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Do All Grafts Give Same Functional Outcome in Normal Population After ACL Reconstruction?

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ABSTRACT

- ***Background:***

In the treatment of anterior cruciate ligaments injuries in both young athletes and the general population, arthroscopic reconstruction has emerged asthe gold standard. Anterior cruciate ligament injuries have been steadily rising as the frequency of road traffic accidents and the number of young athletes participating in sports activities rise. The primary goal of surgery and the rehabilitation process is to rebuild the damaged ligament with an appropriate graft that provides a good functional outcome in the post-operative knee. Analysis of the literature revealed multiple graft options, including the semitendinosus tendon, quadriceps tendon, patellar bone graft, peroneus longus tendon, and other allografts, in their order of use. Recently peroneus longus tendon and semitendinosus tendon are being used in our college for the reconstruction of the injured ACL ligament. The goals of the treatmentare to restore the function of injured knee and to help the patient return to his physicalactivities as early as possible.

- ***Objectives: 1)***

To compare the functional outcome after arthroscopic anterior cruciate ligament reconstruction using peroneus longus tendon graft and semitendinosus graft 6 months postoperatively, in patients with anterior cruciate ligament injury. 2) To assess the risk factors associated with poor functional outcome.

- ***Materials and Methods:***

A cross sectional study based on 60 patients divided into 2 groups, who had undergone ACL reconstruction with peroneus longus and semitendinosus tendon grafts, treated in the orthopaedic department ofGovernment Medical College, Thiruvananthapuram was done. Study was done during the 6th month follow up from the time after surgery in the Orthopaedic outpatient department. Data was collected using structured proforma, questionnaire, physical examination and functional outcome analysed based on IKDC subjective score and Lysholm's score.

- ***Results:***

We have done the study on 60 patients ,30 patients each with peroneus longus and semitendinosus graft. Functional outcome with IKDC subjective scoring and Lysholm scoring and physical examination were done on the 6th month of follow up. In our study, more than 80% of the subjects were males in both the groups and all were in the group range of 20 to 40 years. The most common mode of injury in our study was Road Traffic Accident which accounts for 55% of the total cases. Sports related injury accounted for 30% of the patients. Other modes of injury in our study included fall from height, slip and fall. Left side was more involved in peroneus longus population while equal distribution in semitendinosus population. 80% of the patients showed a negative Lachman's test while 1+ laxity and 2+ laxity was shown by was shown by 16.66% and 3.3% of patients respectively for peroneus longus population. For semitendinosus group, 90% showed normal test, 6.6% showed 1+ laxity and 3.3% showed 2+ laxity. Pivot shift test showed a negative result in 90% patients, Pivot glide was shown by 6.6% of patients. Only 1 patient had a gross pivot shift for peroneus longus while for semitendinosus, 93.3% showed negative, 6.6% showed pivot glide and no gross pivot shift was noted. Functional outcome was measured using IKDC subjective scoring system and Lysholm knee scale. IKDC subjective score ranged from 71.3-93.2for peroneus longus and 79.1-97.2 for semitendinosus. Mean IKDC score was 85.9 and 91.8 respectively for peroneus longus and semitendinosus. Higher mean IKDC score was shown by the patients in the age group between 20-25. Subsequent age group showed a trend of decline in mean IKDC subjective score with increasing age group. The Odds ratio of younger age group having normal/good score is 2 times higher than older population for peroneus longus with a significant p value of 0.048*. For semitendinosus graft, there was neither a significant p value nor an odds ratio. Thus we could conclude that as age increases, functional outcome with peroneus longus graft decreases but not of semitendinosus. Hence caution must be there while picking peroneus tendon as graft for ACL reconstruction in older population. At 6 months of follow-up 90% and 96% of the patients showed a normal or nearly normal outcome for peroneus longus and semitendinosus respectively while 10% patients of peroneus and 3.3% of semitendinosus got an abnormal or severely abnormal outcome in terms of IKDC subjective score. Lysholm scoring was also done post-operatively in our studies. 16.6% of both the population showed excellent outcome while 73.3% and 80% respectively of peroneus and semitendinosus population showed good outcome. The highest mean Lysholm score was obtained in the age group of 20-25. The lowestmean Lysholm score was in the age group 36-40 for both the groups. The mean Lysholm score showed a similar trend like that of the IKDC score, with the increasing age group, the mean Lysholm score showed a decline in value. The mean Lysholm score was 90.6 and 91.6 respectively for peroneus and semitendinosus.

- ***Conclusion:***

Anatomic single bundle reconstruction of the anterior cruciate ligament of the knee with quadrupled Peroneus longus tendon graft and semitendinosus graft gives good functional results for both with latter having better outcome in terms of IKDC subjective score and Lysholm's score. Functional outcome decreases with increase in the age group with peroneus longus graft. Road traffic accidents were the most common cause of ACL injury in our study. Arthroscopic anterior cruciate ligament reconstruction with Peroneus longus tendon graft and semitendinosus graft are both good nut semitendinosus being the better option for anterior cruciate ligament deficient knees.

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Keywords:- *Anterior Cruciate Ligament; Reconstruction; Peroneus Longus; Semitendinosus; Sports Injury; Rta; Subjective Score; Functional Outcome.*

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CHAPTER ONE
INTRODUCTION

One of the most frequent sports injuries is anterior cruciate ligament (ACL) damage. For critical sporting activity, the ACL serves as the knee's primary stabiliser. Hay Groves is credited with performing the first cruciate ligament repair in 1917. When Jones, Erickson, and Macintosh all recommended ACL reconstruction over patellar tendon repair, the current phase of treatment got underway. Arthroscopy has been thekey to unlocking the diagnosis of knee pathologies. The main goal of ACL reconstruction is to increase a person's ability to cut, pivot, and decelerate swiftly. Injuries to the anterior cruciate ligament occur frequently in young, energetic people. Non-surgical treatments cause painful meniscal tears and early-onset osteoarthritis. There are variety of surgical methods from internal bracing with repair, auto grafts with bone patellar tendon bone, hamstrings, quadriceps tendon, quadriceps tendon bone and peroneus longus tendon and variety of allografts. There was a lot of graft selection, include hamstring tendon, bone-patellar tendon-bone (BPTB), synthetic graft. The BPTB graft is still considered to be the gold standard graft in reconstruction (1). The biomechanical toughness of BPTB is comparable to native ACL. With an excellent long-term outcome, BPTB permits early, active, safe rehabilitation without raising the risk of graft failure (1,2). The potential morbidities associated with BPTB, however, include pain in the patellofemoral joint, loss of motion, and patellar fracture (3). Thus, some orthopaedic surgeons try to use peroneus longus tendon as a graft. Today, various surgeries, such as deltoid ligament reconstruction and medial patellofemoral ligament (MPFL) reconstruction, involve peroneus longus tendon autograft (5). Peroneus longus has synergistic function with peroneus brevis. Anothergraft option used widely is semitendinosus tendon. They have decreased donor site morbidity and almost normal knee functions after graft harvesting.

The present study is designed to compare the postoperative functional outcome of arthroscopic Anterior Cruciate Ligament reconstruction with peroneus longus and semitendinosus auto graft fixed in femoral tunnel and in the tibial tunnel using interference screws.

- *Objectives*

- *Primary:*

To compare the functional outcome of arthroscopic anterior cruciate ligament reconstruction using peroneus longus tendon and semitendinosus tendon graft at 6 months postoperatively.

- *Secondary:*

To assess the risk factors associated with poor functional outcome.

- *Background and Review of Literature*

ACL injuries occur 1 in every 3000 people in the general population. Meniscal injuries, knee instability, and early osteoarthritic changes might result from it if not addressed. Goal of anatomic reconstruction of ACL is to regenerate a stable knee that allow return to sports and daily activities. It is routine practise to repair knee ligaments in order to regain stability and functionality. Different grafts are used to restore the anterior cruciate ligament (ACL). With varying degrees of success, allografts, autografts, and synthetic grafts have been employed. The autografts have stood the test of time and have regularly produced positive clinical outcomes. The autografts with the highest acceptance rates are the hamstring and patella bone tendongrafts. The additional autografts are fascia lata, patellar tendon, and quadriceps. Despite the fact that these grafts are frequently employed, disputes on the best graft touse continue due to a few drawbacks (1,2).

ACL as a joint stabilizer which restricts the abnormal translation was 1st explained by Galen (3) (Circa 170 AD). The three signs of ligament injury snaping noise, hemarthrosis, and knee function loss was explained by Amedee Bonnet (4) In 1945. ACL was 1st repaired in 1895 by A W Mayo (5). Reconstruction was done 1st using iliotibial graft in 1917 by Ernest W Hey Groves (6). Semitendinosus graft was 1st used in 1939 by Harry B Macey (8). Joseph S Torg , was a student of Lachman andexplained the Lachman test in 1976(10). Prosthetic ACL made from Dacron was developed in 1975 by Rubin, Marshall and Wary (11).

Clancy used bone patellar bone graft for ACL reconstruction. Semitendinosus and Gracilis was 1st used bu Lipscom in 1982(12). Stranded hamstring graft was usedby MJ Fredman in 1988(13). Endobutton and biodegradable interference screw was devised by Tom Rosenberg and A Staehelin respectively (15)

In their 1988 study, Ray et al. (16) examined the functional result of surgery and nonsurgical treatment for ACL injuries. In the group receiving conservativetreatment, they discovered that 50% of patients had excellent or good results and 50% had fair results or failed, whereas in the surgical group, all patients had excellent or good results with the exception of two. In their study, Cyril B. Frank et al. (17) came to the conclusion that although the results of long-term follow-up were similar, the functional outcome of arthroscopic ACL reconstruction was superior than that of openrepair in the short term.

In their study contrasting arthroscopy assisted and open surgery for ACL repair, Hamid Barzegar et al. (18) came to the conclusion that arthroscopic assisted reconstruction is preferable to open surgery. In their investigation, Musahl V et al.19

discovered that a femoral tunnel positioned in the ACL's anatomical footprint offers knee kinematics that are more similar to those of an intact knee than a tunnel positioned for the optimal graft isometry.

In their meta-analysis contrasting single bundle and double bundle ACL reconstruction, Richard B. Meredick et al. (20) observed no discernible difference between the two groups in pivot shift or KT-1000 arthrometer testing.

Establishing the ideal window for ACL reconstruction is crucial for patients, surgeons performing the procedure, and healthcare systems. The clinical success of ACL restoration within the first several weeks after injury is more significantly influenced by knee effusion, ROM deficits, and rehabilitation regimens than by the actual date of surgery. Although there aren't many prospective comparisons, themajority of experts advise having an ACL reconstruction done as soon as possible after injury to reduce the chance of further damage. Shelbourne et al. (21) showed in their landmark study that ACL reconstructions performed more than 3 weeks after the injury had occurred had a considerably reduced probability of developing arthrofibrosis than those operated within the first 3 weeks. Delaying surgery wastaken into consideration to give the knee's range of motion (ROM) time to return to normal levels and the surrounding soft tissues time to heal after the initial damage. Onthe other hand, proponents of urgent surgery have asserted that tibiofemoral stability restoration reduces the likelihood of additional meniscal and chondral damage. Early surgery also attempts to hasten the return to sporting and employment activities, with significant economic repercussions, despite the lack of detailed cost-benefit analyses. Additionally, it is believed to avoid substantial quadriceps muscle atrophy and decreased strength, which are already recognised benefits.

Smith et al in his recent analysis of 370 ACL reconstruction patients identified that there is no significant difference in outcome (KDC subjective score and lysholm score) between those who underwent reconstruction early (<3 weeks) from those donelate.

Multiple cut off points have been used in studies examining large retrospective cohorts and national registries to provide stronger comparisons. Kennedy et al. (25) showed a considerably increased risk of a medial meniscal tear when an ACL reconstruction was done six months after the injury and of degenerative changes tothe knee with surgery done a year after the injury in a single-surgeon group of 300 patients. Granan et al. (26) discovered in a sizable retrospective cohort from the Norwegian National Knee Ligament Registry that for every month that passed between the accident and surgery, the likelihood of an adult knee cartilage lesion increased by about 1%. In a most recent study, Sri-ram et al. (27) examined 5,086 patients undergoing ACL repair and discovered that delays in surgery of 5 months or longer increased the likelihood of medial meniscal surgery by a factor of two and an additional 6 months, respectively. Overall, when more than 5 months had passed since the incident, the likelihood of chondral damage increased dramatically. The PLTgraft is identical to the original ACL in terms of thickness and strength, according to arecent study by Khajotia BL et al. (28) It may be a suitable autograft alternative for ACL restoration that doesn't impair ankle function and steers clear of potential issues with hamstring and BPTB autografts taken from the knee area. Peroneus longus is an appropriate autograft source for ACL reconstruction, according to a study by Kumar VK et al. (29) based on factors including ease of harvest, appropriate size, cosmetic appeal, excellent post-operative knee scores, and the fact that removing the Peroneus longus tendon has no impact on gait parameters and doesn't cause ankle instability. Thus, it can be employed in orthopaedic procedures as an autogenous graft.

Reconstruction of ACL with peroneus longus gave similar outcome with those of hamstring at 1 year follow up due to availability of large diameter graft, less thigh wasting and excellent AOFAS score. This was demonstrated in a second study by Rhatomy, S. et al. Shi et al study (31) with two years of follow-up data confirms the structural qualities of a PLT and its safety and efficacy as a graft choice in ACL restoration with a concurrent grade III MCL tear. It would be helpful to establish the PLT as a workable autograft in revision scenarios or as an addition to existingautograft options. The advantage of semitendinosus graft was the availability of high cross- sectional areas and the unaffected integrity of extensor mechanism. Moreover the tensile strength of quadrupled hamstring graft is higher than normal ACL. Rate of return to presurgical level was more than 60% with semi T graft .

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CHAPTER TWO
RELEVANT ANATOMY

➢ *Embryology*:

The ventral condensation of foetal blastoma is the source of the ACL ligament. It develops about the eighth week of foetal development. As early as the sixteenth week of gestation, the ACL with the antero-medial and postero-lateral bundles was discovered. The menisci likewise have their origin in the same foetal blastoma.

- *Gross Anatomy:*

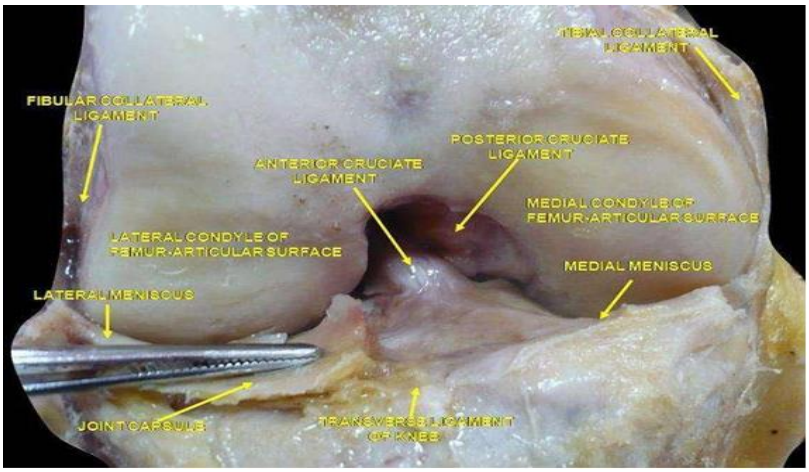

Fig 1 Gross Anatomy of Knee

The ACL joins the femur and tibia with a ring of thick connective tissue that is consistently orientated. ACL and PCL are entirely covered with synovium, which comes from the posterior intercondylar region of the knee. The cruciates are hence extra synovial but intra articular structures (32).

