"COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ."

Submitted by

Dr. ANANT ASHTEKAR

Dissertation submitted to The

BLDE (DEEMED TO BE UNIVERSITY) Vijayapura, Karnataka.

In partial fulfillment of the requirement for the degree of

MASTER OF SURGERY IN ORTHOPAEDICS

UNDER THE GUIDANCE OF

Dr. ASHOK NAYAK

MS ORTHOPAEDICS

PROFESSOR AND HEAD OF UNIT

DEPARTMENT OF ORTHOPAEDICS

B.L.D.E (DEEMED TO BE UNIVERSITY)

SHRI B.M PATIL MEDICAL COLLEGE HOSPITAL

& RESEARCH CENTER, VIJAYAPURA, KARNATAKA-586103

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation which is entitled "COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ." is a bonafide and genuine research work carried by me under the guidance of **DR. ASHOK NAYAK** MBBS, M.S, Professor and Head of unit Department of Orthopaedics at BLDE (Deemed to be University) Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapura.

Date: **Dr. ANANT ASHTEKAR**

Place: Vijayapura

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation which is entitled **"COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ."**

" is a bonafide research work done by **Dr. Anant Ashtekar** in partial fulfillment of the requirement for the degree of M.S in Orthopaedics.

Date:

Place: Vijayapura

DR. ASHOK NAYAK,
(MS ORTHOPAEDICS)
Professor, and Head of unit
Department of Orthopaedics,
B. L. D. E. (Deemed to be University)
Shri B.M Patil Medical College Hospital And
Research Centre, Vijayapura

BLDE (DU)
SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE
VIJAYAPURA

ENDORSEMENT BY THE HEAD OF THE DEPARTMENT

This is to certify that the dissertation entitled "COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ."

" is a bonafide research work done **by Dr. Anant Ashtekar** under the guidance of **DR. ASHOK NAYAK** MBBS, MS, Professor, and Head of unit Department of Orthopaedics at BLDE (Deemed to be University) Shri. B. M. Patil Medical College Hospital and Research Centre, Vijayapura.

Date:

Place: Vijayapura

DR. SANTOSH S NANDI,
(MS ORTHOPAEDICS)
Professor & HOD Department of Orthopaedics,
B. L. D. E. (Deemed to be University)
Shri B. M. Patil Medical College Hospital & Research Centre, Vijayapura

ENDORSEMENT BY THE PRINCIPAL

This is to certify that the dissertation entitled "COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ."

" is a bonafide research work done by **Dr. ANANT ASHTEKAR** under the guidance of **DR. ASHOK NAYAK** MBBS, MS, Professor, and Head of unit Department of Orthopaedics at BLDE (Deemed to be University) Shri. B. M. Patil Medical College Hospital and Research Centre, Vijayapura

Date:

Place: Vijayapura

DR. ARAVIND PATIL,

Principal,

B. L. D. E. (Deemed to be University)

Shri B. M. Patil Medical College Hospital &

Research Centre, Vijayapura

COPYRIGHT DECLARATION BY THE CANDIDATE

I hereby declare that the BLDE (Deemed to be University), Shri B.M. Patil Medical College and Hospital Research Centre, Vijayapura Karnataka, shall have the rights to preserve, use and disseminate this dissertation/thesis in print or electronic format for academic/ research purpose.

Date: **Dr. ANANT ASHTEKAR**

Place: Vijayapura

ACKNOWLEDGEMENT

It is my pride and privilege to express, with a deep sense of respect, my undying gratitude and indebtedness to my guide and esteemed teacher **Dr. ASHOK NAYAK**, As Professor and Head of unit Department of Orthopaedics, BLDE (Deemed to be University) Shri B. M. Patil Medical College, for the constant motivation and support, and co guide **DR PRASHANT KENGANAL** Assistant Professor, Department of Orthopaedics, BLDE (Deemed to be University) Shri B. M. Patil Medical College for their constant motivation and support which they encompassed me with in preparing this dissertation as well as in pursuit of my post-graduate studies. I am extremely grateful to my esteemed HOD, **Dr. Santosh S Nandi** M.S., Professor and HOD, Department of Orthopaedics, BLDE (Deemed to be University) Shri B. M. Patil Medical College, for his overall guidance, inspiration, and care during my residency.

I am grateful to **Dr. Aravind V. Patil** M.S., Principal of B.L.D.E. (Deemed to be University), Shri. B. M. Patil Medical College Hospital and Research Centre, Vijayapura, for permitting me to utilize hospital resources for the completion of my research. I am forever grateful to my teachers **Dr. Ashok Nayak, Dr Prashant kenganal Dr. Dayanand B B, Dr. Ravikumar Biradar,Dr Sandeep Naik Dr. Anil Bulagond, Dr. Bhimangouda Biradar,**

Dr.Shreepad Kulkarni, Dr. Rajkumar M Bagewadi, Dr Gireesh Khodnapur, Dr. Shrikant Kulkarni, Dr. Vijaykumar Patil, Dr. , Dr. sahebgouda patil,Drwadiraj Kulkarni, Dr. Vijay Vitthal Mundewadi for their valuable encouragement and sustenance.

I am thankful to my seniors, **Dr. Nitesh singh Rathore, Dr. Prasad k, and Dr. suhail, Dr.satyam,Dr.Anusha,Dr.kaushal** for their suggestions and advice. I am truly thankful to my fellow post-graduate students, **Dr. Harish,Dr khyathi, Dr. Ajayguru,**

Dr. Naveenkumar Reddy, Dr Charan sai Reddy, Dr. anand, Dr.sudev, Dr.manish, Dr. pranav reddy ,Dr,pranav kamley

as well as my **juniors Dr Vishnukumar, Dr Nilay, Dr Anudeep**

, Dr Ajinkya,Dr prithviraj for their co-operation and encouragement. I express my thanks to the library staff, OT staff, and all hospital staff for their kind cooperation during my study.

I would like to express my thanks to **Dr. Ajakumar Rangoli** a statistician at the Department of Community Medicine, for her help in statistical analysis.

I would like to thank my father, **DR SHRIRAM ASHTEKAR**, for being an inspiration and giving me the strength to pursue my dreams.

I am deeply thankful to my mother, **VANDANA ASHTEKAR**, for being the pillar of my life and constantly encouraging me to pursue my ambitions.

I am deeply indebted to my brother**, SUSHIL ASHTEKAR**, and sister **SNEHA ASHTEKAR**

other family members for their constant encouragement, support, love, and blessings.

I am blessed to have my friends and fellow batchmates **Dr. , Dr. ajinkya, Dr Sanjeet, and Dr. Radhika** for their constant support and

encouragement. Last but not least, I convey my heartfelt gratitude to all the patients, without whose cooperation, this study would not have been possible.

Date: **Dr. ANANT ASHTEKAR**

Place: Vijayapura

ABSTRACT

Background: the anterior cruciate ligament (acl) is crucial for knee joint stability, and its rupture is common often resulting from sports or road traffic accidents. acl reconstruction using hamstring and peroneus longus graft is commonly utilized, yielding positive clinical outcomes. this study aims to evaluatate comparative study of peroneus longus tendon versus hamstring tendon graft in arthroscopic reconstruction of anterior cruciate ligament ."

Material and methods: A prospective clinical study was conducted from january 2023 to january 2025 at Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura. The study included 24 patients with ACL tear .12 patient operated with arthroscopic ACL reconstruction with peroneus longus graft. And other 12 patient operated with Hamstring tendon graft. Comparative study were assessed using the Lysholm and International Knee Documentation Committee (IKDC) scores preoperatively and at 6 and 12 months postoperatively.

Results: Significant improvements were observed in both Lysholm and IKDC scores at 6 and 12 months postoperatively ($p < 0.05$). Ninety-five percent of patients resumed their pre-injury level of activity. With no instances of tunnel widening and a low prevalence of postoperative anterior joint laxity, the study found minimal comlpications

Conclusion: The current study showed that peroneus longus tendon autograft might be regarded as a safe and useful autograft source for arthroscopic anterior cruciate ligament reconstruction. With regard to its strength, greater graft diameter, satisfactory ankle function, and avoidance of potential complications of hamstring autograft obtained from the knee region

- Peroneus longus is superficial in location and easy to harvest compare to hamstring tendon

LIST OF ABBREVIATIONS

- mm – Milli meters
- cm – Centi meters
- ACL – Anterior Cruciate Ligament
- AP – antero-posterior
- IV – Intravenous
- BP – Blood pressure
- AM – Anteromedial
- PL – Posterolateral

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The extra-synovial, intraarticular anterior cruciate ligament (ACL) is housed in knee joint's core complex, which is essential for preserving the joint's stability both statically and dynamically.[1]

Anterior cruciate ligament rupture is most commonly injured knee ligament, and injuries usually result from sports activities and road traffic accidents[3]. Because more people are interested in and participating in sports, the general population is suffering from more ACL tears[1]. The chance of developing symptomatic knee instability after an ACL injury ranges from 16% to almost 100%.[1]

One of the most popular and often carried out arthroscopic procedures, ACL reconstruction is renowned for producing positive clinical results[4-7]. For ACL restoration, hamstring or bone-patellar tendon-bone (BPTB) structures are typically utilised. A bone autograft from the patellar tendon is either better than or comparable to a hamstring autograft, according to earlier studies.[8-10] with the benefits of less donor site morbidity, anterior knee discomfort, quadriceps muscle deficiencies, sensory impairments, and loss of extension compared to BPTB autografts. Graft features along with improved soft tissue graft attachment are responsible for the excellent bio-mechanical graft qualities in ACL restoration using hamstring tendons[13].

