Post Op Xray At 6 Months

CLINICAL IMAGES

CASE 4

NAME OF THE PATIENT	:	**Mr. William Issac**
AGE/ SEX	:	**41/M**
IP: NO	:	**1568866**
THE HISTORY	:	**2 months old injury/ sports(jumping) /left knee**
ANTERIOR DRAWER TEST	:	**positive**
THE LACHMAN TEST	:	**positive**
PLC INJURY	:	**nil**
PIVOT SHIFT TEST	:	**positive**
OSTEOCHONDRAL DAMAGE	:	**nil**
ASSOCIATED MENISCAL INJURY	:	**nil**
ACTIVITY LEVEL OF THE PATIENT	:	**Moderate**
TYPE OF GRAFT	**:**	**HAMSTRING GRAFT**
FIXATION	:	**interference screw with endobutton**
FINAL OUTCOME	**:**	**NORMAL (A)**

PRE OP XRAY **MRI**

Immediate Post Op Post Op At 12 Months

CLINICAL PICTURE

MASTER CHART

CASES DONE WITH HAMSTRING GRAFTS

NAME	AGE	SEX	IP NO.	SIDE	MODE	TIME SINCE INJURY	ASSOCIATED INJURY	TREATMENT	FOLLOW UP	OA CHANGES	FINAL GRADE
VIJAYAKUMAR	34	M	1613790	RIGHT	RTA	6MONTHS	MMT	HAM	10MONTHS	NIL	B
PAWAN	20	M	1630250	LEFT	SPORTS	5MONTHS	NIL	HAM	7MONTHS	NIL	A
WILLIAM ISSAC	41	M	1568866	RIGHT	SPORTS	2MONTHS	NIL	HAM	12MONTHS	NIL	A
DEVANATHAN	29	M	1620249	LEFT	SPORTS	6MONTHS	NIL	HAM	8MONTHS	NIL	B
VEERABADRAN	47	M	1658391	LEFT	RTA	6MONTHS	NIL	HAM	11MONTHS	NIL	A
RAMESH BABU	33	M	1601847	LEFT	RTA	2MONTHS	NIL	HAM	8MONTHS	NIL	A
MUTHUKUMAR	25	M	1642727	LRFT	RTA	6MONTHS	NIL	HAM	6MONTHS	NIL	C
ILAVARASAN	36	M	1606524	RIGHT	RTA	3YEARS	MMT	HAM,PMM	9MONTHS	MODERATE	A
DEVENDRAN	23	M	1559282	LEFT	RTA	3MONTHS	MMT	HAM,PMM	12MONTHS	NIL	A
JOHNSON	27	MALE	1673119	LEFT	SPORTS	2MONTHS	NIL	HAM	6MONTHS	NIL	A

CASES DONE WITH BONE PATELLAR TENDON GRAFT

NAME	AGE	SEX	IP NO.	SIDE	MODE	TIME SINCE INJURY	ASSOCIATED INJURY	TREATMENT	FOLLOW UP	OA CHANGES	FINAL GRADE
SATHISH	26	MALE	1723652	RIGHT	SPORTS	2YEARS	NIL	BPT	7MONTHS	NIL	A
SILAMBARASAN	22	MALE	1734009	RIGHT	RTA	6MONTHS	MMT	BPT,PMM	5MONTHS	NIL	A
RAMESH BABU	32	MALE	1601847	LEFT	RTA	3YEARS	NIL	BPT	8MONTHS	MILD	A
NAGARAJ	22	MALE	1721123	LEFT	SPORTS	3MONTHS	NIL	BPT	6MONTHS	NIL	A
HARI BABU	42	MALE	1632425	RIGHT	RTA	8MONTHS	NIL	BPT	8MONTHS	NIL	B
VINOTH KUMAR	38	MALE	1635297	RIGHT	RTA	3MONTHS	NIL	BPT	6MONTHS	NIL	B
TAMILSELVAN	41	MALE	1560799	LEFT	RTA	3YEARS	NIL	BPT	11MONTHS	NIL	A
SARAVANAN	25	MALE	1646580	RIGHT	RTA	3MONTHS	NIL	BPT	4MONTHS	NIL	A
NANDAGOPAL	26	MALE	1652796	LEFT	RTA	1YEAR	NIL	BPT	8MONTHS	NIL	A
MUTHUKUMAR	27	MALE	1641398	RIGHT	RTA	6MONTHS	NIL	BPT	11MONTHS	NIL	B