- *Bony Attachments*

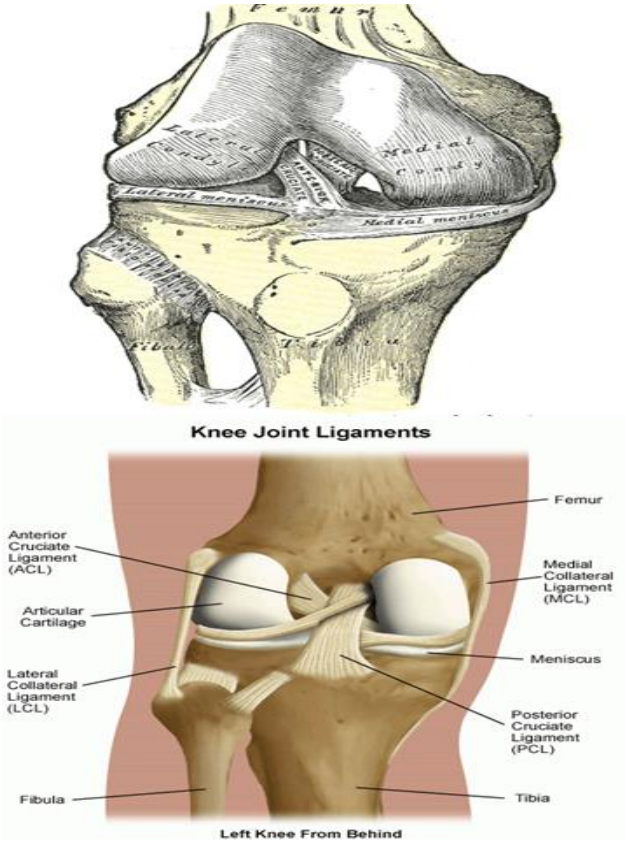

Fig 2 Bony Attachments of ACL

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The emphasis on re-establishing a "anatomical" position of the insertion toachieve as near to an isometric posture as feasible while reconstructing or replacing an ACL has drawn significant attention to the natural architecture of the ACL attachments (33,34). The proximal end of the ACL is connected to the fossa on the medial surface of the lateral femoral condyle's posterior portion. The femoral attachment resembles a portion of a circle with a convex posterior border and astraight anterior border. The lateral femoral condyle's posterior articular edge and the long axis of the femoral attachment are both somewhat forward of vertical. The origin of the ACL ligament lies well posterior in the knee and is 16 to 24 mm in diameter.

The proximal part of the ligament is where the ACL begins to fan out, resulting in a bigger tibial connection than a femoral attachment. About 5mm distal to the femoral insertion is when the ACL's distinctive "twist" begins, which also marks the beginning of the ligament's fanning out (35). The tibial attachment flares to almost twice the bulk width of the ACL in the sagittal plane, with a distinct anterior toe right at the tibial attachment that lies against and conforms to the contour of the intercondylar roof when the joint is in full extension, according to recent magnetic resonance imaging studies of human knees.

- *Spatial Orientation*

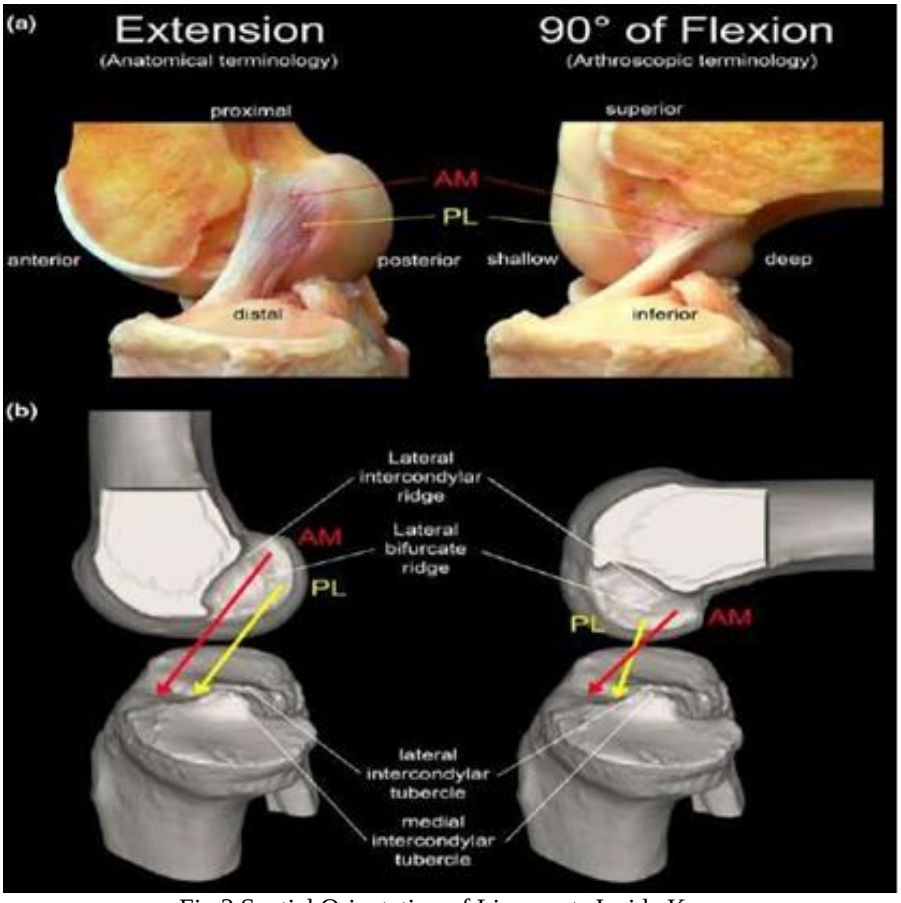

Fig 3 Spatial Orientation of Ligaments Inside Knee

The cruciate ligaments, as their name suggests cross each other as they pass from femur to tibia. This particular orientation is crucial to the function of the cruciate ligaments as they are constraints to the motion of knee joint. From the femur to the tibia, the ACL ligament runs anteriorly, medially, and distally. Additionally, it appears to spiral slightly outward on itself. This twist is most likely caused by theway its bone attachments are oriented (34). This twist's significance is unknown.

The relative stress of the ligament across the range of motion is also caused bythe direction of the ACL's femoral attachment in flexion and extension. The ACL is joined to the femur and tibia by a collection of discrete fascicles that fan out over a flat, board-like region. Depending on where they input into the tibial plateau, these fascicles are separated into two groups: the smaller antero-medial bundle and the larger postero-lateral bundle. Many authors have also made reference to an intermediary bundle.

In flexion, the antero-medial bundle stretches taut, and in extension, the postero- medial bundle stretches taut. When the knee is extended, the two bundles align themselves in a parallel position. The postero-lateral bundle's femoral insertion advances anteriorly during knee flexion, both bundles cross, the antero-medial bundle tightens, and the postero-lateral bundle becomes loose. The postero-lateral bundle andthe antero-medial bundle provide resistance to the anterior translation of the tibia during extension and flexion, respectively.

➢ *Ligament-Bone Attachment*

By incorporating the ligament's collagen fibres with the mineralized bone, the ACL is joined to the femur (36). A fibrocartilage transition zone mediates the sudden transition from elastic ligaments to stiff bone. A gradual change in stiffness and the prevention of stress concentration at the attachment site are likely made possible by this modification in the microstructure from ligament to bone. Recent experimental studies have demonstrated that tendon autografts inserted through bone tunnels restore this transition zone.

➢ *Composition*

The extracellular matrix surrounding fibroblasts make up the ACL. Type 1 collagen and water make up the majority of the extracellular matrix. The mix and interplay of these matrix elements determine the ligament's unique mechanical properties.

➢ *Collagen*

Collagen constitutes the major component of ACL ligament, constituting approximately 75% of the dry weight of the ligament. Type 1 collagen is the major type of collagen in ACL (90%) and rest is Type 3 collagen.

➢ *Elastin*

Although elastin is only found in tiny amounts in the ACL (about 5%), it plays a crucial role in the structure and operation of the extracellular matrix. Elastin contributes to some of the tensile resistance in the ligament as well as some of the ligament tissue's healing through its interactions with the collagen fibres of the ligament.

➢ *Proteoglycans*

These macro molecules make up 1% of the dry weight of the ACL. However, they have an important role in organizing the extracellular matrix and interacting withthe tissue fluid.

➢ *Glycoproteins*

These non-collagenous protein molecules (fibronectin, laminin) are thought to facilitate interactions between cells and their surrounding matrix.

➢ *Water*

Water makes up at least 60% of the wet weight of the ligament and, along with the ground material of the ligament (proteoglycans), lubricates the motion of thecollagen fibres while also giving the ligament viscoelastic qualities.

➢ *Blood Supply*

The medial and lateral inferior genicular arteries, as well as some of their terminal branches, provide some of the primary terminal branches of the ligament's major blood supply (33).

The synovial membrane, which surrounds the ligament, is densely covered in blood vessels, the majority of which come from the ligamentous branches of the middle genicular artery. The infrapatellar fat pad connects a few of the smaller terminal branches of the medial and lateral inferior genicular arteries, which in turn provide some blood vessels to the synovial plexus. In order to create a web-like network of peri-ligamentous vessels, the synovial vessels arborize. Later, they produce smaller connecting branches that pierce the ligament transversely and anastomose with a network of endo-ligamentous vessels (33). The majority of the blood that supplies the ACL comes from soft tissues (fat pad and synovium). Although the distal femoral epiphysis and proximal tibial epiphysis receive additional branches from the middle geniculate artery, the ligamentous osseous junctions of the ACL do not considerably add to the ligament's vascular system.

➢ *Nerve Supply*

The ACL has been characterised as having nerve fibres and sensory receptors, which frequently accompany arteries in the form of neurovascular bundles (37). In addition to the vasculature, several nerve fibres and various sensory end organs are also found in the ligament.

Four morphologically distinct types of sensory endings have been described in the human ACL-

- *Ruffini receptors which are sensitive to stretching and are located at the surface of the ligament, predominantly on the femoral portion where thedeformations are the greatest (38)*
- *Vater–Pacini receptors which are sensitive to rapid movements and are locatedat the femoral and tibial ends of the ACL (38)*
- *Golgi-like tension receptors are located near the attachments of the ACL as well as at its surface, beneath the synovial membrane (39)*
- *Free-nerve endings function as nociceptors, but they may also serve as local effectors by releasing neuropeptides with vasoactive function. Thus, they may have a modulatory effect in normal tissue homeostasis or in late re-modelling of grafts (38,40)*

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These anatomical findings suggest that the ACL does have a sensory function and can therefore offer some conscious awareness of joint movement and position, which is supported by clinical and experimental studies. It is yet unknown how these sensory components function in joints with or without an intact ACL.

In conclusion, the ACL is a complex structure at every level, ranging from its gross structure to its molecular organization. Although exact replication of this structure has not been accomplished.

- *Functions PF ACL:*

- The ACL is the primary stabilizer of the knee contributing 86% ofthe resistance to anterior displacement forces (41).
- It prevents hyperextension of the knee, mainly through soft tissuebuttress action in the posterior intercondylar shelf.
- The ACL affords rotator control by providing a check to internal fixation.Varus, internal rotation mechanisms are associated with incidence of ACL injuries (42)
- It offers secondary restraint to excessive varus and valgus stresses;this is significantly only after collateral ligaments have been injured.
- Tension in the ACL fine tunes the precision of the screw homemotion of the knee.

- *Evolution of Arthroscopy (43)*

One of the 20th century's most significant advancements in the diagnosis and care of orthopaedic patients is the arthroscopy. The Greek words "arthro" and "scope," which both imply "to view," were combined to create the English word "arthroscopy."

Arthroscopes first appeared on the market in 1912. "Severis Nordentoft," a Danish surgeon, published a paper in 1912 titled "On the endoscopy of closed cavitiesutilising my Trocar endoscope." He used the phrase "arthroscopia genu." He was using a device that was comparable to Jakobeus' laparoscope. His was the sole endoscopy-related paper, so his contribution was quickly forgotten.

Japanese physician Takagi examined a cadaver knee in 1918 while using a cystoscope. He helped in the creation of the arthroscope in 1920 as a result of the instrument's failure. However, the instrument's diameter was huge and made it difficult to use. Takagi created a 3.5 mm diameter arthroscope in 1931. Additionally, he discussed the usage of saline solution for knee distention and improved visualisation.

While this was happening, a Swiss surgeon named "Eugene Bircher" utilised alaproscope to see the meniscal lesions in the knee. He referred to it as an "arthroendoscopy." Takagi and Bircher are known as the "Father of arthroscopy" due to their early contributions to the development of the procedure.

Michael Burman wrote a classic study titled "Arthroscopy or the Direct Visualization of the Joints" in 1931. He also released the first arthroscopic photos ever published, twenty coloured aquarelles of arthroscopy findings of different joints.

Masaki Watanabe performed the first therapeutic arthroscopic procedure in 1955 when he removed a xanthomatous tumour from the superior recess of the knee. In 1962, he was the first to carry out an arthroscopic partial meniscectomy. His title asthe "Father of Modern Arthroscopy" is well-deserved. He created the No. 21 arthroscope, which was used as a production model.

O'Connor performed the first partial meniscectomy in North America. He was the one who added the operating arthroscope's initial rod lens.

Dr. Lanny Johnson invented the first motorised shaving equipment in 1976.

Dr. John Joyce organised the first arthroscopy in 1972.

The invention of fibre optics and the usage of television technology in the 1970s led to the development of surgical arthroscopy because it allowed doctors to observe the joint on the television screen rather than directly with their eyes, freeing up their hands.

The development of three-dimensional visualisation during arthroscopy and manually rotateable optics from 0 to 90 degrees is where arthroscopy is headed in the future. The Virtual Reality Arthroscopic Training Simulator (VRATS), which will train physicians in arthroscopic procedures, is also forthcoming.

- *Mechanism of Injury:*

The main modes are

- *Direct Contact Injury*

- *Non-Contact Injury*
  Women are mainly affected due to

✓ Intercondylar notch is small
✓ Increased Q angle
✓ Hormonal causes of ligament laxity
✓ ACL is small and decreased in strength

The intrinsic stability of knee joint depends on the capsule and ligamentous structures around it. Antero posterior and rotational stability is provided by the cruciate ligaments and capsule while the medio lateral structure provide the varus and valgus stability.

Non-contact deceleration with valgus and twisting movement is the most frequentcause of injury. The most frequent modes of injury in solitary ACL instances were deceleration, internal/external rotation, and hyperextension, which happen when a runner suddenly changes direction while jogging or lands after a jump.

A major knee injury is not caused by valgus forces until the medial collateral ligament is intact, yet the ACL is harmed when the MCL is injured due to continued valgus thrust. The medial meniscus gets wedged between the articulating surfaces of the tibial and femoral condyles when the aforementioned rotation component also occurs, resulting in the classic unhappiness triad of O' Donoghue.

➢ *Classification of ACL Injuries:*
It is based on American Medical Association handbook. An injury which involves only the ligaments are called Sprain. It is classified into 1st , 2nd and 3rd degree sprain based on the amount of fibres involved and symptoms. In 1st degree, minimal fibres are involved with local tenderness but no instability. 2nd degree includes mild to moderate instability and finally 3rd degree have complete tear with marked instability. They can a o lso be called as mild, moderate and severe sprain. Based on the degree of instability with stress test, 3rd degree sprain is further divided int0 1+, 2+ and 3+ instability. In 1+, the joint surface moves <5mm while 5-10mm and > 10mm respectively in 2+ and 3+ respectively.

First-degree sprains are simply symptomatically treated, and most patients are able to resume their normal activities within a few days. However, the ligament needs to be protected. Second-degree sprains with mild local damage and joint reaction but no obvious instability can be managed conservatively. It is necessary to wait until the inflammatory reaction has gone and rehabilitation is finished before engaging invigorous activity again. Protection may be offered by a functional brace that prevents motion across particular arcs. Unless there is a specific contraindication, surgical repair may be necessary for third-degree sprains with total ligament destruction.

➢ *Natural History:*
Since the research that are now available are biassed towards symptomatic patients who seek treatment, there is debate over the natural course of ACL tears.

Studies have shown that if a person with an ACL injury returns to sports and repeatedly has bouts of instability, he may get osteochondral injuries and meniscal tears, which will ultimately lead to arthritis. In the first year following repair and resumed sports activity, the risk of second ACL tears is fifteen times higher than in patients who had not previously sustained an injury.