"Two popular techniques for fixing grafts are suspensory fixation (involves attachment of the graft to bone outside cortex)[14] and aperture fixation (securing the graft to the bone through a tunnel by putting a screw)[14]. Presently, there are two common types of cortical suspension devices: fixed loop (initial generation) and adjustable loop (2nd generation)[15,16]. The fixed-loop device (FLD), fills the tunnel with graft without the need for an additional implant[16] by securing the graft to a continuous suture loop that is attached to a button that is flipped and locked at the distal femoral cortex[16]. Following graft tensioning, a cavity is left above the graft as the femoral socket has a 6-8mm longer drilling than required, accommodating the button's flip movement. This may contribute to the "bungee cord effect" and the windshield wiper effect, increasing the likelihood of tunnel widening (TW).[4,15,17]

Conversely, in an adjustable-loop device (ALD), which features a button fixed to the graft, there is no longer a need for extra tunnel length to flip the button because this loop is tightened to pull the graft through to the top of the femoral[16,18].

ALD was designed to adapt seamlessly to varying tunnel lengths; it features a unidirectional locking mechanism[4], with its length maintained by friction between the sutures. Utilizing an adjustable loop endo button facilitates better control and retensioning of the graft after passive knee cycling, ensuring no excess space within the tunnel[19,20]. Their widespread use is attributed to their simplicity, elimination of the need for additional incisions on the femoral side[21], their potential to accelerate tendon-to-bone healing[22,23,] and also protect the graft from damage caused by the insertion of screws[24,25]. Current biomechanical data suggest that adjustable loop devices are the strongest fixation devices at "time zero" in terms of load to mechanical failure"[16]

"Suspensory and aperture methods of fixation using adjustable loop endobutton for femur and suture disc for tibia tunnel fixation has been studied, and increased stiffness of the construction is related to aperture fixation compared with the suspensory method[. 26,27] and increased graft ruptures, whereas suspensory fixation showed increased overall arthrometric stability and decreased graft ruptures[28].

Studies show that to facilitate graft tunnel healing and maintain its strength, it is better to use an adjustable loop endo button for the femur and suture disc for the tibia[29]. Hence, to substantiate the existing literature, we plan to conduct this prospective clinical study to assess the functional outcome of using the same".

AIM & OBJECTIVES

-comparative study of peroneus longus tendon versus hamstring tendon graft in arthroscopic reconstruction of anterior cruciate ligament .

-in arthroscopic acl reconstruction, the goal is to assess the functional outcome and donor site morbidity between the peroneus longus tendon group and the hamstring tendon group.

REVIEW OF LITERATURE

Galen[30] was the first to describe the fundamental characteristics of the anterior cruciate ligament that it acts as a joint stabilizer and limits excessive motion at the knee joint (Circa 170 AD)

James Stark[31], according to an Edinburgh-based general practitioner, in a couple of cases of cruciate ligament tears in the 19th century, the knee would give way with a snap, and the patient would lose control of the leg while lifting it. The first clinician to describe cases of anterior cruciate ligament insufficiency in English literature is frequently credited as “Stark.”

A study titled, Clinical and experimental inquiry into knee joint bloody effusions and in sprains" was published by Paul F. Segond[32] in 1879. Through his studies, he learned that anterior cruciate ligament tears were commonly seen alongside tibial plateau lateral margin avulsion fractures. He inspired the term of the fracture, ‘Segond fracture,’ which is now recognized as the pathognomonic sign of an Anterior Cruciate Ligament tear.

The 1st repair of ACL by catgut ligatures sewn to the tissues and synovial membrane on the inside of the external condyle in 1895 was reported by A W Mayo Robson[33].

The first Anterior Cruciate Ligament Reconstruction was done using an iliotibial band by retaining the upper attachment in the thigh and was passed through canals bored into the femur and tibia by Ernest W. Whey Groves[34] in 1917.

William C Campbell[35] published the first description of a use of medial-third patellar-tendon transplant in ACL reconstruction in 1935.

In 1939, Harry B. Macey[35] was the first to describe the semitendinosus autograft in ACL Reconstruction.

Extra-articular reconstruction using Tensor fascia-lata (Lateral Extra-articular Tenodesis) was done first by D L McIntosh[36] in 1972, and the Lateral Pivot shift was first described in his article.

Rubin, Marshall, and Wary[37], in 1975, used the first Dacron prosthetic in ACL-Reconstruction.

Joseph S. Torg[38], a trainee of John Lachman, first described the Lachman test in 1976, which aids ACL tear diagnosis, specifically those for the anteromedial bundle.

In 1979, Marshall et al.[39] described quadriceps tendon autograft usage for Anterior Cruciate Ligament Reconstruction.

In 1982, Lipscomb[40] performed the first ACL-Reconstruction by harvesting hamstring tendons.

In 1982, Jack Lysholm et al.[41] created a scoring system for knee ligament surgery follow-up that focused on assessing instability symptoms[41]. In their study, the scoring system mainly emphasized the patient’s evaluation and function, and objective signs (instability of ligaments and range of motion) are to be noted separately. They suggested a strong correlation between patients’ self-assessment of function and the scores obtained on their own scale and between examination findings of instability signs and low total scores.

A patellar-tendon-based graft was used for anterior cruciate ligament reconstruction by Clancy initially and turned out to be the strongest, having 160% of the normal anterior cruciate ligament's strength, according to Nayes et al. [42] in 1984.

In 1988, an arthroscopic Anterior Cruciate Ligament Reconstruction by using quadruple semitendinosus and gracilis autografts was first done by M.J. Fredman.[43]

In their article, Anterior cruciate ligament reconstruction with autografts in 1991, Tom Rosenberg[44] first described the use of Endobutton for graft fixation, and L Paulos explained the use of Polyethylene Anchor.

In 1993, F. Hefti[45] et al. published a paper titled “Evaluation of knee ligaments with the IKDC form”. In 1987, the group of European and American knee surgeon assembled to establish the International Knee Documentation Committee (IKDC). Research on the outcomes of treating knee ligament injuries that are published in a scientific journal must, according to the International Knee Documentation Committee, include an evaluation in the format specified in the paper. Additionally, the committee also suggested using Noyes et al.’s [46] definitions describing knee ligament injuries.

In 1995, Gene R. Barrett[47] et al. conducted a study to evaluate functional outcome of endobutton fixation in ACL reconstruction, in their study, they concluded that endobutton fixation shows promise in anterior cruciate ligament reconstruction procedure and the pitfalls of screw fixation are avoided.

In 1996, Paolo aglietti[48] et al. conducted a prospective clinical study to evaluate the semitendinosus and the gracilis tendon autograft in an arthroscopic anterior cruciate ligament reconstruction in athletes. Study included 69 patients and concluded that operation is a simple, an effective, and has low complication rates.

In 1997, John C. L’Insalata[49] et al. conducted a study to compare tunnel expansion in ACL reconstruction between hamstring and patellar tendon autografts. The study consisted of 60 patients (30 patients in each group), and they concluded the tunnel expansion were considerably more following the ACL reconstruction utilizing hamstring autografts than with patellar tendon autografts.

In 1997, Simonian P[50] et al. carried out a study on nine patients followed up for three years. The effect on knee function, flexion & extension strength, individual posterior thigh muscle size, and the degree of hamstring tendon retraction were specifically assessed. In conclusion, despite a more proximal insertion of the retracted tendons, the tendon harvest of a hamstring muscles did not much significantly impair the function and the strength.

In 1998, Wolfgang Nebelung[51] et al. conducted a prospective clinical study to evaluate bone tunnel expansion after ACL reconstruction with the semitendinosus tendon using an endobutton fixation on a femoral side in 29 patients with follow-up of 2 years and concluded that at 2 years follow-up, tibial and femoral bone enlargement was seen using an endobutton construct in ACL reconstruction[51].

In 2000, D.D.M spicer[52] et al. conducted a study to evaluate an anterior knee symptoms after the four-strand hamstring tendon of anterior cruciate ligament reconstruction. 44 of 50 consecutive patients, who have undergone four-strand hamstring tendon autograft arthroscopic ACL reconstruction was followed up for 24 months, and they concluded that ACL constructions using hamstring tendons can lead to anterior knee pain and associated symptoms, especially with kneeling, but they are rarely a limitation to activities.