Meniscal injuries are common with acute ACL injuries, occurring 50 to 70 percent of the time, and the lateral meniscus is the one that is most frequently injured. Due to anomalous loading and shear pressures, there is a high prevalence of late meniscal damage in ACL-injured knees. Due to its tight attachment to the capsule, themedial meniscus is the one that is most frequently hurt in chronic ACL tears.

After their first ACL damage, between 21 and 31% of patients experience osteochondral alteration. For individuals with both acute and chronic ACL injuries, MRI is a sensitive method for detecting the bone injuries. These osteochondral defectscould be osteoarthritis' antecedents.

➢ *Clinical Evaluation*
A thorough clinical history is the first step in the clinical examination of a patient with an ACL injury. A non-contact deceleration injury or a jumping motion make up the typical history. At the time of the injury, the patient typically hears or feels a popping in the knee. Following the injury, the patient frequently loses consciousness and cannot stand up right away. The patient cannot resume his activity right once, and walking is frequently challenging. Hemarthrosis starts to manifestafter a few hours. In the aforementioned scenarios, the likelihood of an ACL damage is roughly 70%. Physical examination is simpler if

done before hemarthrosis occurs.

At the time of presentation, discomfort and the knee joint giving way are common symptoms. ACL rips typically result from non-contact injuries, whereas numerous ligaments might be injured during contact.

Meniscal injuries that are accompanied with locking episodes, clicks, or clunks can be detected by their symptoms. The individualization of patient care is aided by knowing the patient's profession and personal needs.

➢ *Physical Examination*

It's crucial to examine the normal knee. With a strong manual push, the anterior translation of the tibia on the femur can range from 5 to 15 cm. However, in 95% of patients, the variation from right to left is less than 3mm. The patient's level of relaxation, the accuracy of the applied force, the examiner's capacity to recognise joint motion, and the endpoint stiffness all have a role in the ability to show aberrantanterior translation in a patient with ruptured ACL. The quality of the terminal point on anterior translation, whether firm or soft, is crucial in identifying the state of the ACL in addition to the amount of translation.

- *Clinical Examination for ACL Injury Lachman Test*

Fig 4 Lachman Test

It is one if the easily performed test. The knee is flexed to 20-30^{o}. One hand is kept over the distal thigh and the other over proximal tibia with thumb over the tibial tubercle and rest of finger posteriorly to ensure that the hamstrings are relaxed. Always do it on the normal side 1st. Increased translation or soft end point denotes positive test. Grading is mentioned below.

Table 1 Interpretation of Lachmann Test

Grade	Interpretation
0	Negative
1+	0–5 mm of anterior displacement, sometimes with an end point
2+	5–10 mm of anterior displacement, with no end point
3+	10 mm of anterior displacement, with no end point

- *Pivot Shift Test*

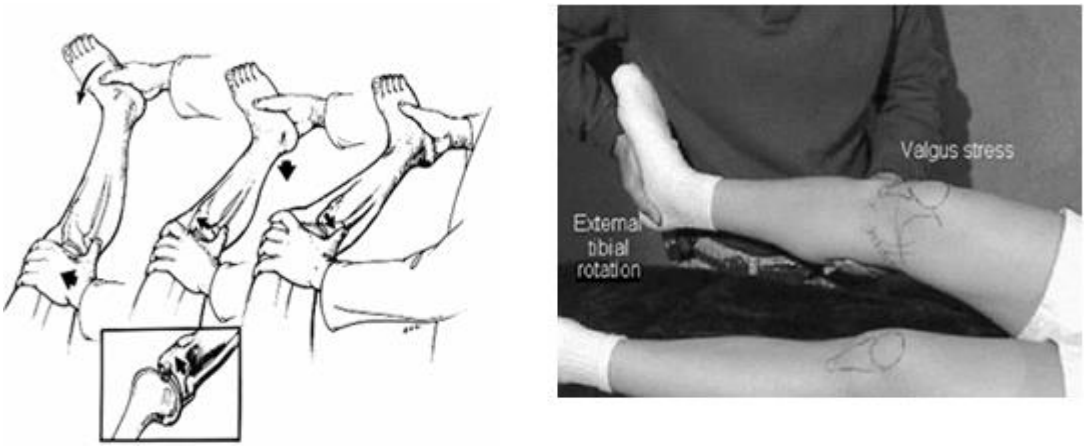

Fig 5 Pivot Shift Test

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It produce the symptoms of patients. Hold the ankle with one hand and apply a valgusforce with the other hand. Then knee is flexed. In extension, when the tibia is internally rotated, in slide anteriorly. When flexion begins, it reduces back with a snapat 20-30^{o}. The grading is as below

Table 2 Grading of Pivot Shift Test

GRADE	INTERPRETATION
0	Negative shift
1+	A glide
2+	A pivot shift
3+	A gross pivot shift where the feeling is that the condyles are dislocated

- *Anterior Drawer Test*

The examiner sits on the patient's foot while doing the anterior drawer test with the knee bent 90 degrees. To calculate the amount of translation, the tibia is pulled with both hands. The Lachman's test is more sensitive than this. The shape of the medial femoral condyle is hypothesised to be the cause of a negative anterior drawer test in patients with an ACL rupture. When the anterior translation of the tibia occurs at 90 degrees of flexion, the posterior horn of the medial meniscus is wedged into the femoral condyle, while the stopping impact of the meniscus is smaller at 20 degrees of flexion. Additionally, at 20 degrees of heat, the impact of discomfort,hemarthrosis, and muscle defence reaction will be decreased.

Fig 6 Anterior Drawer Test

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CHAPTER THREE
CLINICAL EXAMINATION FOR INJURY TO MENISCI

- *McMurray's Test*

When doing McMurray's test, the knee is fully flexed. Externally rotate the leg while grabbing the back foot, apply varus tension, and slowly extend the knee to check for medial meniscal damage. Internally rotate the leg while holding the back foot, apply valgus force, and slowly extend the knee to test for lateral meniscus injury. A positive test is when there is pain or a popping feeling during extension. The posterior, middle, and anterior horns of the corresponding meniscus are thought to be involved based on pain during the initial, middle, and late phases of extension. .

Fig 7 McMurray's Test

- *Apleys Grinding Test*

The patient is placed in the prone position for the exam. Knee is 90 degrees bent. With the examiner's knee, fix the patient's thigh. Now, starting from the foot, compress and rotate the leg. A medial meniscal tear is indicated by pain during this manoeuvre. An indication of a lateral meniscal tear is pain with compression and internal rotation.

- *Tests for Injury to Collateral LigamentsVarsus / Valgus Stress Test*

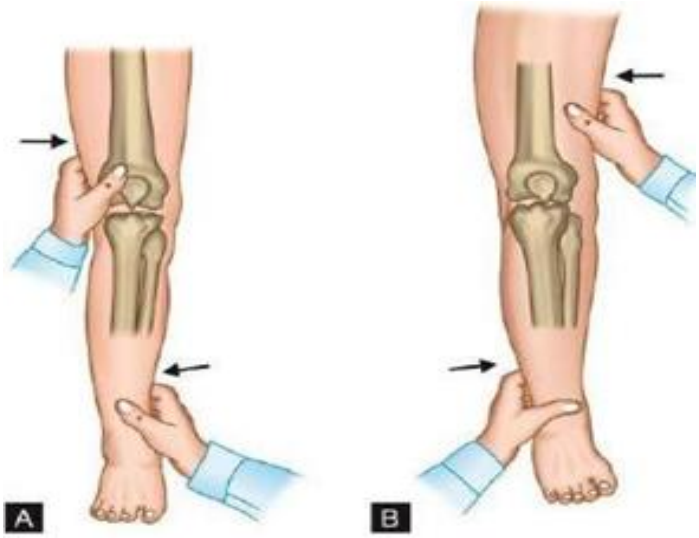

Fig 8 Valgus / Varus Stress Test

The patient is lying supine during this test. Put a valgus stress on the knee while it is extended. Injury to the medial collateral ligament is indicated by pain and an irregularopening up of the medial joint space. Varus stress is now applied to the knee during the test. The lateral collateral ligament has been injured if there is pain and an irregular opening in the lateral joint space. When performed with 30 degrees of flexion, the test is more precise.

➢ *Imaging*

- *Plain Radiographs*

A straightforward anteroposterior and lateral radiograph of the knee should be performed as the screening test. This will show open growth plates, bony avulsions of the ACL, severe osteochondral fractures, fractures of the tibial plateau, or fractures of the epiphysis. The majority of the time, x-rays are normal, but on occasion, a small fleck of bone that is raised from the lateral tibial plateau is referred to as the SEGOND sign, also known as the lateral capsular sign. This pathognomonic sign indicates an ACL injury. X-rays can occasionally show the deep lateral femoral notch sign (prominent lateral condylopatellar groove), which results from a pivot shiftinjury.

Fig 9 Xray Showing Seagond Sign

➢ *Magnetic Resonance Imaging:*

The non-invasive visualisation of the ACL and other soft tissue components inthe knee joint made possible by the MRI aids in the patient's preoperative evaluation. T2 weighted sequences in two to three arthrogonal planes are the bare minimum protocol needed for imaging of the ACL.

The typical ACL appears as a solid or striated band with a small divergence distally on a sagittal picture. The ACL is frequently straight, while normal ACLs can exhibit minor inferior convex drooping.

When compared to PCL, the ACL has a slightly stronger signal. The ACL can be clearly seen in a coronal section, however compared to the sagittal plane, the band is typically attenuated and less thick.

In a study by Adriaensen et al.(44), the anteromedial and posterolateral bundles of ACL can be visualised in MRI in 94 % of patients in three tesla field strength.

The central portion of the ligament is where ACL tears occur most frequently. Injury occurs distally at the site of tibial attachment more frequently than proximally near the origin, where it occurs 7 to 20 percent of the time.

➢ *Primary Signs of ACL Tear*

- *Not visualized in normal location*
- *Discontinuity of Fibres*
- *Loss of linearity/ Angulated*
- *Distal ACL flattening*
- *Loss of normal ACL axis (considered normal if it is less horizontal thanBlumensaat line)*

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Fig 10 Non-Visualisation as a Primary

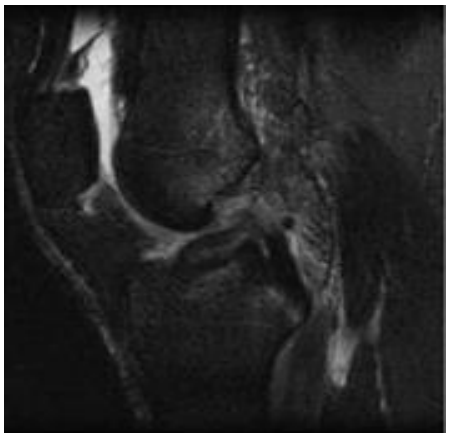

Fig 11 Flattened Axis of Sign of ACL Distal ACL

Fig 12 Angulation/Non Linearity

Fig 13 PCL Redundancy

Fig 14 Segond Fracture

➢ *Secondary Signs*

- *Tibia and femoral bone bruises*
- *Lateral femoral condyle with osteochondral fractures*
- *Bone bruises on tibia medially*
- *Sagittal cut show tibia with anterior translation*
- *Lateral collateral ligament is vertical in alignment*
- *Segond fracture*
- *Fracture of tibial spine*
- *Redundant PCL*

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➢ *Partial ACL tears:*

These are frequent, with partial ACL tears accounting for 10 to 43% of all ACL tears. When evaluated arthroscopically, tears involving less than 25% of the ACL have a favourable prognosis, while those involving 50% to 75% of the ACLhave a high likelihood of progressing to full tears (45).

➢ *Chronic ACL tears:*

With the exception of the absence of bone bruising and oedema in the knee joint, the symptoms of chronic ACL insufficiency are identical to those of acute tears. When the ACL is gone and the lateral intercondylar notch on the MRI merely reveals fat, this condition is known as the "empty notch sign." The sensitivity and specificity of MRI for identifying ACL injuries using direct indicators range from 92 to 94 percent and 95 to 100 percent, respectively (46)

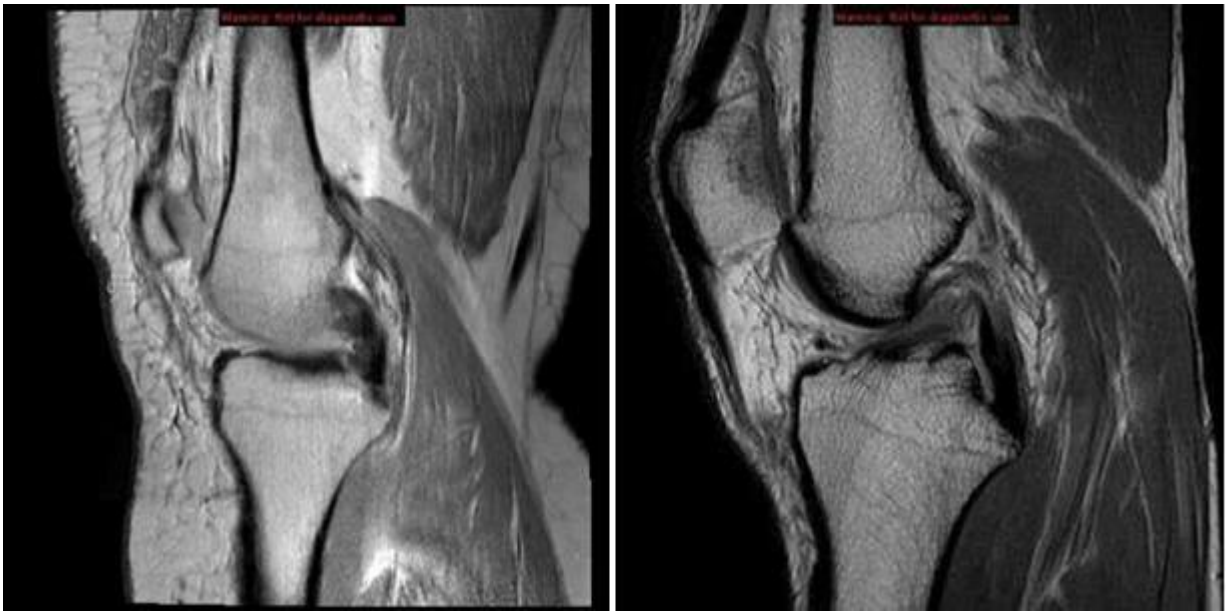

Fig 15 MRI Showing Partial ACL Tear

➢ *Diagnostic Arthroscopy*

The diagnosis of knee pathology has been made possible with the arthroscope. Diagnostic arthroscopy performed under general anaesthesia is a useful tool for identifying ACL damage. Technical issues with the acute knee arthroscopy are the same as those with the elective instance. First, the hemarthrosis needs to be expelled. To fully evaluate the extent of ligament injury, the synovium and ligamentum mucosum around the ACL must frequently be removed. The two bundles are probed with the hook to determine tension. Before beginning any arthroscopic surgical operations, a diagnostic arthroscopy is performed.

➢ *Portals in Arthroscopy*

In arthroscopy, it's crucial to have adequate illumination, joint distension, and optimal portal placement for the admission of the arthroscope and additional tools. Portal placement must be done carefully since an erroneous placement makes it difficult to see the joint and difficult to manoeuvre the instruments inside the joint. An arthroscope may suffer harm if it is forced through an unnaturally positioned portal, in addition to potentially injuring the joint.

Before joint distension, the portal entry locations need to be properly marked. The patella, patellar tendon, medial and lateral joint lines, and the posterior contours of the medial and lateral condyles of the femur are delineated as markers in bone and softtissue. To ensure that the portals are placed correctly, the surgeon should mark the landmarks and portals before and after distension.

In a study by Stetsin and Templin, it was discovered that knee arthroscopy with two portals resulted in a quicker recovery and return to activity than arthroscopy with three portals. This was due to the fact that using three portals violated the vastus medialis oblique.

- *Standard Portals:*

The Standard Portals Include,

✓ Anterolateral
✓ Anteromedial
✓ Superolateral
✓ Posteromedial

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- *Anterolateral Portal*

Diagnostic arthroscopy is performed mainly through this portal. Surgeon can visualize almost all the structures except PCL and some part of lateral meniscus probably anterior. The portal is established 1 cm lateral to patellar tendon and also above lateral joint line about 1cm. The lower pole of patella should be 1 cm distal to it. If it is close to the joint line or patellar tendon it may damage the lateral menisci or fat pad respectively, making it difficult for the surgeons to visualize the joint.

- *Anteromedial Portal*

It is established mainly to see lateral compartment and to palpate lateral and medial compartment components. The land marks are 1cm medial to patellar tendon, 1cm superior to medial joint line and 1 cm distal to lower pole of patella. First a needle can be inserted to know the exact location of the portal by seeing through the 1st portal.

- *Posteromedial Portal*

Triangle bounded by tibia and femoral condyles posteromedially is the landmark. It is visualized if knee is flexed to 90º before inflation. Porta I 1cm anterior to posteromedial femoral condyle and 1cm superior to joint line. Disease of posterior menisci and loose bodies can be assessed. Scope is inserted at 30º.

- *Superolateral Portal*

Situated 2.5cm above patella superolaterally and lateral to quadriceps. Mainly used to see patellofemoral compartment, patellar tracking and congruity.

In order to ensure that the entire knee is inspected and no area is missed, the diagnostic arthroscopy inspection of the structures inside the knee is performed in a sequential order. Anterolateral port (viewing portal) is created with an 11mm bladeat the level of the inferior pole of the patella, directly lateral to the patellar tendon, when the knee is flexed 90 degrees. Then the scope is introduced and knee is examined in a sequential manner of the following:

- *Suprapatellar Pouch*
- *Patellofemoral Joint*
- *Medial Gutter*
- *Medial Meniscus*
- *Intercondylar Notch*
- *Lateral Meniscus*
- *Lateral Gutter*
- *Posterolateral Compartment*

The anteromedial (working) portal is then established when all abnormalities have been noted. The accompanying pathologies are treated in accordance, including the removal of loose bodies and partial or complete meniscectomy for meniscal tears.

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CHAPTER FOUR
METHODOLOGY

➢ *Study Design*
Prospective Observational Study

➢ *Study Setting*
Orthopedic outpatient department of Government medical College, Thiruvananthapuram

➢ *Study Population*

- *Inclusion Criteria:*

✓ Patients who underwent arthroscopic ACL reconstruction using peroneuslongus tendon and Semitendinosus graft following traumatic ACL injury
✓ Patients who are willing to give consent, aged 18 years and above.

- *Exclusion Criteria:*

✓ Patients with associated bony and other ligamentous/ tendon injury
✓ Patients with degenerative ligament injury

- *Study Period*
Maximum one and a half year after IEC approval has obtained.

- *Sample Size*
Sample Size(n) was Calculated using the formula

$$n = \frac{(Z1-\alpha/2 + Z1-\beta)^2 (S1^2 + S2^2)}{(\mu1 + \mu2)^2}$$

S1 = Standard deviation of functional outcome of ACL reconstruction using peroneuslongus tendon graft in reference study 1

S2 = Standard deviation of functional outcome of ACL reconstruction usingsemitendinosus tendon graft in reference study 2

μ1 = Mean of functional outcome of ACL reconstruction using peroneus longustendon graft in reference study 1

μ2 = Mean of functional outcome of ACL reconstruction using semitendinosus graft in reference study 2.

✓ Single bundle ACL Reconstruction with Peroneus longus Tendon graft by Dr Ravikumar,Dr Bharat Singh,Dr Ajinkya Gautam
✓ A prospective study of functional outcome of ACL reconstruction with Semitendinosis graft with Endobutton and Bioabsorbable screw by Dr Anil Kumar Mishra and Dr Girish S

- S1=3.52 μ1=96.12
- S25.54 μ2=88.70

Hence **n=30**, that is, 30 patients each receiving ACL reconstruction using peroneuslongus graft and semitendinosus graft.

➢ *Sampling Technique*
Subjects meeting the study criteria will be consecutively added till therequired sample size is met

➢ *Study Variables*

- *Age Distribution*
- *Gender Distribution*
- *Side of Injury*
- *Mode of Injury*

- *Lachman Test*
- *Pivot Shift Test*
- *IKDC Subjective Knee Score*
- *Tegner Lysholm Knee Scoring Scale*
- *Donor Site Morbidity*
- *Return to Regular Work*

➢ *Data Collection Tool*

- International Knee Documentation Committee subjective evaluation score (International Knee Documentation Committee (IKDC) SubjectiveEvaluation Form).
- Lysholm score
- Interviewer administered semi-structured questionnaire.

➢ *Data Collection Techniques*

All patients with suspected ACL injury will be evaluated. On their first visit to OPD/ Casualty, a detailed history will be taken about the nature of injury, mechanism of injury, duration of injury, other associated injury, symptoms, details of initial treatment and medical history. Then a detailed general examination and physical examination will be carried out. Finally to end with all required radiological investigations are done.

➢ *Surgical Technique:*

- *Instrumentation:*

Many specialised instruments are required for arthroscopic anteriorcruciate ligament reconstruction. An arthroscopic system consists of

✓ Television monitor
✓ Camera
✓ Light source and fibre optic light source cable
✓ Arthroscope
✓ Shaver system and hand piece
✓ Tourniquet (pneumatic)
✓ Drill tip , guide pins
✓ Trocar, cannula, ACL probe
✓ Meniscus punch
✓ 4mm/5mm shaver burr
✓ Tibial aiming guide
✓ Cannulated headed reamers (5 to 10 mm)
✓ Femoral entry point aimer (6mm / 7mm offset)
✓ Extra-long 2.4 mm guide pin with suture eye (beath type guide pin)
✓ 4.5 mm cannulated reamer for passage of endobutton
✓ Depth gauge
✓ Sizing master

- *Implants:*

Graft can be fixed with various methods, mainly divided into direct and indirect methods. The commonly used direct fixation devices are

✓ Interference screws
✓ Endo-button
✓ Staples
✓ Washers
✓ Cross pins
✓ Polyester tape/titanium button
✓ Suture post

In our study, we used interference screws and endobutton.

Fig 16 Endobutton

- *Endobutton:*

The endobutton aids in ensuring that the majority of the graft is contained within the tunnel. The centre two holes of the endobutton, which has four holes total, are used to form the loop for the quadrupled graft. The endobutton can be flipped with the help of the two peripheral holes that allow sutures to pass through. Withstanding cyclical stress is stronger than the interference screw.

✓ *Advantages of Endobutton*

- Easily Placeable
- Stable
- Small
- Compact
- Lacks Interference

✓ *Disadvantages are*

- Points of Fixation are Wide
- Windshield Viper And Bungee Effect
- Instrumentation For Graft Preparation Needed

- *Interference Screw:*

These direct fixation tools aid in retaining the graft in place. It is put in the bone tunnel, in between the graft. The titanium interference screw and the bioabsorbable interference screw are two of the different types that are available.

Fig 17 Titanium Interference Screw

Fig 18 Bio-Absorbable Screw

✓ *Advantages of Interference Screw*

- Can be placed intra-articularly
- Profile is low

✓ *Disadvantage*

- Graft injury
- May lose screw while insertion
- May cause cortex blowout posteriorly

- Revision may be difficult
- Change of graft position
- Graft may advance
- Laceration of screw

- *Biodegradable Screws:*
  These have a fixation strength comparable to that of metal screws.

✓ *Advantage of bio –Screw*

- Compactable with MRI
- NO need for Removal

✓ *Disadvantage*

- Reactions
- Weakening of fixation due to deformation

➢ *Arthroscopic Portals*
Standard portals for diagnosing ACL injury and for its reconstruction areantero-lateral and antero-medial portals.

➢ *Anterolateral Portal*
Diagnostic arthroscopy is performed mainly through this portal. Surgeon can visualizealmost all the structures except PCL and some part of lateral meniscus probably anterior. The portal is established 1 cm lateral to patellar tendon and also above lateral joint line about 1cm. The lower pole of patella should be 1 cm distal to it. If it is close to the joint line or patellar tendon it may damage the lateral menisci or fat pad respectively, making it difficult for the surgeons to visualize the joint.

➢ *Anteromedial Portal*
It is established mainly to see lateral compartment and to palpate lateral and medial compartment components. The land marks are 1cm medial to patellar tendon, 1cm superior to medial joint line and 1 cm distal to lower pole of patella. First a needle can be inserted to know the exact location of the portal by seeing through the 1st portal.

- *Examination Under Anaesthesia and Patient Positioning:*
All of the study participants had supine spinal operations while under anaesthesia. Anesthesia was used for the pivot shift test, Lachman test, anterior drawer test, and posterior drawer test. After soft padding, a pneumatic tourniquet is applied and placed in the upper thigh. From the ankle all the way up to the tourniquet, the limb is cleansed. The knee joint is placed slightly away from the usual operating table's distal breakpoint while the patient is lying on his or her back. The unaffected limb is set in an upright support. In each case, a preoperative dose of ceftriaxone (1 g) is administered as a preventive antibiotic before the tourniquet is inflated. Before inflating the tourniquet, the arm is held upright to exsanguinate it.

- *Surgical Technique*
Initially a femoral and a tibial tunnel was drilled. Their location corresponds to the native ACL attachment on Tibia and femur. Tunnel was drilled using anterolateral portal in femur. The graft is passed through this tunnel and fixed in the femoral side using endobutton and tibial side using bio-screw.

- *Diagnostic Arthroscopy:*

Fig 19 Diagnostic Arthroscopy

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Diagnostic arthroscopy was performed first, then the graft was harvested. At the level of the inferior pole of the patella, directly lateral to the patellar tendon, anterolateral port (viewing portal) is constructed employing 11 blades in 90 degrees of knee flexion. Then the scope is introduced and knee is examined in a sequential manner of the following:

- ✓ Suprapatellar pouch
- ✓ Patellofemoral joint
- ✓ Medial gutter
- ✓ Medial meniscus
- ✓ Intercondylar notch
- ✓ Lateral meniscus
- ✓ Lateral gutter
- ✓ Posterolateral compartment

The anteromedial (working) portal is then established when all abnormalities have been noted. The accompanying pathologies are treated in accordance, including the removal of loose bodies and partial or complete meniscectomy for meniscal tears.

➢ *Harvesting of Graft and Graft preparation*

A 2 cm incision was made above and behind the lateral malleoli of the ipsilateral limb to harvest the PLT. Identification of the peroneal muscle tendon (longus and brevis) and tenodesis of longus to brevis were performed. To prevent scarring inside the groove, tenodesis is often done about 3 to 4 cm proximal to the tip of the lateral malleolus (47). A lengthy tendon remover was used to harvest PLT. Skin staples and absorbable subcutaneous sutures were used to close the incision.

AN approximately 2 to 3cm incision is put along the pes anserinus from tibial tubercle to postero medial border of tibia. Subcutaneous tissue dissected till sartorius fascia. Now the gracilis and semitendinosus can be palpated with fingers. Gracilis is superior in position but semitendinosus in larger and thicker. The sartorius fascia is now opened and the two tendon are dissected and separated. Atleast 10 cm of semitendinosus should be free from extratendinous tethers. The free end is whipstiched. A tendon stripper is used to release it from its musculotendinous attachment. Wound closure was done.

On a tendon board, the harvested graft was pre-tensioned. After that, the graft was looped four times to create a quadrupled graft. The transplant had an Endobutton femoral fixation device attached to one end. To precisely match the quadrupled graft'ssize to the required femoral and tibial tunnels, the graft was run through cylindrical sizers.

Fig 20 Incision Site for Harvesting PLT Graft

Fig 21 Identifying Peroneus Longus Tendon Graft

Fig 22 Isolating Peroneus Longus and Distal Tenodesis with Peroneus

Fig 23 Harvesting PLT graft with tendon stripper Brevis

Fig 24 Incision Site for Harvesting

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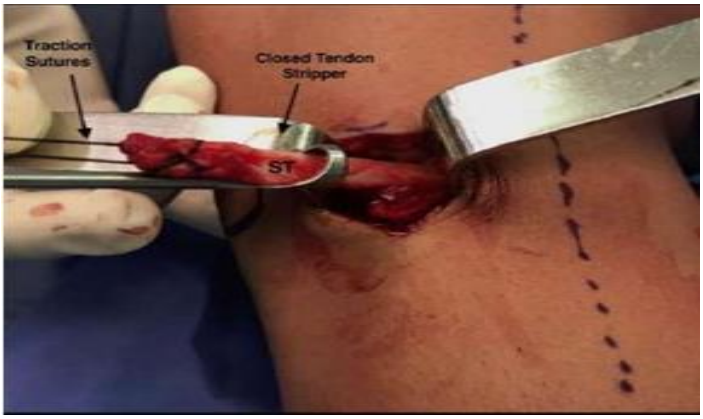

Fig 25 Harvesting Semitendinosus Semitendinosus Graft

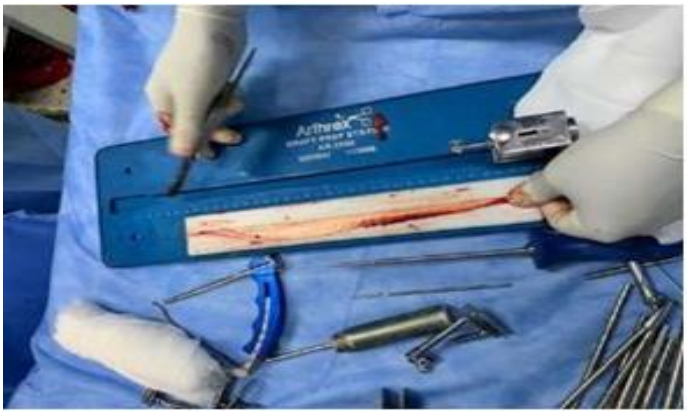
Fig 26 Preparation of the Graft

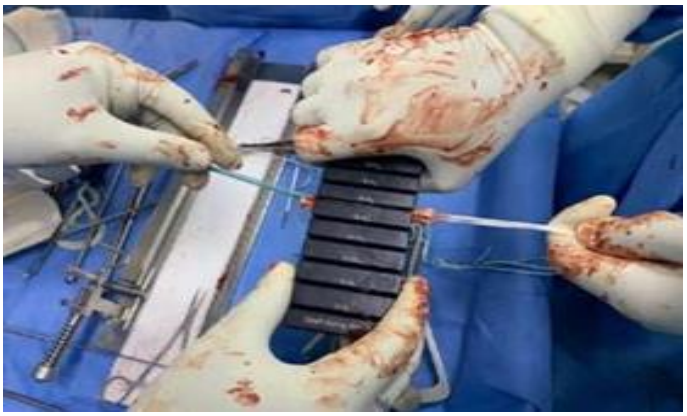
Fig 27 Sizing Cylinder

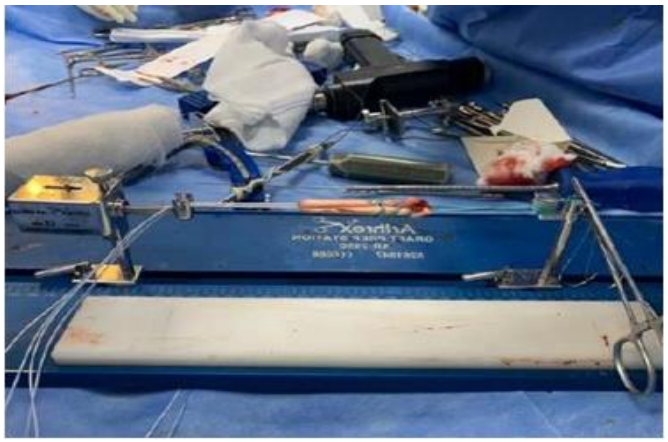
Fig 28 Pre-Tensioning Device and Graft Length Measurement

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- *Identification of the ACL Footprints*

Re-inserting the scope after shaving off the torn ACL substance. ACL footprints were found on the tibial and femoral sides. As a proprioceptive stimulator and identification cue for the graft placement, remnants of the ACL were retained at the footprint areas.