In 2001, Vernon J. Cooley[53] et al. conducted a case series to study 5-year results in patients without meniscus loss in quadrupled semitendinosus ACL reconstruction of 184 patients and came to a conclusion that great clinical results are obtained with quadrupled semitendinosus tendon autograft for ACL reconstruction.
None of the patients had re-injury and continued with their pre injury activities.

In 2003, Leo Chen[54] et al. conducted a 10-year clinical trial where technique of an ACL reconstruction using the quadruple semitendinosus autograft using an Endo Button on femoral side was described. The senior author of this article, Dr. Rosenberg used this technique for more then ten years, with case of fixation failure on both femur and tibia. This technique using quadrupled semitendinosus tendon autograft reconstruction has little morbidity, low resurgery rate, and outstanding clinical outcomes[54].

In 2003, Kevin B. Freedman[55] et al. conducted a meta-analysis study that compared patellar tendon and hamstring tendon autografts in arthroscopic ACL reconstruction. 1348 patients were put in a patellar tendon autograft group (21 studies) and 628 patients in the hamstring tendon autograft group (13 studies); they concluded that patellar tendon autograft group showed better static knee stability and better patient satisfaction which was a result of lower graft failure rate when compared with hamstring tendon autograft group. However, anterior knee pain was a major complication in patellar tendon reconstruction group[55].

In 2004, Tim Rose[56] et al. conducted a prospective clinical study to compare patient outcomes during the early rehabilitation phase in ACL reconstruction with ligamentum patellae and semitendinosus tendon autograft. The study included 50 patients, and it was concluded that ACL reconstruction with semitendinosus tendon results in an advantages in regaining the pain and function during the rehabilitation phase compared to ligamentum patellae. This can be recommended in ACL reconstruction of young, active patients and athletes.

In 2005, Chadwick C Prodromos[26] et al. conducted a retrospective clinical study to evaluate the stability results of the hamstring anterior cruciate ligament reconstruction when followed up at 2 to 8-years. They retrospectively reviewed 153 consecutive primary hamstring ACL reconstructions in the skeletally developed patients with no other than ligament reconstructions and concluded that Hamstring autograft ACL reconstructions in both males and females produce reliable and durable stability with no reported graft failures, good clinical scores, very good range of motion and low graft site morbidity, without any hardware problems.

In 2005, Samir Abdul Razik Ibrahim[57] et al. conducted a randomized prospective study for comparing bone patellar-tendon-bone vs semitendinosus tendon autografts for arthroscopic ACL reconstruction. Eighty-five patients with chronic ACL deficient knees underwent arthroscopic ACL reconstruction, and the study concluded that in terms of the patient satisfaction, the activity level, and the knee function, both groups showed similar outcomes. Bone patellar-tendon-bone graft patients showed the patellofemoral problems and the loss of knee motion more frequently in a comparison with semitendinosus graft patients.

In 2006, "Matjaz Sajovic[58] et al. conducted a prospective, randomized comparison of hamstring versus patellar tendon autografts for ACL reconstruction with a 5-year follow-up; this study concluded that greater osteoarthritis prevalence is seen in patients operated with patellar tendon autografts after five years of surgery."

In 2006, Allen F. Anderson[59] et al. "conducted a cross-sectional survey to provide clinicians as well as researchers with normative data to better evaluate the interpretation of results on IKDC subjective knee evaluation form. The form was mailed to 600 people, each of whom was divided into eight categories based on age and gender. The survey concluded that the IKDC Knee Form provides a valuable outlook into symptoms, function, sports activity and it is a well-standardized instrument."

In 2006, James J Irrgang[60] et al. "conducted a cohort study to evaluate the responsiveness of International Knee Documentation Committee (IKDC) knee form; they concluded that the IKDC subjective knee form is a sensitive indicator of a patient's symptoms, function and level of sports participation.

In 2007, Gauti Laxdal[61] et al. conducted a prospective randomized comparative study of bone-patellar tendon-bone (BPTB) and hamstring grafts for ACL reconstruction in 134 patients. They concluded that two years after ACL reconstruction, the use of semitendinosus autografts rendered significantly less discomfort during the knee walking test than the use of BPTB autografts".

In 2007, Mattias Liden[62] et al. "Conducted a prospective randomized study for* arthroscopic ACL reconstruction using central-third bone patellar tendon bone (BTB) autografts and quadruple semitendinosus (ST) autografts in 71 patients and concluded that subjective as well as objective outcome were similar after using the central third BTB autograft and quadruple ST autograft after seven years of ACL reconstruction. Additionally, no significance in difference in terms of donor-site morbidity was found between the two groups".

In 2007, Susan L. Keays[63] et al. "conducted a cohort study comparing patellar tendon versus semitendinosus tendon graft with a 6 year follow-up considering the graft site's impact on function, strength, stability, range of motion, and joint deterioration following ACL reconstruction. The study included 62 patients (31 patients received patellar tendon grafts and 31 received semitendinosus grafts); it was concluded that 6-

year outcomes were very satisfactory, and reconstruction using the semitendinosus tendons resulted in improved functional performance and a lower incidence of osteoarthritis."

In 2007. Gregory B. Maletis[8] et al. "conducted a prospective randomized study of anterior cruciate ligament reconstruction comparing BPTB vs. Quadrupled semitendinosus tendon autografts. Forty-six patients in the BPTB group and 50 in the semitendinosus group were included. The study concluded that reconstruction of ACL with both BPTB and quadrupled semitendinosus graft can lead to success, although BPTB grafts led to an increase in anterior knee sensory deficit and difficulty kneeling."

In 2007, Matthias buchner[64] et al. "conducted a 6-year follow-up clinical. Functional radiological and isometric results after arthroscopic ACL reconstruction with quadrupled semitendinosus tendon autograft of 85 patients and concluded that ACL reconstruction with quadrupled semitendinosus tendon autograft provides very good and good subjective, functional, and stability and can be recommended for the patient with active ACL deficiency."

Randy Mascarenhas[65] et al. performed a retrospective atudy in 2012 to look at clinically reported results and players under 25 years old's return to sports after ACL surgery using hamstring or BPTB tendon autograft. The study found that 70% of young athletes are able to resume some level of intense or extremely intense athletic activity after receiving either hamstring or bone-patellar tendon-bone autografts[65]. Better extension preservation, greater the patient-reported outcome scores, and less the radiological evidence of osteoarthritis are the results of hamstring transplants.

In 2012, H.E Bourke[66] et al. "conducted a study to evaluate the outcome of isolated ACL ruptures treated with anatomical arthroscopic reconstruction by utilizing hamstring tendon autograft at a mean of 15 years. A total of 100 successive men and 100 successive women with 'isolated' ACL rupture went through four-strand hamstring tendon reconstruction, and the study concluded that using this technique 15 years post-operatively with respect to ligamentous stability, objective and subjective outcomes showed good results and did not seem to cause osteoarthritis".

In 2012, Dave Lee Yee Han[67] et al. conducted a systematic review for evaluating the effectiveness of suspensory vs aperture fixation in anterior cruciate ligament soft tissue graft fixation. Patients were followed up for two years and evaluated using the IKDC, Lysholm knee scale and the Tegner activity level, as well as anterior knee joint laxity measurements. The study displayed comparable outcomes between both suspensory and aperture fixation, and return to sports timing also did not show any differences.

In 2014, Akio Eguchi[68] et al., in their study Mechanical characteristics of suspensory fixation devices: comparing fixed and adjustable length loop devices for anterior cruciate ligament reconstruction[68]. Their study concluded that the fixed loop endo button provides greater mechanical strength than the adjustable loop endobutton[68]. The adjustable loop endo button caused noticeably more displacement during preloading in the isolated device testing than the fixed loop endo button. This could be attributed to the adjustable loop endo button's ability to stretch until a specific tension is applied[68].

In 2014, Evan J. Conte[69] et al. "conducted a systematic review to determine whether the size of the hamstring autograft can be predicted and may be a risk factor for the failure of ACL restoration; the study concluded that failure rates are reduced in quadrupled-strand hamstring autografts with a diameter of at least 8 mm. Grafts larger than 8 mm were found to provide a protective effect in patients aged less than 20 years, a group identified as having an increased risk of failure."

In 2015, Chidanand KJC[70] et al. "conducted a prospective clinical study to evaluate the clinical outcome of arthroscopic ACL reconstruction with suspensory fixation of quadrupled hamstring tendon autograft with endobutton on femur and suture disc on tibia. Thirty patients were included in the study, and they were operated on between September 2012 and March 2014. They were assessed clinically using IKDC at six months, one year, and two years[70]. According to the study's findings, the suture disc on the tibial side and the endo button on the femoral side would help the graft maintain its strength and aid in graft tunnel healing until good graft-to-bone healing fully occurs. This makes the device a strong and reliable suspensory type of fixation for ACL reconstruction[70]."