- *Femoral Tunnel Drilling by Medial Portal (Anatomic FemoralTunnel) Technique*

With the leg on the surgical table, knee flexed maximally to > 120 degrees. A drill tip pin exited the lateral femoral cortex through the medial portal and anterior cruciate ligament insertion. This pin would leave the femoral shaft laterally and horizontally. There is a hole in the femoral tube. A femoral drill with the necessary diameter was then overdrilled into the femoral tunnel. For the purpose of enabling Endobutton flipping, a hole with the same diameter as the femoral drill was drilled 10 mm longer than the length of the femoral tunnel graft.

Fig 29 Medial portal view at 90° The tip of the angled microfracture awl is located at the center of the ACL femoral attachment site, 2 mm deep (proximal) to the lateral bifurcate ridge, and halfway between the lateral intercondylar ridge and the inferior (posterior) articular cartilage border

- *Tibial Tunnel Drilling*

Tibial Tunnel drilling

It is drilled with a tibial aimer jig which had an angle of 55º. A guide wire is feeded from medial metaphysis of tibia into the joint through the tibial insertion ofACL. Its landmarks are 7cm anterior to Pcl edge inside, 4cm from joint line exteriorly and 2 cm medial to tubercle. It maintains the alignment with PCL and anterior horn of lateral meniscus.

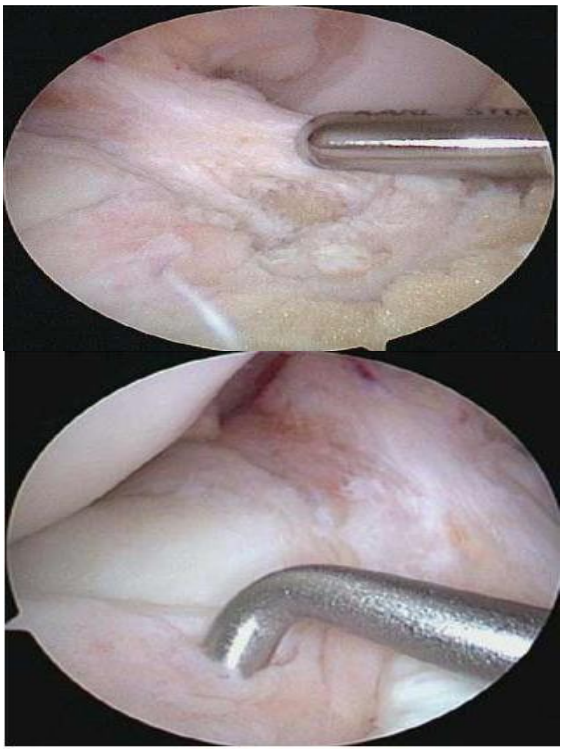

Fig 30 Arthroscopic view of tibial insertion sites

- *Graft Loading and Passage*

Through the medial portal, a No. 5 ethibond leading suture loop was passed before being removed laterally. Out of the tibial tube, something was extracted. The prepared graft was stitched together with the No. 5 Ethibond suture, the leading and trailing sutures, and the appropriate endobutton.

- *Graft Preparation, Passage and Fixation:*

The graft is quadrupled after preparation based on its length and is connected to endobutton with a loop. Through the tibial tube, the Ethibond suture that is already in the joint is removed. After that, passing sutures for the ACL graft are pulled out of the lateral thigh by going through the suture loop. These sutures are used to pull the graft through the tibial tunnel, into the joint, and finally into the femoral tunnel. Theendobutton is turned once the predicted length of the graft is inside the tunnel.

The graft is then subjected to repetitive knee flexion and extension whilebeing continuously pulled through the tibial tunnel. The graft is then arthroscopicallyvisualised to check for any indications of alignment, impingement, etc. A proper length interference screw (bio-screw) is used to secure the tibial side of the transplant.The ports and the graft harvest site wound are closed in layers. Sterile compressive dressing is then applied. The limb is immobilised with the use of knee brace. After the procedure wounds at the port and site of harvest are closed, compressive dressing with sterile pads are given. Knee immobilizer is used.

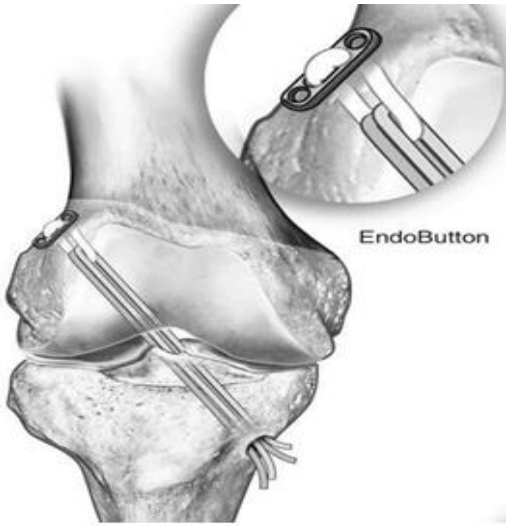

Fig 31 Endobutton fixation of femoral end of the graft

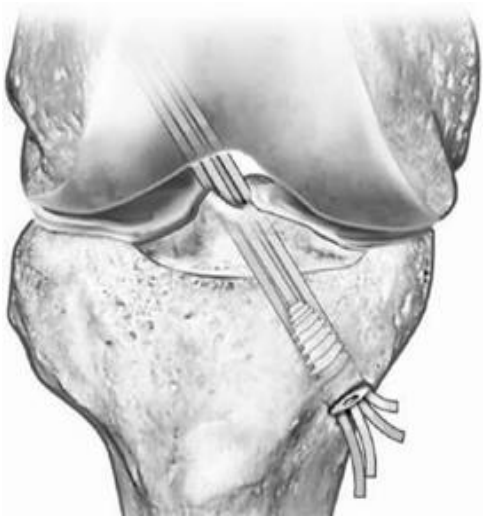

Fig 32 Bioscrew fixation of tibial end of the graft

- *Post-Operative Management:*

In the first few days following surgery, immobilisation in a knee brace and limb elevation were performed. Following surgery, patients received intravenous antibiotics for three days. On the third postoperative day, the wound was examined. On the third postoperative day, drains were withdrawn. Up to the fifth post-op day, oral antibiotics were administered instead of injectable antibiotics. The patient was then released on the fifth post-operative day. If the wound is healthy, the sutures are removed on day 10 following surgery. The patient requested a follow-up visit two,four, and six months after surgery.

➢ *ACL Rehabilitation Protocol*

- *Stage I: 0-2 Weeks*

✓ Mobilise patella
✓ 0 to 90º motion brace
✓ Quadriceps strengthening
✓ Hamstring curls in prone and standing
✓ Passively extend
✓ Pillow kept below heel
✓ ROM knee flexion passive, active and active assisted
✓ Siting slide
✓ Using crutches for partial weight bearing upto 75%
✓ Extension while sleeping

- *Goals*

✓ Complete extention
✓ Flexion upto 90º
✓ Improve quadriceps strength for normal gait

- *Stage II: 2 to 4 Weeks*

✓ ROM progress to 120º by 4 weeks
✓ Progress hamstring curls with weight
✓ Initially use crutches for ambulation avoid it when there is no more limb
✓ At 45º do wall sits with tibia vertical
✓ Extension with resistance from 90 to 60º

- *Goals*

✓ Improve ROM 0-120º
✓ Weight bearing without limb

- *Stage III: 4 To 10 Weeks*

✓ To achieve full ROM by 6 weeks
✓ Strengthening of hamstring and quadriceps to be carried on

- *Stage IV: 12 To 16 Weeks*

✓ To start cardiovascular fitness exercises
✓ Continue muscle strengthening
✓ Exercises aiming flexibility to be done

- *Stage V: 16 To 18 Weeks*

✓ If a stable knee with full ROM and quadriceps strength achieved startplyometric activities like shuttle
✓ To do jogging if quadriceps strength >65%

- *Stage VI: 5 To 6 Months*

✓ Drills and sports training

- *Stage VII: 6 Months*

✓ Sports participation to be initiated if Full ROM , Quadriceps >85%,Hamstring >90%

➢ *Evaluation***:**

To ascertain the tunnel placement and positions of the endobutton and interference screw, all patients had post-operative anteroposterior and lateral radiographs. Functional results were evaluated at six-week, six-month, and one-year intervals for the

patients.

The International Knee Documentation 2000 score(IKDC) and Lysholm Knee Scoring Scale were used for evaluation of patients.

There were 3 domains in IKDC subjective score - Symptoms, Knee Functions, Sports activity. Each question carried individual points and the total score was 87. The score for each person was simply added and were converted to a scale of 0 to 100.

- *Subjective IKDC score = [Sum of items/Maximum possible score] × 100*

Higher scores are viewed as higher levels of function and fewer levels of symptoms, with the score when used as a measure of function. A score of 100 is considered to indicate no restrictions on daily activities or athletic endeavours as wellas the lack of symptoms. They were classified as normal, almost normal, abnormal, and seriously abnormal based on the outcome scores.

- *Normal - 90-100*
- *Nearly normal - 80-90*
- *Abnormal - 70-80*
- *Severely abnormal -below 70*

- *The **Lysholm Knee Scoring** Scale consists of eight parameters forevaluation.*

The parameters evaluated are

- *Limping*
- *Aided walking*
- *Episodes of knee locking*
- *Knee instability*
- *Knee pain*
- *Knee swelling*
- *Climbing of stairs*
- *Squatting*

Each of the parameters have their own score and the total maximum possible score would be 100. Scores were given based on patients ability to do eachparameter.

- *Excellent - 95-100*
- *Good- 84-94*
- *Fair-65-83*
- *Poor- 64 or less*

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CHAPTER FIVE
RELAVANCE OF STUDY

Anterior cruciate ligament injury continues to be a prevalent orthopaedic condition, particularly in young people. The modern high-speed auto culture and active lifestyle have increased knee ligament damage. ACL repair and open arthrotomy were previously performed. In the recent past, there have been significant advancements in the way that ACL injuries are treated. The preferred medical procedure today is ACL reconstruction. It is a surgical procedure used to reconstruct the torn ACL using soft tissue (the semitendinosus and gracilis muscles) or a bone- patella-tendon-bone graft. From extraarticular, non-anatomic reconstruction of the ACL to the modern, anatomic reconstruction, there is evolution in ACL reconstruction. Anatomic reconstruction strives to produce a ligament with the same bone attachments and course as the native ACL, restoring knee kinematics while providing stability and function of the ACL. The reconstruction of the ACL involves the use of several allografts. Our college has recently started using the Peroneus longus tendon graft and semitendinosus graft for ACL reconstruction. In my study, I will assess how well the knee functions following an ACL reconstruction using a peroneus longus tendon graft and semitendinosus graft.

- *Ethical Considerations*

- *Institutional ethical committee clearance obtained.*
- *Informed written consent obtained.*
- *Confidentiality ensured and maintained throughout the study.*

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CHAPTER SIX
RESULTS AND ANALYSIS

We have done the study on 60 patient (n=60), 30 each of those with peroneus longus and semitendinosus graft. Functional outcome with IKDC subjective scoring and Lysholm scoring and physical examination were done on the 6th month of follow up. The results obtained are as follows.

- *Age and Sex distribution:*

Table 3 Age and Sex distribution

		Frequency(proportion) N=60	Peroneus Longus(N=30)	Semitendinosus (N=30)
Age category	20-25	17 (28.33)	9(30)	8(26.66)
	26-30	26(43.33)	13(43.33)	13(43.33)
	31-35	11(18.33)	5(16.66)	6(20)
	36-40	6(10)	3(10)	3(10)
gender	Male	49(81.66)	24(80)	25(83.33)
	Female	11(18.33)	6(20)	5(16.66)

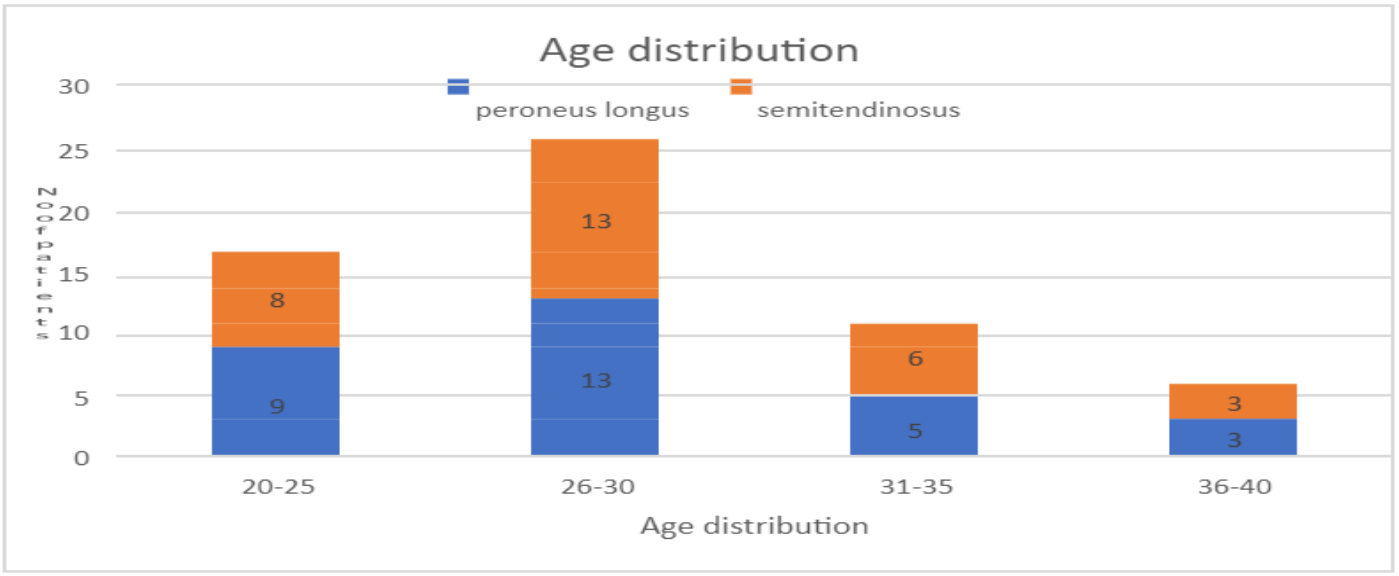

Fig 33 In our study, all the subjects were in between 20 and 40 year. Majority of the study subjects belonged to the age group 26-30 years with 13 each with peroneus longus andsemitendinosus graft.

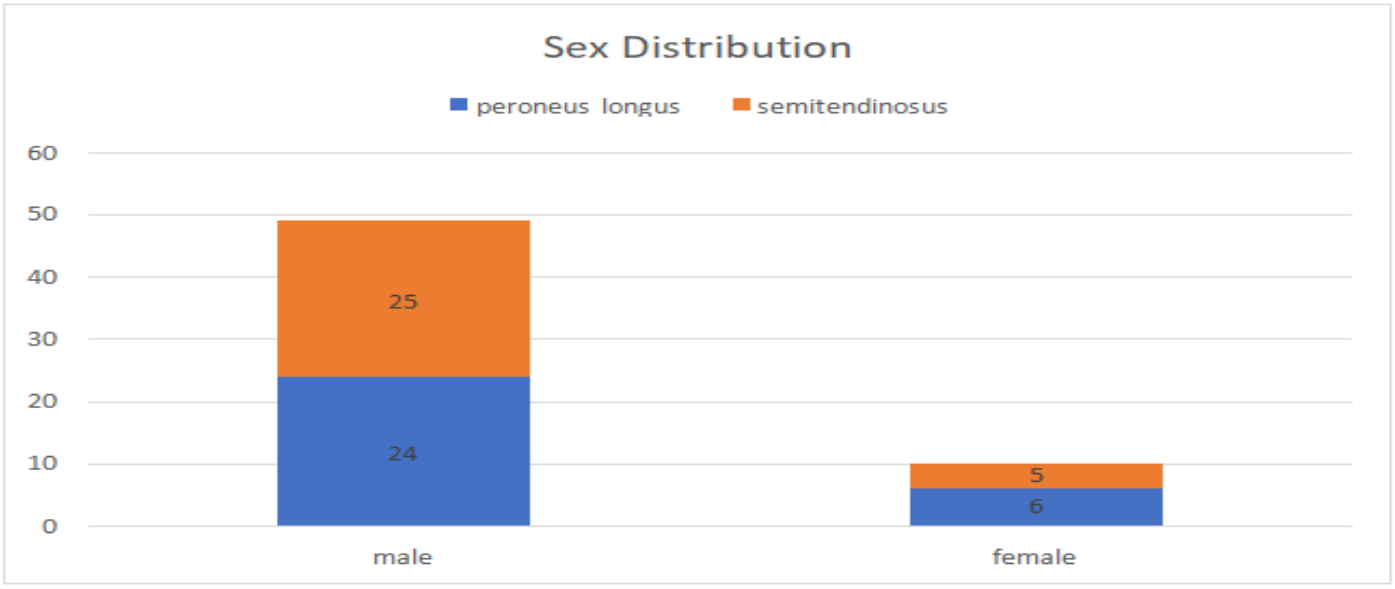

Fig 34 In Our Study,>80% of the Subjects were Males in Either of the Groups.

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➢ *Mode of Injury and Side Involvement:*

Table 4 Mode of Injury and Side Involvement

		Frequency(proportion) N=60	Peroneus Longus(N=30)	Semitendinosus (N=30)
Mode of Injury	RTA	33(55)	16(53.33)	17(56.66)
	Sports	18(30)	9(30)	9(30)
	Others	9(15)	5(16.66)	4(13.33)
Side	Right	29(48.33)	13(43.33)	16(53.33)
	Left	31(51.66)	17(56.66)	14(46.66)

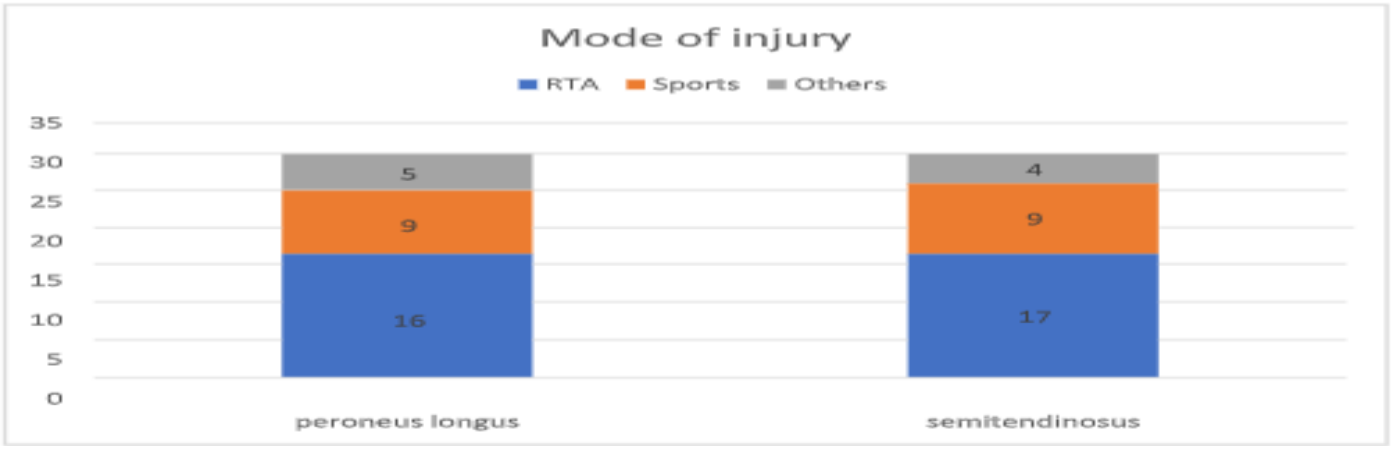

Fig 35 The most common mode of injury in our study was Road Traffic Accident which accounts for about 55% of total cases followed by sports related injuries. Other mode of injuries includes slip and fall, fall from height etc.

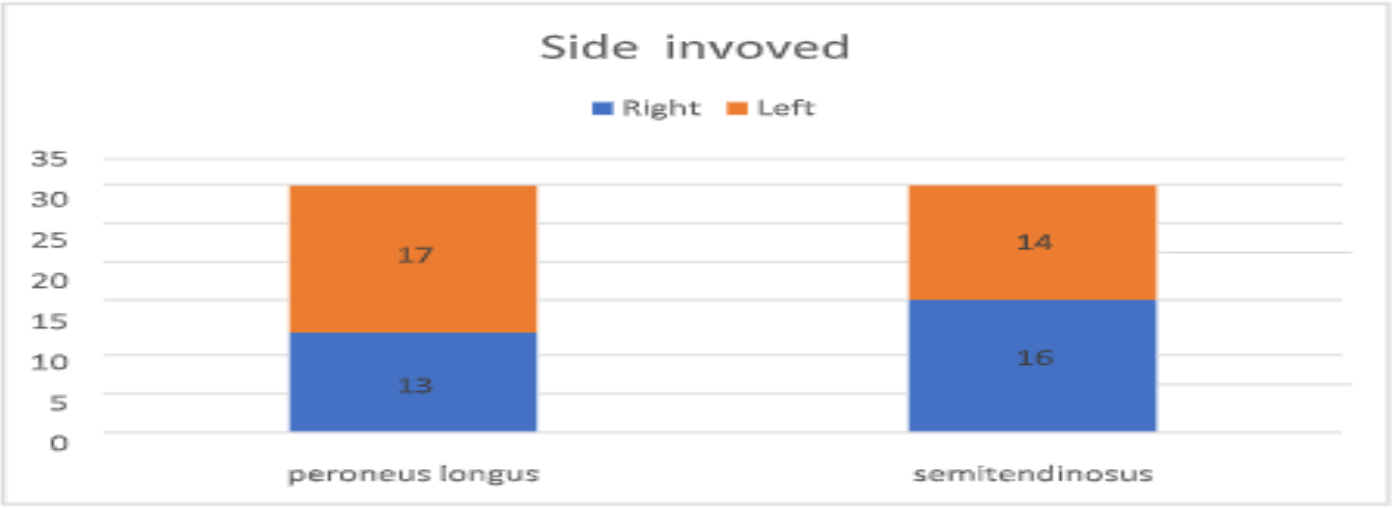

Fig 36 From this, we can conclude that in patients with peroneus longus graft majority had left sided involvement but almost similar involvement in population with semitendinosus graft.

➢ *Physical Examination Lachman and Pivot shift test:*

Table 5 Physical Examination Lachman and Pivot shift Test

Frequency(proportion) N=60			Peroneus Longus(N=30)	Semitendinosus (N=30)
Lachman Test	negative	51(85)	24(80)	27(90)
	1+	7(11.6)	5(16.6)	2(6.6)
	2+	2(3.3)	1(3.3)	1(3.3)
	3+	0	0	0
Pivot Shift Test	negative	55(91.6)	27(90)	28(93.3)
	1+	4(6.6)	2(6.6)	2(6.6)
	2+	1(3.3)	1(3.3)	0
	3+	0	0	0

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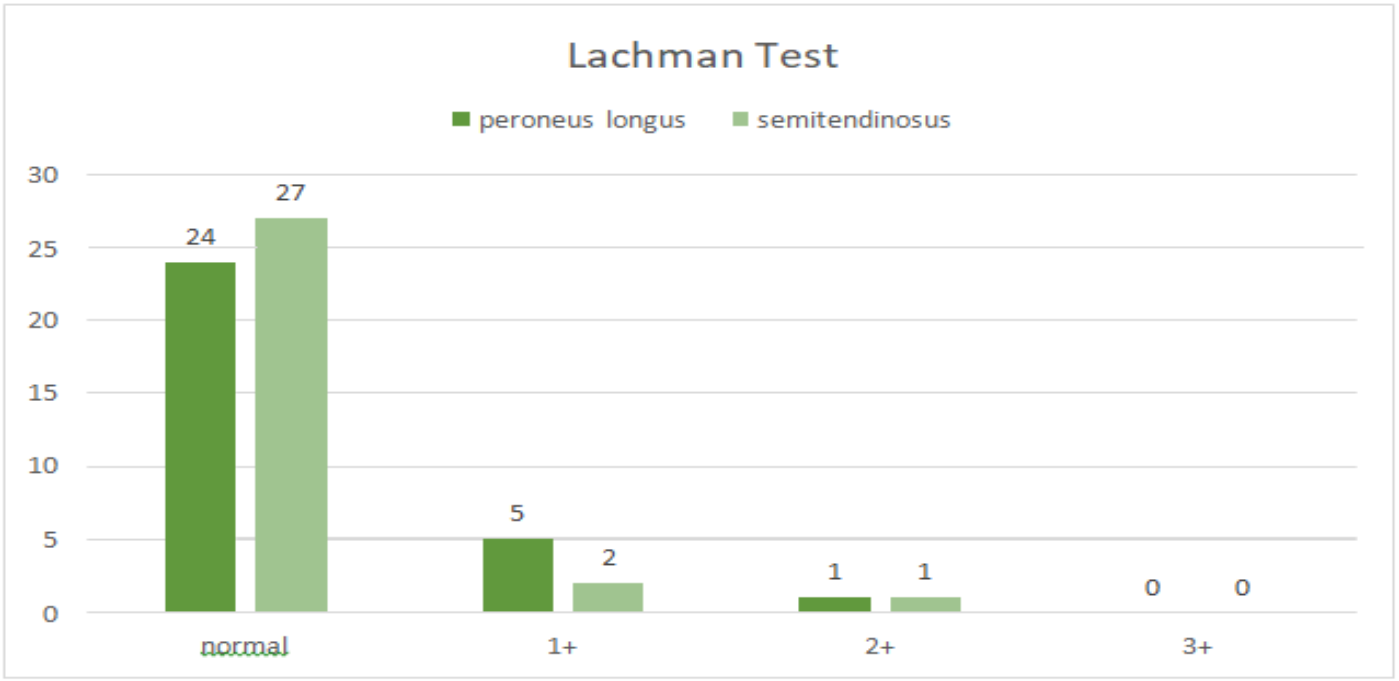

Fig 37 Lachman test showed a Normal finding in 85% of study population in both the groups. 5 patients with peroneus longus graft and 2 with semitendinosus graft showed 1+ laxity and 1 patient from either group had 2+ laxity.

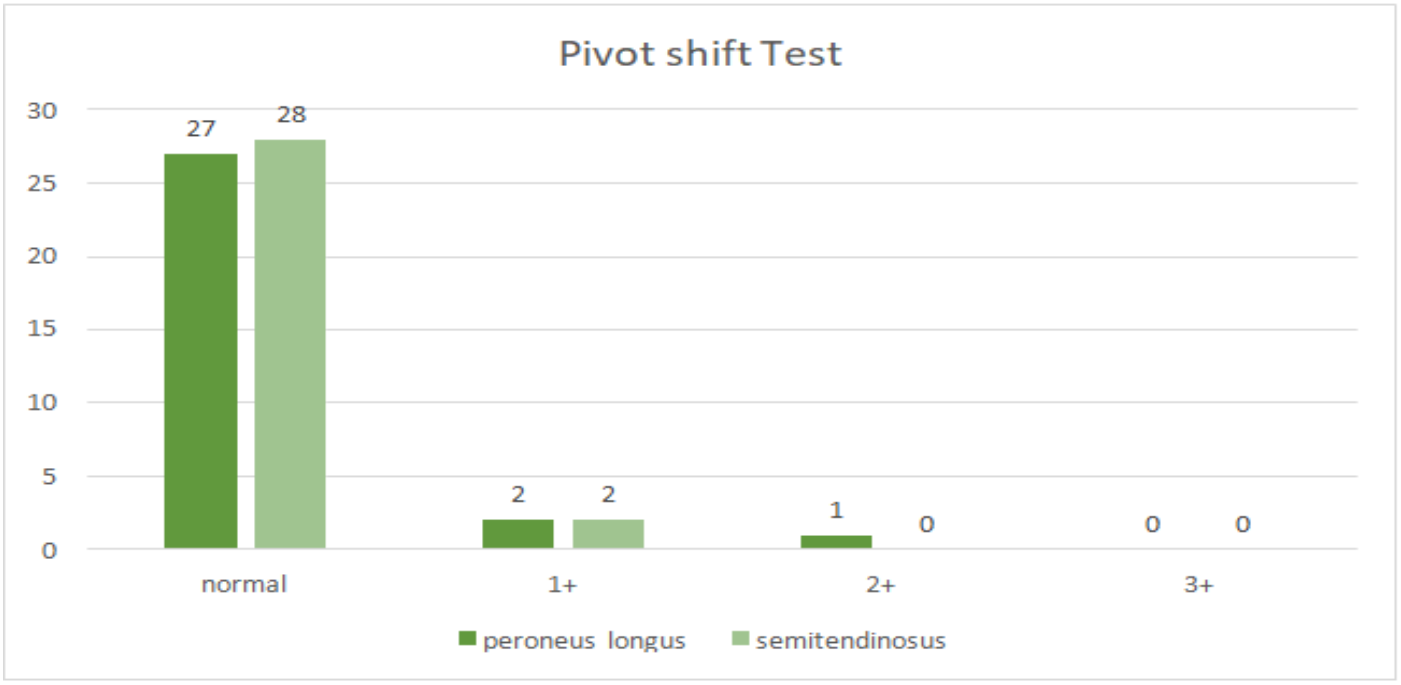

Fig 38 Pivot shift test was negative in >90% of study population. Pivot glide was reported in 2 patients each from both the groups. 1 patient with peroneus longus graft reported gross pivot shift.

- *IKDC Subjective Score and Lysholm Score:*

Table 6 IKDC Subjective Score and Lysholm Score

IKDC SCORE category	Total (N=60)	Peroneus longus (N=30)	Semitendinosus (N=30)
Normal (90-100)	33(55%)	16(53.33%)	17(56.66%)
Near normal (80-89.9)	23(38.33%)	11(36.66%)	12(40%)
Abnormal (70-79.9)	4(6.66%)	3(10%)	1(3.3%)
Severely abnormal (<70)	0	0	0

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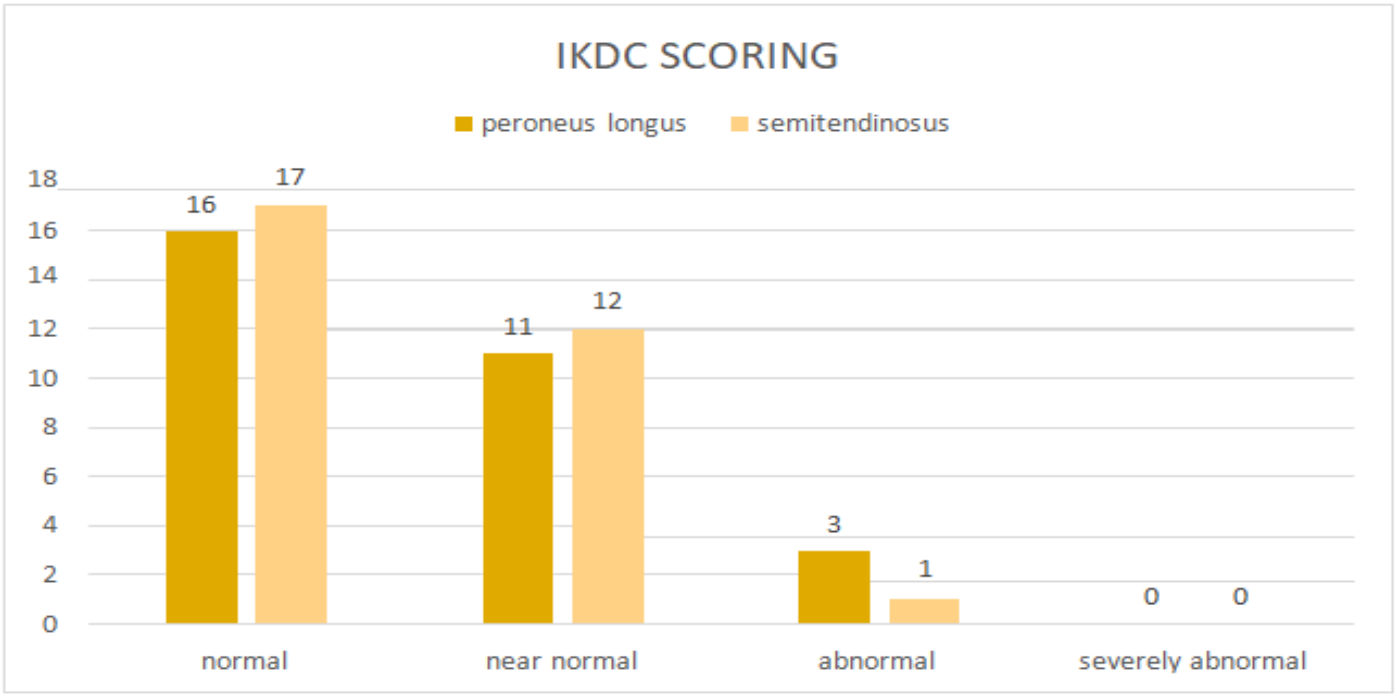

Fig 39 In our study,16 and 17 subjects respectively from peroneus longus graft andsemitendinosus study population had normal score(>53%) and 11 and 12 respectively had near normal score. Abnormal score was found in 10% of peroneus longus population and 3.3% in semitendinosus population.