In order to assess fixed and adjustable loop cortical suspension systems, Nam Hong Choi[18] et al. carried out a retrospective comparative study of radiological and clinical outcomes following Hamstring anterior cruciate ligament restoration in 2016. ACL reconstruction was performed on 117 patients in total; 67 of these patients had fixed loops, and 50 had adjustable loops. It was discovered that, in contrast to the femoral fixation using a fixed loop device, the femoral fixation using an adjustable loop device produced the similar clinical results, but it did not lessen tunnel widening following hamstring ACL reconstructions[18].

In 2016, Mohtadi N[71] et al. conducted a study in 330 patients with isolated anterior cruciate ligament insufficiency. In total, 25 unique operations were necessary for 24 patients (7.3%), comprising 25 separate operations for the patellar tendon, quadrupled hamstring, and doubled hamstring. The meniscal tears (3.6%), the intra-articular scarring (2.7%), the chondral pathology (0.6%), and the wound dehiscence (0.3%) all required repeat surgery. Overall, the quadrupled/doubled hamstring groups experienced more complications, but at two years, more patellar tendon patients reported moderate to severe knee.

In 2017, Vinod Jagtap[29] et al. "studied the functional outcome of arthroscopic anatomical single-bundle ACL reconstruction using semitendinosus quadrupled graft with fixation using an endo button on the femoral side and suture disc on the tibial side. They found out that the functional outcome is good, and this method will help the graft to facilitate graft tunnel healing and maintain its strength until good graft-tobone healing occurs completely."

In 2017, Hardik Sheth[72] et al. "conducted a prospective study to evaluate the outcomes of arthroscopic ACL reconstruction using Fixed suspensory devices and Adjustable suspensory devices for femoral side graft fixation and concluded that ACL reconstruction using fixed loop and adjustable loop suspensory devices are equally effective fixation method."

In a study published in 2017, Etienne Cavaignac[73] et al. examined 95 patients who had isolated anterior cruciate ligament reconstruction; 50 of them underwent the procedure using the quadriceps tendon and 45 using the hamstrings. The study found that using a quadriceps tendon graft in anterior cruciate ligament reconstruction produces functional results that are on par with or better than those obtained with a hamstring graft without increasing morbidity.

"To ascertain whether suspensory or aperture fixation of hamstring tendon autografts offered superior stability and clinical outcomes in ACL restoration, William M. Browning[28] III et al. performed a meta-analysis in 2017. Their study concluded that suspensory fixation provided better arthrometric stability and fewer graft ruptures compared with aperture fixation of a quadrupled hamstring tendon autograft in ACL reconstruction"

In 2017, Brent T Wise[74] et al. "conducted a comparative clinical study to evaluate the consequence of ACL reconstruction with fixed versus adjustable loop button fixation. A total of 57 patients were included in the study: 33 in the adjustable loop and 24 in the fixed group. The study found no statistically significant difference, observed in the laxity of ACL grafts or in functional outcomes of grafts after surgery fixed when variable loop or fixed loop endo button technique were used."

In 2017, Manoj R kashid[75] et al. conducted a comparative study to access clinical and radiological outcomes in suspensory versus aperture fixation on femoral side using hamstring tendon autografts in anterior cruciate ligament reconstruction. Fifty patients were included in the study. 2 groups were randomly assigned to undergo arthroscopic ACL reconstruction using a quadrupled hamstring autograft on the femoral side with suspensory and aperture fixation[75].The study concluded that aperture and suspensory fixation methods of hamstring graft are clinically comparable, and there is no benefit of using one method over another; although suspensory fixation techniques, result in increased tunnel widening, this has little bearing on the overall clinical outcomes or functional knee ratings[75].

In 2018, Pokharel B[13] et al. "conducted a prospective study to compare fixed versus adjustable length loop devices in ACL reconstruction. A total of 60 patients were taken, and it was found that fixed length and adjustable loop cortical suspension are equally effective in femoral fixation of graft in ACL reconstruction.

In 2018, Darby A. Houck16 et al. conducted a meta-analysis and concluded that the adjustable loop device in terms of ultimate load to mechanical failure is the strongest fixation device at "time zero."

In 2018, Philippe colombet[17] et al. "conducted a prospective study to evaluate clinical and functional outcomes of ACL reconstruction at a minimum of 2 years using adjustable suspensory fixation with quadrupled semitendinosus tendon autograft in 131 patients and concluded that adjustable loop cortical fixation device yielded acceptable anterior laxity and clinical results, with 2.1% failure rate. These results are in good comparison to the fixed loop devices."

In 2018, Christian Asmus Peter Asmussen[76] et al. conducted a cohort study to evaluate passive knee stability after ACL reconstruction using Fixed loop endobutton and adjustable loop endobutton as a femoral fixation device in 3175 patients and concluded that patients who underwent fixation with the adjustable loop had improved passive knee stability one year post surgery, measured by anterior tibial translation and pivot-shift test results, similar to patients who underwent fixation with the Endobutton. Both devices showed No difference was seen in knee stability or reoperation rates.

In 2018, Rahul Ranjan[77] et al. "conducted a prospective randomized study to compare fixed loop and adjustable loop endobutton for femoral fixation of graft in ACL reconstruction in 102 patients and concluded that both fixed and adjustable loop endobutton gives substantially equivalent functional results and knee stability."

In 2018, Sharma et al.[78], conducted a case series using fixed and adjustable loop techniques for early outcome analysis of arthroscopic anterior cruciate ligament reconstruction. A total of 40 cases were included, of which 20 cases underwent fixed loop, and 20 cases underwent adjustable loop fixation. The study's findings indicated that in an ACL deficient knee, both fixed and adjustable loop techniques offer reliable fixation, comparable graft laxity reduction, and comparable functional outcomes[78].

Joseph T. Gamboa[19] et al. concluded in a 2018" study on the graft re-tensioning technique using an adjustable loop fixation device in arthroscopic anterior cruciate ligament reconstruction that the graft tensioning technique is an easy and efficient way to reduce graft laxity and leave a snug ACL construct[19]. Furthermore, as retensioning will reduce the ensuing laxity, re-tensioning the graft following tibial fixation may eliminate the need for a posterior drawer on the knee[19]."

In 2019, James Randolph Onggo[4] et al. "conducted a multi-database search to study femoral fixation in ACL reconstruction using adjustable vs fixed loop devices. A total of 21 studies were taken for review, of which 11 studies showed a statistically significant large maximum irreversible displacement of the graft in the adjustable loop devices group. Five studies reported statistically significantly higher graft stiffness for fixed loop devices than adjustable loop devices, 2 showed no statistically significant difference, and three studies that examined knotting showed no statistically significant difference between Fixed loop devices and Adjustable loop devices."

In a study conducted in 2019 by John Nyland[79] et al., the quadriceps tendon group included 17 patients, whereas the hamstrings tendon group had 61 patients. Overall, pivot shift laxity was higher in Group 2. Greater pivot shift laxity was seen in Group 2 suspensory femoral fixation compared to Group 1 compression femoral fixation. Additionally, based on the initial and end subject numbers, Group 2 compression femoral fixation showed higher failure rates and more anterior knee laxity than Group 1 compression femoral fixation. Based on the initial and final subject numbers, hamstring tendon compression femoral fixation had a higher failure rate than suspensory femoral fixation.

In 2019, Adnan A Alim Al Sebaie et al. "conducted a study to determine the short-term clinical outcome of adjustable suspensory fixation for femoral graft in ACL reconstruction and found that there is no significant difference in tunnel widening of adjustable suspensory fixation for femoral graft in ACL reconstruction with excellent stability and functional and clinical outcome."

In 2019, Hyeon Wook Ahn[81] et al. "conducted a comparative prospective study of clinical and radiological outcomes using fixed vs adjustable loop suspensory devices of 79 patients and concluded that both fixed loop and adjustable loop devices in ACL reconstruction provided good clinical and radiological outcomes with no significant differences."

In 2020, SJ Kabir[82] et al. "conducted a prospective clinical study for evaluating the functional outcome of bone-patellar tendon autograft in arthroscopic ACL reconstruction, which included 25 patients with Chronic ACL deficient knee. Patients were followed for six months. The quadriceps muscle showed atrophy at the final follow-up, and five patients complained of anterior knee pain."

Ramy Said Assaad Mohamed[83] et al. "performed a prospective study in 2020 to assess the outcomes of employing fixed and adjustable loop cortical suspension devices in arthroscopic ACL reconstruction[83]. The study employed Lysholm knee score 12 months after surgery. A total of 60 patients underwent ACL reconstruction with hamstring tendon autograft with fixed and adjustable loop endobutton in 30 patients each. The study concluded that cortical suspensory fixation devices are very effective methods, and although they have different biomechanical profiles, the clinical outcomes are the same[83]."

"The clinical outcomes of the adjustable loop device and fixed loop device were compared in a prospective randomized study by Naiyer Asif[84] et al. in 2021. They came to a conclusion that ACL reconstruction using fixed and adjustable loop suspensory devices for graft fixation produces comparable and satisfactory clinical Results"[84].