Table 7 IKDC Subjective Score and Lysholm Score

Lysholm Score Category	Total (N=60)	Peroneus longus (N=30)	Semitendinosus (N=30)
Excellent (95-100)	10(16.66%)	5(16.66%)	5(16.66%)
Good (84-94)	46(76.66%)	22(73.33%)	24(80%)
Fair (65-83)	4(6.66%)	3(10%)	1(3.3%)
Poor (≤64)	0	0	0

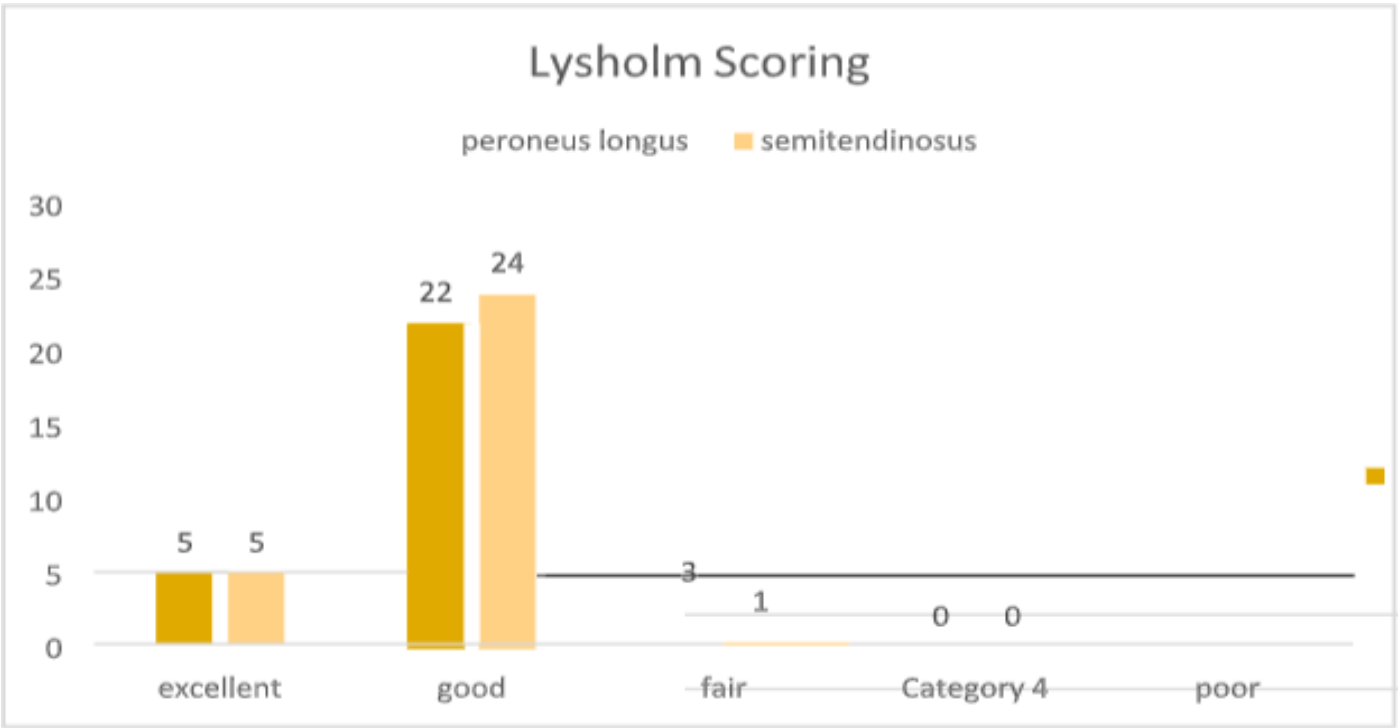

Fig 40 In our study, 5 patients each from either group had excellent outcome whereas 22 patients from peroneus longus group 24 from semitendinosus group had good outcome.

➢ *Mean IKDC Subjective Score*

Table 8 Mean IKDC Subjective Score

	Age category	Mean IKDC(N=60)	Mean IKDCPL (N=30)	Mean IKDC ST(N=30)
Age group	20-25	93.44	92.47	94.52
	26-30	90.23	89.78	90.68
	31-35	86.60	83.72	89.01
	36-40	81.10	80.70	81.50

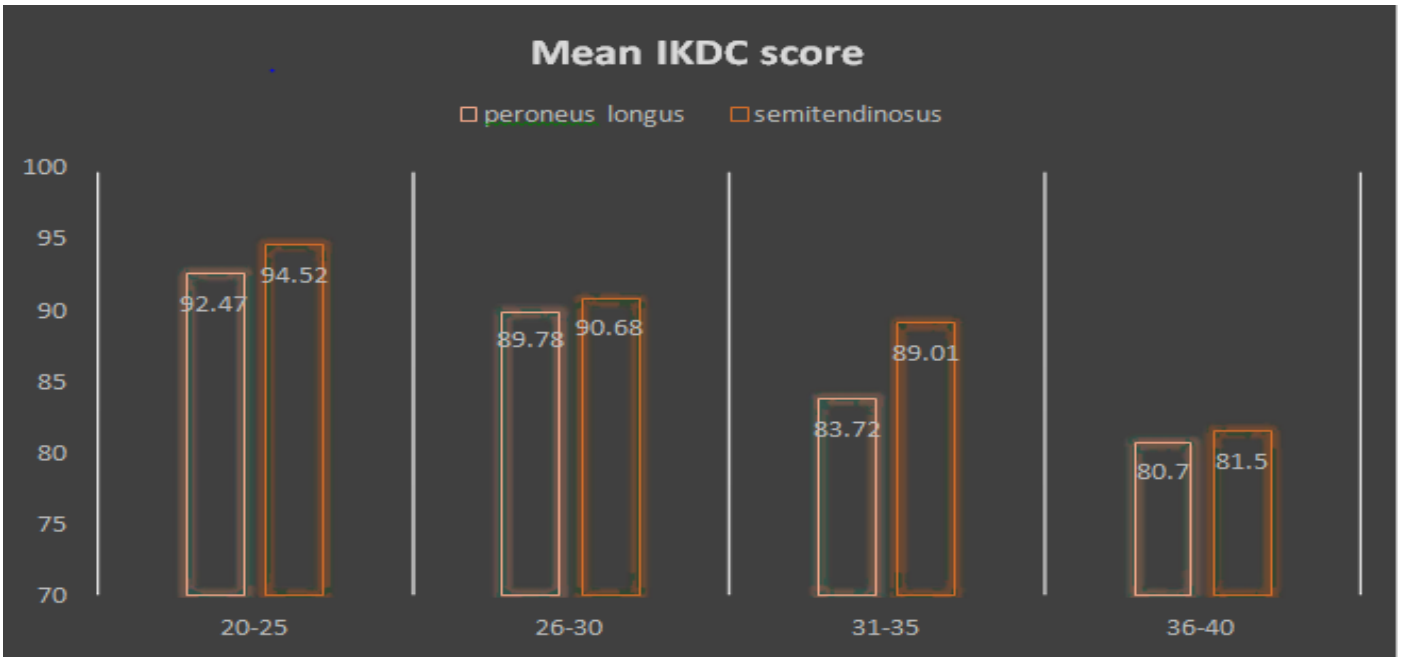

Fig 41 In our study IKDC subjective score ranged from 71.3-93.2 for peroneus longusgraft and 79.1-97.2 for semitendinosus graft. The mean IKDC subjective score was 85.9 and 91.8 respectively. Age group 20-25 showed highest mean for both thegrafts.

➢ *Peroneus Longus IKDC Score and Age Distribution Assessment:*

Table 9 Peroneus Longus IKDC Score and Age Distribution Assessment

		IKDC Normal	SCORE abnormal	Total	OR(CI)	P value
Age Category	20-30	21(95.5%)	1(4.5%)	22	12.60	0.048*
	31-40	5(62.5%)	3(37.5%)	8	(107-148.12)	

*Fisher's Exact

➢ *Semitendinosus IKDC Score and Age Distribution Assessment:*

Table 10 Semitendinosus IKDC Score and Age Distribution Assessment

		IKDC Normal	SCORE abnormal	Total	OR(CI)	P value
Age	20-30	21(100%)	0	21		0.3*
Category	31-40	8(88.9%)	1(11.1%)	9		

*Fisher's Exact

- *OR- Odds Ratio*
- *CI- Confidence Interval*

The odds of younger age group having a normal/good IKDC score is 12 times higherthan older population for peroneus longus graft (**p value =0.048**)

While for semitendinosus graft, P value =0.3, which is insignificant.

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Hence we can conclude that functional outcome with peroneus longus graftdecreases with age of patient more significantly compared to semitendinosus.

➢ *Mean Lysholm Knee Score*

Table 11 Mean Lysholm Knee Score

	Age category	Mean Lysholm (N=60)	Mean Lysholm PL(N=30)	Mean Lysholm ST(N=30)
Age group	20-25	94.41	93.77	95.12
	26-30	91.47	91.41	91.53
	31-35	88.45	86.40	90.16
	36-40	84.83	84.33	85.33

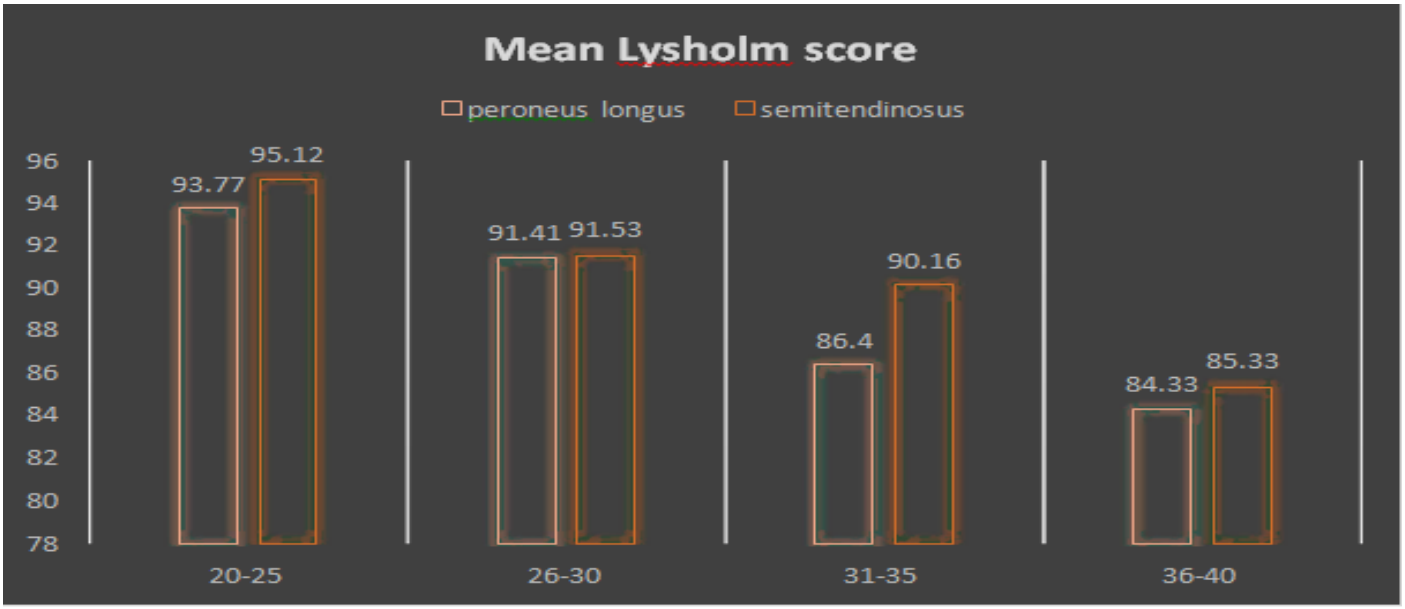

Fig 42 The mean Lysholm score was 90.6 and 91.6 for peroneus longus and semitendinosus respectively. Lysholm score ranged from 76-97 for peroneus longus and 83-97 for semitendinosus graft. Age group in 20-25 has got the highest mean Lysholm score.for both the graft.

➢ *IKDC Subjective Score Assessment of Both Graft*

Mean IKDC score of Semi T - 91.8 Mean IKDC of Peroneus Longus- 85.9

Table 12 Mean IKDC score of Semi T - 91.8 Mean IKDC of Peroneus Longus- 85.9

Graft	Mean Rank	P value
Peroneus longus	19.55	<0.001
Semitendinosus	41.45	

Thus there is a significant difference between the IKDC functional outcome of these 2grafts with a **P value <0.001** using Mann Whitney U test.

Hence semitendinosus graft is superior to peroneus longus graft for better functionaloutcome.