In 2021, Young Ji Kim[85] et al. "conducted a prospective study to study the clinical and radiological results after ACL reconstruction using an adjustable loop device in 80 patients and concluded that ACL reconstruction using adjustable loop cortical suspensory fixation results in good clinical outcomes as well as gives good stability of the knee with relatively little tunnel widening in both Single bundle and Double bundle reconstruction group."

In 2021, Sai Phani Balijepalli[14] et al. "conducted a prospective study to evaluate functional outcomes in arthroscopic ACL reconstruction by suspensory fixation in comparison with aperture fixation in 40 patients and concluded that ACL reconstruction by suspensory and aperture fixation methods seem to offer satisfactory results in terms of subjective scores and stability tests in patients with ACL tears, with no particular clinical advantage of one method over the other."

In 2021, Yoshimasa Ono[86] et al. "conducted a randomized prospective comparative study of fixed versus adjustable loop endobutton in graft position maintenance in ACL reconstruction. Patients were randomized into two groups with 13 patients each; the study concluded that both fixed loop and adjustable loop had similar graft retaining ability in vivo for 12 months."

In 2021, Ramesh kumar[87] et al. "conducted a study to determine the clinical reliability of adjustable femoral cortical suspensory fixation in anterior cruciate ligament reconstruction and the correlation of clinical outcomes with Demographic and Perioperative Factors in 100 patients and concluded that quadrupled hamstring graft with adjustable-loop fixation showed excellent subjective and objective outcomes with no residual laxity or failure of graft over mid-term follow-up. Postoperative laxity was not correlated with graft and tunnel dimensions."

In 2021, Lifeng yin[20] et al. "conducted a retrospective study comparing fixed and adjustable loop cortical fixation on 1st day of surgery in 94 patients and concluded that compared to fixed loop endobutton, the adjustable loop endobutton had a reduced gap distance, improved bone preservation, and a similar graft insertion length in the femoral canal"[20].

In 2022, Brinkman[88] et al. "conducted a prospective randomized comparative study to assess mid-term outcomes of all-soft quadriceps tendon autografts are noninferior to hamstring autografts in primary ACL reconstruction with a minimum fiveyear follow-up; study included 37 and 46 patients in quadriceps and hamstring autograft group respectively and concluded that both two and five years postoperatively, the groups showed comparable rates of reaching "minimal clinically important difference" (MCID) criteria. Similar rates of return to sports & postoperative complications were also seen across the two groups."

In 2022, SK Pandey[89] et al. "conducted a prospective study for evaluating the functional outcome of arthroscopic anterior cruciate ligament reconstruction using adjustable loop cortical suspensory fixation in 22 patients and concluded that the procedure suggested is an easy, reliable and effective way to reduce graft laxity and maintain a rigid ACL construct. Furthermore, re-tensioning the graft following tibial fixation removes the need for a posterior drawer on the knee because it will reduce any laxity that results from the procedure."

In 2022, Sebastian Schutzenberger[6] et al. "conducted a retrospective cohort study to evaluate ACL reconstruction with femoral and tibial adjustable versus fixed loop suspensory fixation. A total of 67 patients were included in the study, which concluded that the use of an adjustable-loop device and fixed-loop device on the femoral side and tibial side led to similar clinical results**.** Although the all-inside technique with adjustable loop fixation and popliteal harvesting did not demonstrate any quantifiable superiority to a technique with fixed loop fixation and anteromedial semitendinosus harvesting, it is less invasive causing a significantly lower rate of saphenous nerve lesions and might bring cosmetic benefits."

In 2022, Simone Birkebaek[5] Elmholt et al. "conducted a meta-analysis and a systematic review of fixed loop vs adjustable loop cortical button devices for femoral fixation in ACL reconstruction. The study concluded no differences regarding knee laxity and patient-related outcomes, and both devices are safe to use in ACL reconstruction."

In 2023, Christian Hwee Yee Heng90 et al. "conducted a prospective clinical study comparing fixed-loop device (FLD) vs adjustable-loop device (ALD) graft fixation outcomes with 2-year follow-up in patients undergoing primary ACL reconstruction. The study included 105 patients, and they concluded that FLDs and ALDs for suspensory fixation of hamstring tendon autograft in ACL Reconstruction had similar clinical outcomes with at least of 2-year follow-up. There was no evidence of graft loosening from loop lengthening."

In 2023, Ronak Yashwantbhai khatri[91] et al. "conducted a randomized controlled study to evaluate functional outcomes of quadriceps tendon vs. hamstring tendon autograft using suspensory fixation at femoral and tibial sites for primary anterior cruciate ligament reconstruction. 34 patients were included in the study and randomization was done into two groups, and functional outcomes were assessed using Lysholm knee score and IKDC scores. The study concluded that at the end of 2 years of follow-up, both autografts showed similar outcomes, with no specific graft site complications."

The comparative study on the clinical outcome of femoral side graft fixation in the primary ACL reconstruction was carried out in 2024 by R Prabhakar Singh[92] et al. Two endo button groups were created for a total of forty patients: group A had a fixed endo button, while group B had an adjustable loop endo button. It concluded that there were no significant differences in clinical outcomes in both fixed and adjustable loop endo buttons, but the benefit of an adjustable loop endo button is that it allows for intra-operative tibial fixation and post-cycling graft retightening[92].

In 2024, Ahmed M. Abdulwahab1[5] et al. conducted a meta-analysis to evaluate functional outcomes after ACL reconstruction using an adjustable femoral cortical suspensory fixation device. The meta-analysis included ten research studies with a total of 613 patients, and they concluded that using the adjustable loop suspensory fixation device for ACL reconstruction produces favorable functional outcomes in terms of knee stability and mobility.

In 2024, Janina kaarre[93] et al. "conducted a study to determine whether interference screw (metal) fixation combinations manifest high revision rates in primary hamstring tendon ACL reconstruction. 23,238 patients that underwent primary hamstring tendon autograft between 2005 to 2018 were included and they concluded that metal interference screw fixation, especially when performed on both, femoral and tibial sides, most commonly resulted in a revision surgery."

EMBRYOLOGY

By the sixth week of intrauterine life, distinguishable knee structures have formed, with knee joint development starting around the fourth week [94].

In tests of 43 embryos between developmental stages 18 and 23 (44–56 postovulatory days), Wojciech Ratajczak[95] found that at stage 18, the embryos show a consistent Interzone that will eventually grow into the knee joint.

By stage 19, the medial portion of this interzone is where the cruciate ligaments begin to form, and the interzone has differentiated into dense, highly stained peripheral regions known as meniscal primordia.

All of the knee joint's internal structures are further defined by stage 20, and stages 21–23 mark their full formation.

The anterior cruciate ligament (ACL), which has a common developmental origin from the blastema, emphasises the coordinated development of the meniscus and the cruciate ligament. The ACL begins as a ventral ligament and progresses as the intercondylar gap forms, emerging before joint cavitation and remaining outside the synovial space[94].

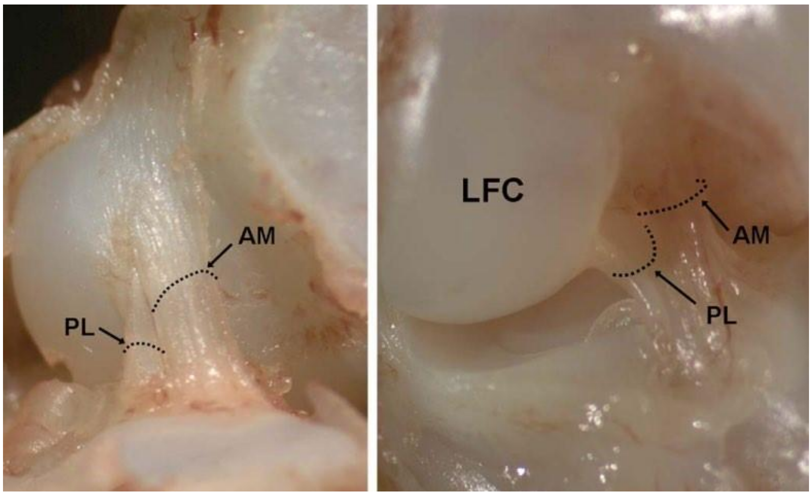


Figure 1. 16-week fetus demonstrating ACL with the knee in extension and flexion (AM- anteromedial, PL- posterolateral, LFC- lateral femoral condyle)[96]

ANATOMY

Comprising several fascicles of strong connective tissue, the anterior cruciate ligament (ACL) is located intra-articularly but outside the synovial membrane. It originates from medial aspect of posterior portion of lateral femoral condyle and extends between femur and tibia. It follows an oblique path inside the knee joint and ends at a large region in the middle of the tibial plateau. The ligament fibres show a modest outward rotation along their whole length.

"With an average width of 11 mm [97]and a thickness of about 44 mm3 at its mid-substance, the anterior cruciate ligament (ACL) roughly triples in size at its attachment sites"[98 99].

Its overall length is between 31 and 38 mm[100]. Because the graft's attachment sites are isometric, exact anatomical placement is essential during ACL restoration.

"The ACL begins in an oval area that is around 18 mm long and 11 mm wide on the medial surface of the posterior portion of the lateral femoral condyle[101].

The anterior attachment is nearly linear, while the posterior attachment exhibits a convex curvature[97]

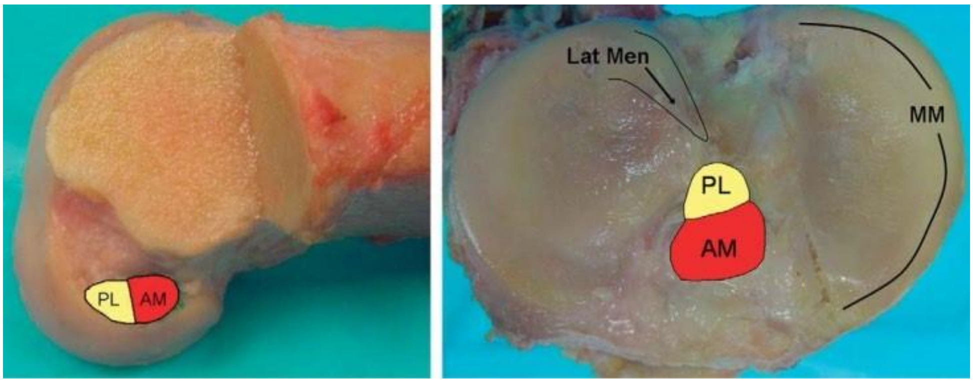


Fig 2.[105] ACL femoral and tibial insertion sites (MM- medial meniscus, Lat Men- lateral meniscus)

Anterolateral to the tibial tubercle in the intercondylar fossa, the medial and lateral tibial spines are where the ACL attaches to the tibia. About 11 mm in the coronal plane and 17 mm in the sagittal plane are the axial measurements of the ACL insertion"[98 102]

"Numerous ideas, including single, double, and triple bundle notions, have been proposed regarding the anterior cruciate ligament (ACL). The current consensus recognises two separate functional bundles, the anteromedial (AM) bundle and the posterolateral (PL) bundle, which are identified by their tibial insertions. The AM bundle starts proximally at the femoral origin, whereas the PL bundle starts distally at the femoral attachment and inserts into the posterolateral part of the tibial insertion[98]. In the context of ACL reconstruction surgery, these anatomical differences have attracted a lot of attention.

As the knee moves from extension to flexion, there are notable changes in the alignment of the anteromedial (AM) and posterolateral (PL) bundles of the anterior cruciate ligament (ACL). The femoral attachment sites of these bundles are parallel and vertically orientated at full extension, but at 90 degrees of flexion, they become horizontally orientated, creating a crossing pattern. In terms of function, the AM bundle behaves in the opposite way, with the PL bundle tightening during knee extension and loosening during flexion."

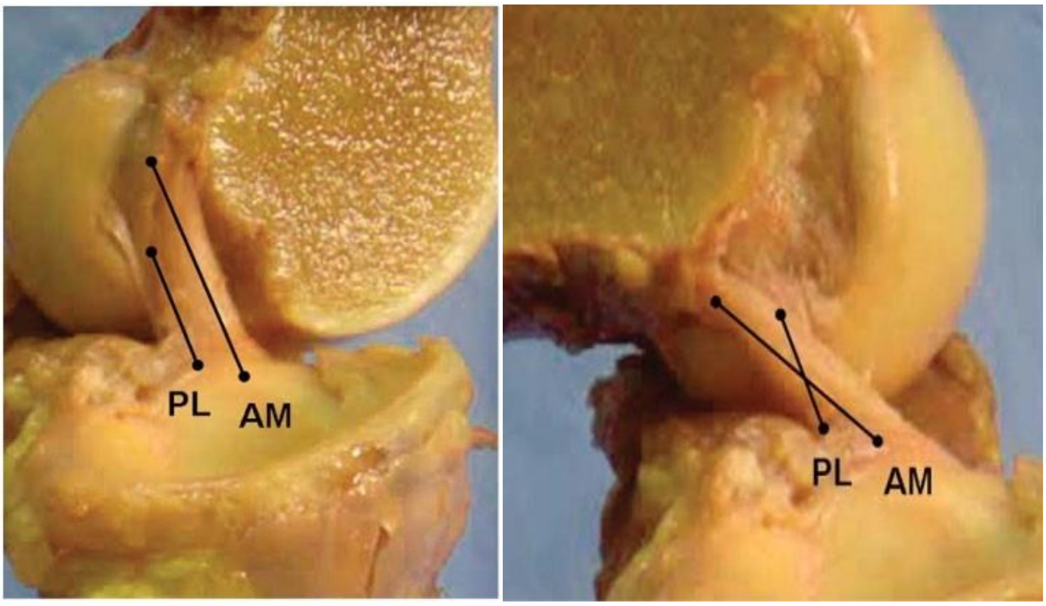


Fig 3[106]. Crossing pattern of Anteromedial (AM) and Posterolateral (PL) bundles in extension and in flexion

These bundles' distinct functional roles suggest particular clinical ramifications. The Lachman test, which evaluates anterior translation of the tibia because of its function in stabilising the knee during extension, is primarily impacted by failure of the

PL bundle. On the other hand, the anterior drawer test, which assesses anterior tibial translation, is typically more affected by single rupture of the AM bundle. The PL bundle is also essential for preventing the knee from rotating both internally and externally[103 104], which emphasises how important it is for overall knee stability.

Blood supply[107]:

The middle genicular branch of the popliteal artery is the main source of blood flow to the anterior cruciate ligament (ACL). Beyond the infrapatellar fat pad, this branch extends distally to the joint capsule junction after entering the posterior capsule directly. Branches in this area pierce the synovial membrane, helping to form a synovial plexus that envelops the ligament as a whole. Additionally, the lateral inferior geniculate artery may have smaller terminal branches that supply blood to this synovial plexus.

Finer branches that anastomose with a network of longitudinally orientated veins within the ligament allow vascular penetration of the ACL itself. These arteries support the circulatory requirements of the ligament by aligning parallel to the collagen bundles.

Nerve supply[108]: "The posterior-articular branch of the posterior tibial nerve innervates the anterior cruciate ligament (ACL). The majority of neural structures are found in the sub-synovial levels and close to the origin of the ACL. Within the ACL, nociceptive receptors include Ruffini receptors resembling stretch receptors and free nerve terminals. The ligament's substance contains small nerve fibers involved in proprioception and nociception."

Histology[109]: Collagen fibrils that comprise the anterior cruciate ligament (ACL) have a diameter of 150–250 nm and are arranged in a complicated network. These fibrils display a variety of unique organisational structures, including as planar, helical, parallel or twisted, and non-linear topologies. While the peripheral fascicles of the ligament are usually arranged in a helical pattern, the core fascicles of the ACL can seem either straight or deformed. "Recruitment" and "crimp" refer to the non-linear arrangement of ACL fibrils and the primary wave-like characteristic, respectively.

The crimp, a characteristic sinusoidal pattern in the matrix of the anterior cruciate ligament (ACL), functions as a buffer that resembles an accordion. Like a shock absorber along its length, this shape enables the ligament to tolerate limited expansion without harming its fibers[111]. In essence, the crimp in the fibrils is first straightened by modest pressures during tensile stretching, necessitating greater stressors for additional elongation. A non-linear load-elongation curve is produced by the recruitment of more fibrils to support the load, progressively increasing tissue stiffness as stresses increase.

The anterior cruciate ligament (ACL) has three different zones visible under a microscope. Fibroblasts, glycoproteins, and type II collagen are among the high cellular density found in the proximal portion. Dense collagen fibres and fibroblasts with spindle and fusiform shapes are found in the central portion. Additionally, this area has oxytalan fibres that can endure multidirectional pressures and elastic fibres that can sustain repeated maximal stress. Chondroblasts and ovoid fibroblasts are particularly common in the distal portion of the ACL.

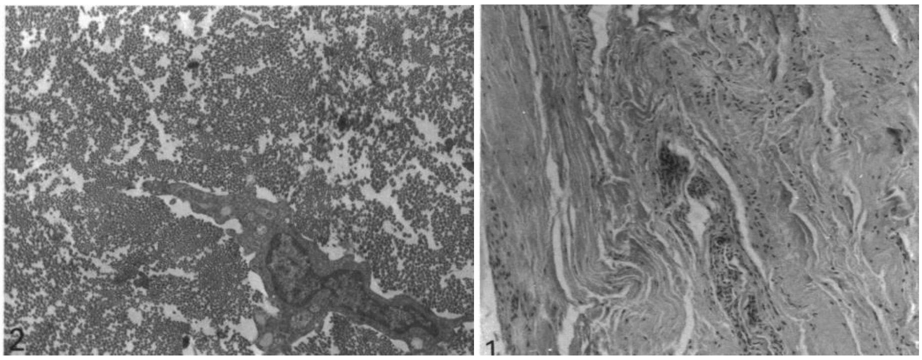


Fig 4[109]. Showing Transverse section of ACL (composed of collagen fibrils) & Fig 5[109], showing the Longitudinal paraffin section subdivided into fascicles.