➢ *Donor Site Morbidity and Return to Work:*

Table 13 Donor Site Morbidity and Return to Work

		Total	Peroneus Longus	Semitendinosus
Donor Site Morbidity	Yes	6	4	2
	No	54	26	28
Returned To Work	Yes	50	23	27
	No	10	7	3

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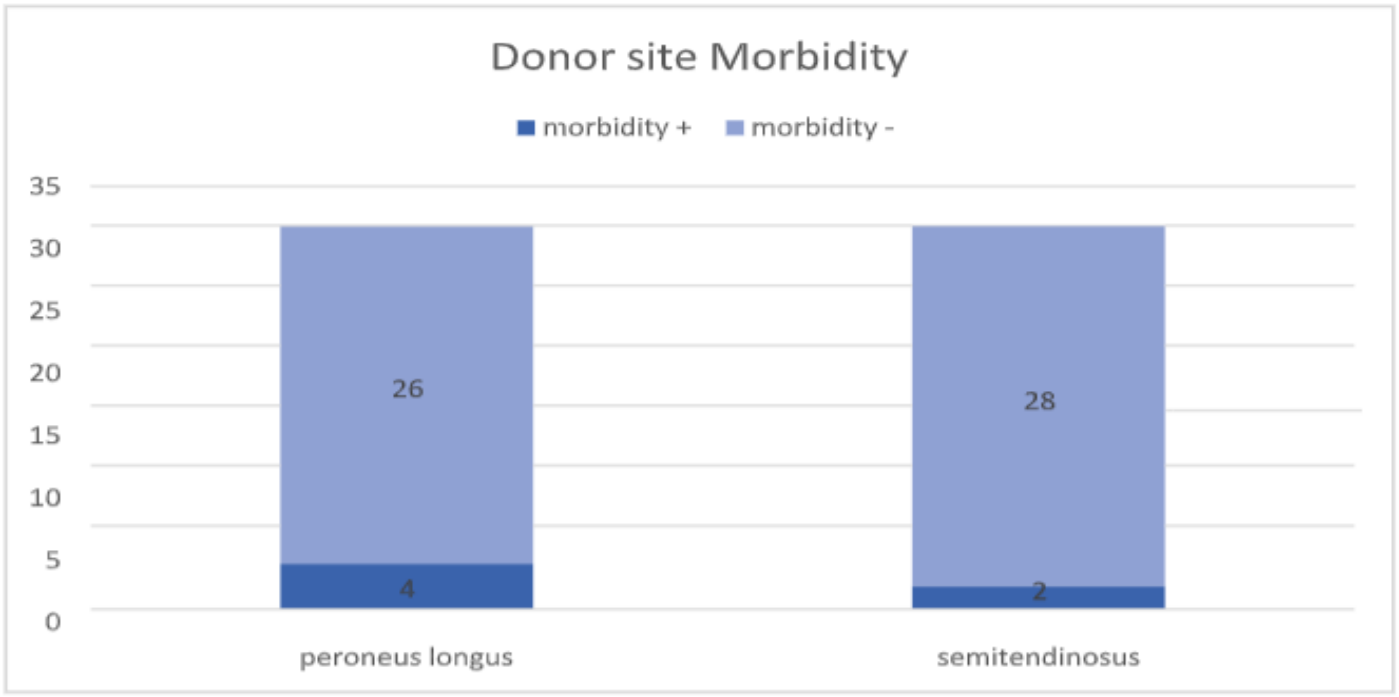

Fig 43 From our study we found out that 4 patients from peroneus longus graft populationand 2 from semitendinosus graft population had donor site morbidity.

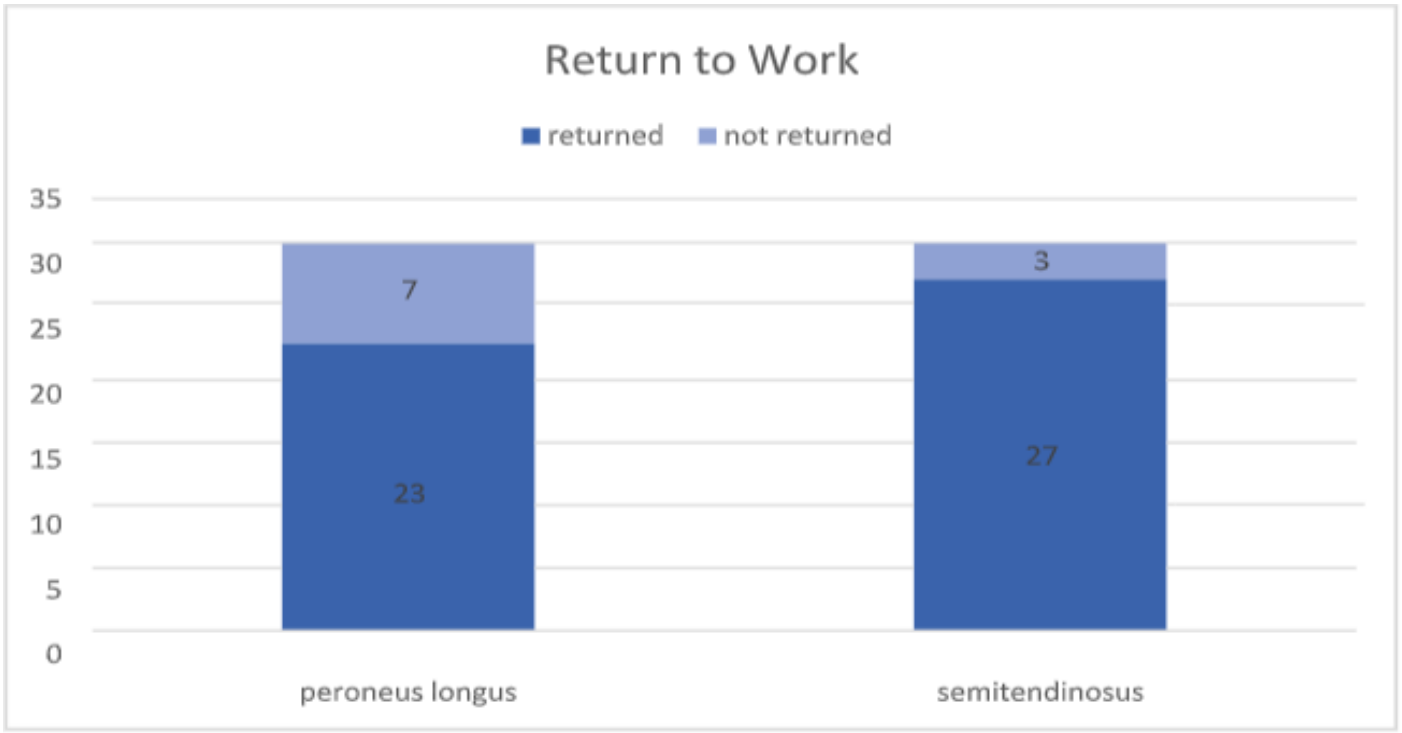

Fig 44 Except 7 patients from peroneus longus population and 3 patients from semitendinosuspopulation all others returned to their work after 6 months postoperatively.

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CHAPTER SEVEN
DISCUSSION

ACL have been the main knee stabilizer and it also aids to provide proprioceptive sensation of the joint. If there is rupture or injury to ACL, it would result In pain, give away sensation and instability. Associated meniscal and cartilage injuries may cause chronic instability and early osteoarthritis. Hence ACL reconstruction is of atmost importance and well accepted.

In our study we evaluated the functional outcome of patients who had undergone ACL reconstruction using peroneus longus tendon graft and semitendinosus graft, 6 months after the surgery. The study was a cross-sectional study done in the Orthopaedic out-patient department of Government Medical college, Thiruvananthapuram. The study included 2 groups, with 30 subjects each.

In our study >80% of the subjects were male in either of the groups. Subjects were in the range of 20-40 years. Majority of patients were below 30 years of age (about 71% of patients).Left sided involvement was seen in peroneus longus population but equal distribution in semitendinosus population. The most common mode of injury was road traffic accident which accounted for 55% of the patients and 30% were sports related injuries.

Post-operatively, physical examination of the knee was done with Lachman's test and Pivot shift test. 80% of the patients showed a negative Lachman's test while 1+ laxity and 2+ laxity was shown by was shown by 16.66% and 3.3% of patients respectively for peroneus longus population. For semitendinosus group, 90% showed normal test, 6.6% showed 1+ laxity and 3.3% showed 2+ laxity.

Pivot shift test showed a negative result in 90% patients, Pivot glide was shown by 6.6% of patients. Only 1 patient had a gross pivot shift for peroneus longus while for semitendinosus, 93.3% showed negative, 6.6% showed pivot glide and no gross pivot shift was noted.

Functional outcome was measured using IKDC subjective scoring system and Lysholm knee scale. IKDC subjective score ranged from 71.3-93.2for peroneus longus and 79.1-97.2 for semitendinosus. Mean IKDC score was 85.9 and 91.8 respectively for peroneus longus and semitendinosus. Higher mean IKDC score was shown by the patients in the age group between 20-25. Subsequent age group showed a trend of decline in mean IKDC subjective score with increasing age group. The Odds ratio of younger age group having normal/good score is 2 times higher thanolder population for peroneus longus with a significant p value of 0.048*. For semitendinosus graft, there was neither a significant p value nor an odds ratio. Thuswe could conclude that as age increases, functional outcome with peroneus longus graft decreases but not of semitendinosus. Hence caution must be there while picking peroneus tendon as graft for ACL reconstruction in older population. At 6 months of follow-up 90% and 96% of the patients showed a normal or nearly normal outcome for peroneus longus and semitendinosus respectively while 10% patients of peroneus and 3.3% of semitendinosus got an abnormal or severely abnormal outcome in terms of IKDC subjective score.

Lysholm scoring was also done post-operatively in our studies. 16.6% of both the population showed excellent outcome while 73.3% and 80% respectively of peroneus and semitendinosus population showed good outcome. The highest mean Lysholm score was obtained in the age group of 20-25. The lowest mean Lysholm score was inthe age group 36-40 for both the groups. The mean Lysholm score showed a similar trend like that of the IKDC score, with the increasing age group, the mean Lysholm score showed a decline in value. The mean Lysholm score was 90.6 and 91.6 respectively for peroneus and semitendinosus. Study done by Kumar VK et al. (29) and Khajotia BL et al. (28) showed a similar result in the functional outcome.

According to a study done by K P Saravana kumar and S Madhu , in which bone-patellar tendon bone graft was used for ACL reconstruction ,at 6 months of their follow-up 42% patients came with in the excellent to good outcome which is better compared to our study.(48) Another study done by Sandeep Kulavarma Rama got an excellent outcome in terms of IKDC scoring in knee function at 2 years of follow up.(49) Another study done by Syed Danish et al., using the bone patellar tendon bonegraft got a mean Lysholm score of 83.06 at 1 year of follow-up which is less compared to our study (50) The study done by Suranigi S M et al., got a mean post- operative Lysholm score of 98.8 at 2 year follow-up which is a better result compared to our study (51)

Study conducted by Chodavarapu LM et al., using hamstring graft got a mean postoperative Lysholm score of 91.16 which was comparable to our study but they got a mean IKDC score of only 58.7 at 1 year of follow-up (52). Another study done by Sadhana et al., got 90% patients with a Normal post-operative IKDC score which iscomparable to our study (53).

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➢ *Complications:*

- 4 patients from PL population and 2 patients from semiT population had donor site morbidity suggesting that peroneus longus have higher rate of donor site morbidity
- 7 patients from PL population and 3 from semiT population didn't returnto their normal work which is again favourable towards semitendinosus graft.

➢ *Limitation of the Study:*

- *Small sample size*
- *The study results were based on subjective scores and not based on objective score assessment.*
- *The patients were only followed up to 6 months after surgery for this study. Longer duration follow-up studies are required to assess the long-term outcome of the procedure.*

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CHAPTER EIGHT
CONCLUSION

- *Anatomic single bundle reconstruction of the anterior cruciate ligament of the knee with quadrupled hemi Peroneus longus tendon graft and semitendinosus graft gives good functional results with the latter being better in terms of IKDC subjective score and Lysholm's score.*
- *Functional outcome decreases with increase in the age group significantly with peroneus longus graft.*
- *Road traffic accidents are the most common cause of ACL injury in our study population*

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ANNEXXURE V MASTER CHART

Peroneus Longus Population

Serial No	Age	Sex	Side	Mode of Injury	Lachman's Test	Pivot Shift Test	IKDC score	Lysholm Score	Complications	Return to work
1	33	M	right	RTA	negative	negative	85.2	90	nil	yes
2	23	M	right	RTA	negative	negative	89.3	93	nil	yes
3	21	M	left	RTA	negative	negative	88.1	93	nil	yes
4	26	M	left	RTA	negative	negative	86.5	90	nil	yes
5	34	M	left	OTHERS	negative	negative	74.5	82	donor site morbidity	no
6	30	M	right	RTA	1	negative	83.5	90	nil	no
7	27	M	left	RTA	negative	negative	89.4	94	nil	yes
8	24	F	left	SPORTS	negative	negative	92.9	91	nil	yes
9	36	M	right	RTA	negative	1	84.2	88	nil	no
10	22	M	right	RTA	negative	negative	93.2	97	nil	yes
11	37	M	left	RTA	2	negative	81.6	89	nil	no
12	28	F	right	SPORTS	1	negative	76.2	84	donor site morbidity	no
13	26	M	left	SPORTS	negative	negative	88.7	95	nil	yes
14	28	M	right	RTA	negative	negative	86.4	92	nil	yes
15	32	M	right	RTA	negative	negative	85.6	89	nil	yes
16	30	M	left	OTHERS	negative	negative	87.2	92	nil	yes
17	21	M	left	SPORTS	1	negative	92.5	96	nil	yes
18	29	M	left	RTA	negative	n	88.3	92	nil	yes
19	38	F	right	RTA	negative	negative	70.2	76	donor site morbidity	no
20	25	M	right	SPORTS	negative	negative	87.4	94	nil	yes
21	24	F	left	OTHERS	negative	2	88.9	93	nil	yes
22	30	M	left	SPORTS	negative	negative	84.7	90	nil	yes
23	28	M	left	RTA	1	negative	85.7	93	nil	yes
24	26	M	right	RTA	negative	negative	92.4	96	nil	yes
25	22	M	left	SPORTS	negative	negative	90.6	95	nil	yes
26	25	F	right	SPORTS	negative	1	89.1	92	nil	yes
27	34	M	right	OTHERS	negative	negative	87.3	92	nil	yes
28	30	M	left	RTA	1	negative	85.6	89	nil	yes
29	28	F	left	SPORTS	negative	negative	90.5	94	nil	yes
30	35	M	left	OTHERS	negative	negative	71.3	79	donor site morbidity	no

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Semitendinosus Population

Serial No	Age	Sex	Side	Mode of Injury	Lachman's Test	Pivot shift Test	IKDC Score	Lysholm Score	Complication	Return to work
1	26	M	right	SPORTS	negative	negative	92.4	93	nil	yes
2	28	M	right	RTA	negative	negative	91.4	91	nil	yes
3	21	M	right	RTA	negative	negative	97.2	97	nil	yes
4	27	M	left	RTA	negative	negative	92.9	93	nil	yes
5	30	M	right	RTA	negative	negative	91.5	91	nil	yes
6	26	M	left	SPORTS	negative	negative	94.2	94	nil	yes
7	29	F	left	SPORTS	negative	negative	92.1	92	nil	yes
8	33	M	right	RTA	negative	negative	90.6	90	nil	yes
9	37	M	right	others	2	1	79.1	83	donor site morbidity	no
10	22	M	left	RTA	negative	negative	96.6	97	nil	yes
11	31	M	left	RTA	negative	negative	90.5	89	nil	yes
12	28	F	left	RTA	negative	negative	93.9	92	nil	yes
13	24	M	right	SPORTS	negative	negative	96.5	97	nil	yes
14	29	M	right	RTA	negative	negative	91.7	90	nil	yes
15	30	M	left	SPORTS	negative	negative	90.1	89	nil	yes
16	39	F	left	RTA	1	1	82.4	85	donor site morbidity	no
17	32	M	left	others	negative	negative	91.1	91	nil	yes
18	25	M	right	SPORTS	negative	negative	93.1	93	nil	yes
19	28	M	right	RTA	negative	negative	89.6	89	nil	yes
20	21	M	left	RTA	negative	negative	95.4	95	nil	yes
21	26	M	right	others	negative	negative	94.1	93	nil	yes
22	34	M	right	RTA	1	negative	91.9	91	nil	yes
23	27	M	right	SPORTS	negative	negative	92.5	92	nil	yes
24	35	F	left	others	negative	negative	89.5	88	nil	yes
25	31	M	right	RTA	negative	negative	92.1	92	nil	yes
26	29	F	left	RTA	negative	negative	91.9	91	nil	yes
27	23	M	left	SPORTS	negative	negative	95.4	95	nil	yes
28	24	M	left	RTA	negative	negative	94.3	93	nil	yes
29	36	M	right	RTA	negative	negative	88.9	88	nil	no
30	24	M	right	SPORTS	negative	negative	93.8	94	nil	yes

ABBREVIATIONS

- Anterior Cruciate ligament Bone patellar tendon bone graft
- International Knee Documentation committeeMedial Meniscus
- Medial Patello femoral ligamentPosterior Cruciate ligament Peroneus Longus tendon graft

ACL	-
BPTB	-
IKDC	-
MM	-
MPFL	-
PCL	-
PLT graft	-