"essential part of the structure of the anterior cruciate ligament (ACL) is the junction between flexible ligamentous tissue and hard bone. A transitory zone made up of both mineralised and fibrocartilage facilitates this connection. This architectural region usually consists of non-mineralized and mineralised cartilage zones, the ligament itself, and the subchondral bone plate where the ligament connects. In addition to allowing for a slow change in intrinsic elasticity, this microstructural transition successfully reduces stress concentration at the attachment site."

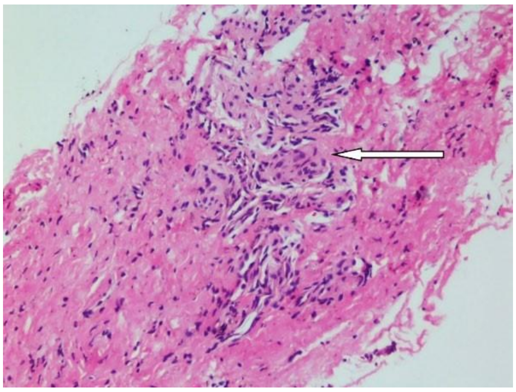


Fig 6[112]. ACL partial tear

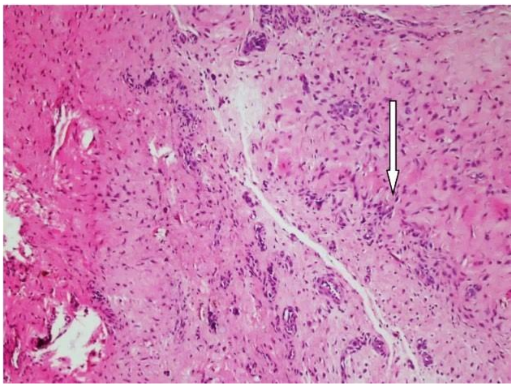


Fig 7[112]. ACL complete tear

Functions of Anterior Cruciate Ligament[113]:

"The anterior cruciate ligament (ACL) plays a major role in both static and dynamic joint balance in addition to its functions in proprioception and mechanical support. The ACL's proprioceptive function is confirmed by histological investigations that show nerve terminals within it.

The maximal tensile strength of the ACL is roughly 1725 +/- 270 N, which is less than the peak forces experienced during intense sports. By dispersing load across the knee, dynamic stabilisers like muscles are essential for improving joint stability[97].

The ACL's mechanical role is to prevent anterior translations at 90 degrees of flexion (anteromedial bundle) as well as during extension (posteromedial bundle). Additionally, the posteromedial bundle resists hyperextension. Additionally, by restricting internal rotation and stabilising the joint as it approaches full extension, the ACL helps regulate knee rotation. The ACL also serves as an extra defence against adduction and abduction stresses across the range of knee flexion."

Injury Mechanism:

"The knee joint is stabilised in the coronal plane by the medial and lateral structures, and in the sagittal plane and rotational plane by the cruciate ligaments and capsuloligamentous structures. The location of the joint affects the functions of the major and secondary stabilisers. The femur rotates on the tibia during knee flexion, relaxing the knee capsule and other ligamentous structures and making them more vulnerable to ligament damage.

When enough force is exerted, ligament injury develops, leading to long-lasting deformation. Rotational trauma, which encompasses processes like flexion-valgus-external rotation, flexion-varus-external rotation, forceful external rotation, or hyperextension trauma[115], is the most common cause of anterior cruciate ligament (ACL) injuries. Rotational trauma frequently results from sudden changes in direction or deceleration and can happen as a contact injury (30%), like in an automobile accident where the knees are bent, or as a non-contact injury (70%), like in football or soccer.

When valgus forces cause a substantial injury to the knee, the medial collateral ligament (MCL) needs to stay intact. However, the ACL is also vulnerable when the MCL sustains damage as a result of continuous abduction thrust. The typical "Unhappy Triad of O'Donoghue," which involves injuries to the ACL, MCL, and medial meniscus, can also result from the medial meniscus becoming trapped between the femoral and tibial condyles when rotational stresses are present.

Women are more susceptible to anterior cruciate ligament (ACL) injuries due to anatomical differences such as a smaller intercondylar notch, a greater Q angle, and a smaller and less strong ACL. Despite these predispositions, demographically, men sustain more ACL injuries overall."

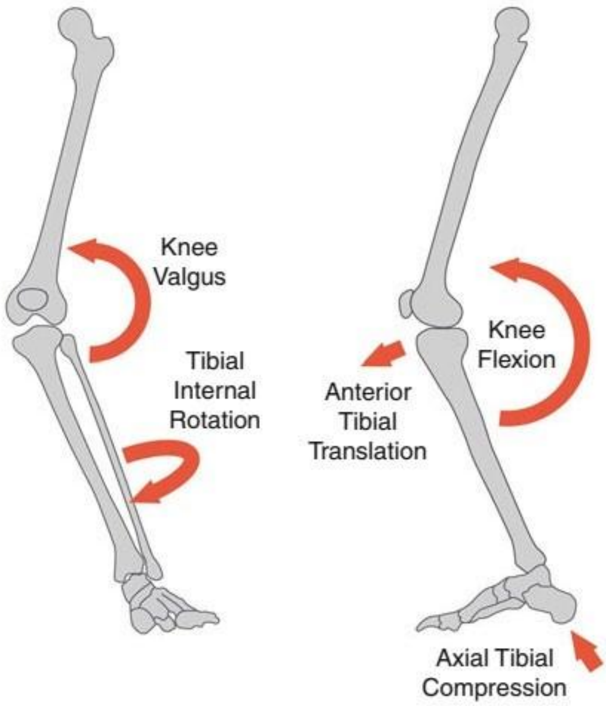


Fig. 8[114], Multidirectional mechanism of ACL injury

Natural history:

"In the first year following ACL repair and returning to sports, the risk of suffering another ACL injury is fifteen times higher than that of those who have never experienced one. Meniscal problems accompany between 50 and 70 percent of acute ACL injuries, with the lateral meniscus most commonly impacted in acute situations.

In knees with ACL deficiency, late meniscal injury is quite prevalent because of aberrant loading and shear forces.. In chronic ACL injuries, the medial meniscus is more commonly injured due to its close association with the capsule.

According to research, those with ACL injuries who return to sports and have recurrent bouts of instability are more likely to develop meniscal tears and chondral injuries, which can ultimately result in arthritis. 21–31% of individuals get osteochondral changes following a first ACL injury. Magnetic resonance imaging (MRI) may sensitively identify both acute and chronic ACL injuries, and these osteochondral abnormalities could be precursors to osteoarthritis."

Clinical Evaluation:

"ACL ruptures are typically caused by rotational trauma (flexion-valgus-external rotation, flexion-varus-internal rotation, forced external rotation) or hyperextension trauma Common symptoms commonly reported by patients with acute ACL injury are[115]: Getting a thorough clinical history is the first step in the clinical examination of a patient with an ACL injury.

- feeling or hearing a pop in the knee.
- being unable to resume the prior activity
- joint effusion developing quickly, usually within an hour
- mechanisms of injury that typically involve a change in direction (e.g., a noncontact injury incurred during a sudden change of direction in football)"

It is simple if the test is conducted shortly after the injury. By then, muscular guarding would not have evolved. Often, but not usually, there is hemarthrosis, or an effusion[115]

During presentation, pain and knee giving way are common symptoms. Meniscal injuries are frequently identified by locking episodes or clicking or clunking sounds. Comprehending the unique state and requirements of a patient is essential to customizing the course of treatment.

Physical Examination:

The clinical examination involves a sequential approach, starting with inspection, followed by palpation, measurement, and movement assessment. To aid in diagnosis and the subsequent treatment plan, specific tests are performed for the menisci, collateral ligaments, and cruciate ligaments.

Tests performed for ACL injuries:

"The Anterior Drawer Test is carried out with the patient in a supine posture with the hip and knee flexed at 45 and 90 degrees, respectively. The examiner sits on the dorsal portion of the patient's foot to stabilise it. Observing the relative movement of the tibia to the femur, a little anterior and posterior force is given on the proximal tibia. The tibia is rotated 30 degrees internally and 30 degrees externally in order to repeat this manoeuvre."

An ACL injury is indicated by an anterior displacement of roughly 5 to 7 mm relative to the contralateral side. It is crucial to initially look for posterior tibial sagging in order to prevent false positive results.

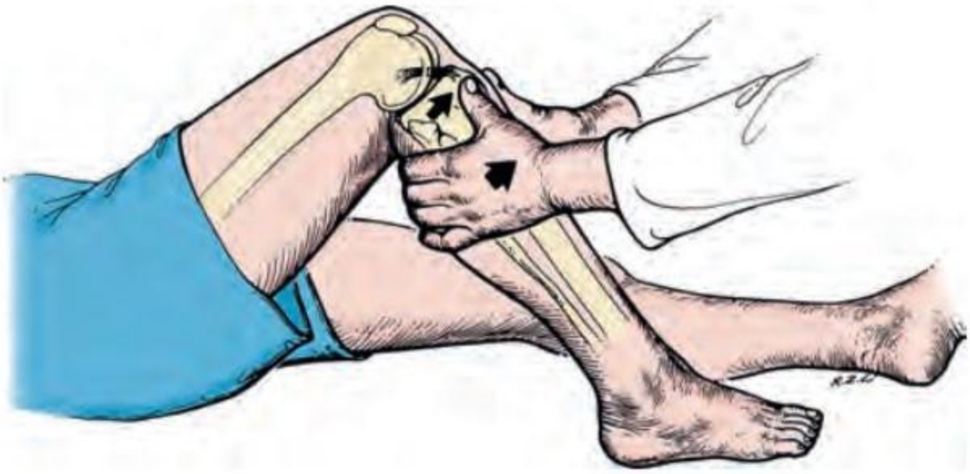


Fig. 9[117]: Anterior Drawer Test

Lachman test[116]: The Lachman Test can be used in place of the Anterior Drawer Test when a severely painful knee makes it impossible to perform the test because of the inability to reach 90-degree flexion. The patient rests supine during this examination, and the joint is flexed between 0 and 20 degrees and slightly externally rotated.

" The examiner uses one hand to translate the proximal tibia anteriorly and the other to stabilise the femur. The anteromedial joint edge of the proximal tibia[139] should be supported by the thumb. An ACL damage is confirmed by a gentle anterior translation of the tibia in relation to the femur.

The Lachman Test is more sensitive for evaluating the ACL's posterolateral (PL) bundle since it is at its most relaxed in flexion and at its tightest in extension. On the other hand, the Anterior Drawer Test is more sensitive for assessing the anteromedial (AM) bundle since it is relaxed in flexion and tightest at 60 degrees of knee flexion."

The Lachman test[115] is the clinical test that is most sensitive and specific for ACL injury. In a number of aspects, the Lachman test is better than the traditional anterior drawer test. Although haemarthrosis has relatively little influence on it, it is extremely vulnerable to ACl rupture. Because the slightly flexed position helps to relax the muscles surrounding the knee, it can be performed with relatively little pain, even in cases of acute injury. Additionally, this position permits more anterior tibial translation in the case of a unilateral ruprure.115

Fig. 10[117] : "Lachman Test"

Pivot shift test[116]:

The subluxation that occurs when the ACL is injured can be elicited using this indirect test for ACL damage. The typical pivot-shift manoeuvre, demonstrated by Callway and McIntosh, involves positioning the patient in a supine position.

The examiner grasps the ankle and rotates it internally while lifting the afflicted leg off the table. Both the knee and the limb should be totally relaxed and stretched. If pain or oedema prevents the knee from fully extending, the test may not be accurate.

"After an ACL rupture the femur drops posteriorly due to gravity, causing the tibia to anteriorly sublux over the femur. The examiner grasps the lateral side of the proximal section of the leg[116] and applies a valgus force while flexing the knee with one hand. The anteriorly subluxed tibia will abruptly return to its normal position with a palpable or audible clunk when the knee is flexed between 15 and 30 degrees."

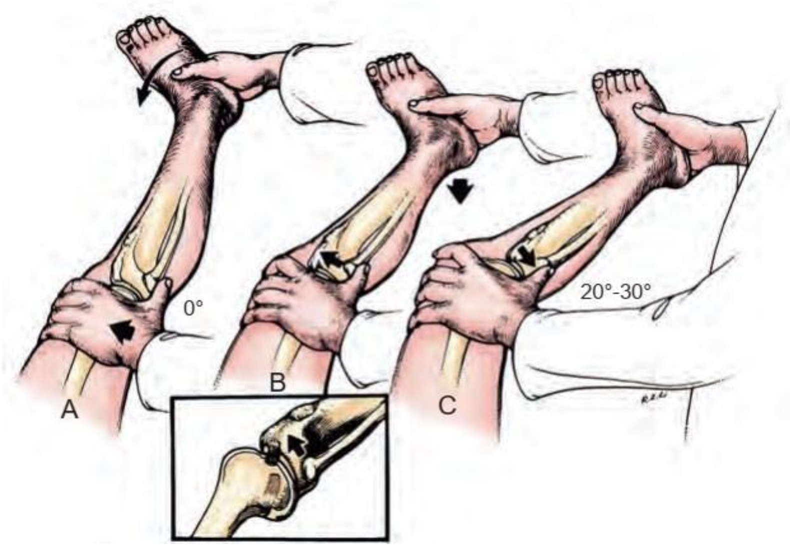


Fig. 11[117]: Pivot-Shift Test

McMurray test[117]:

A noticeable click is produced on joint line 118 by the McMurray test. This is illustrated medially by passively extending the knee from flexion to extension and externally

Laterally, the knee is passively moved from flexion to extension as the tibia is internally rotated. A click in the first few degrees of movement from complete flexion could be the result of a posterior tear. The tear is probably more anterior if a click is felt later as the knee extends further.

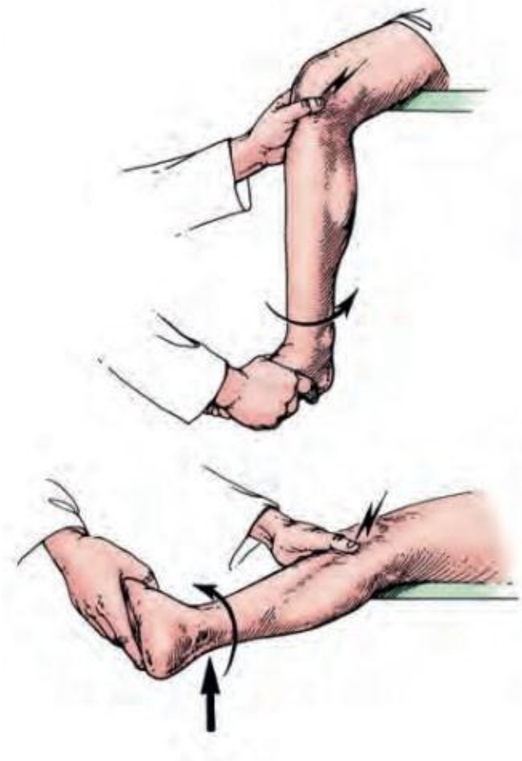


Fig. 12[117]: McMurray Test

Radiographic evaluation:

To evaluate for degenerative changes, fractures, alignment, and other associated injuries, anteroposterior (AP) and lateral X-rays should be taken. Radiographs may reveal Segond fractures, which involve the lateral tibial rim[119,120], and posterior lateral tibial plateau fractures [121-124], as well as tibial spine avulsion fractures[125], which are more common in patients with immature skeletons.

Stress radiographs (lateral view) are utilised to show ACL injury during the anterior drawer test. Any anterior translocation larger than 5 mm is considered abnormal. Significant differences are also defined as those that are greater than 3 mm in comparison to the contralateral knee. Sometimes a pivot-shift injury causes a pronounced lateral condyle-patellar groove, or the "deep lateral femoral notch sign," to appear on X-rays.

Magnetic resonance imaging:

Preoperative assessment of the patient is done by MRI, a non-invasive method that helps to see the ACL and other surrounding soft tissue components of the knee.

It typically takes multiple scans to visualise the ACL's obliquity in the sagittal plane[126]. The femoral intercondylar roof is parallel to its typical orientation or slope. When the ACL shows up on T1, proton-density, or T2-weighted sagittal imaging as a band of fibres with low signal intensity[128] and a slight distal divergence, it is considered normal.

The torn ACL is indistinct and appears lax[122]. "When a disrupted ligament exhibits focal or generalized elevated signal intensity on T1. Proton density, or T2 weighted imaging and no sequencing demonstrates a normal ligament, the ligament is said to be torn.[128] The signal intensity in ACL tear is higher than that of the normal ligament, intermediate signal intensity on proton-density images and is mildly hyperintense on T2-weighted images.[127]

Located close to the medial aspect of the lateral femoral condyle on posterior images and extending to the tibial plateau on anterior pictures, a normal ACL is seen in the coronal plane as a low signal intensity structure[128] on posterior views. T1 or T2 weighted images show localised enhanced signal intensity in fibres at the femoral origin of the ACL, even though there are some intact fibres at the tibial plateau[128]. When no sequence demonstrates a normal ligament, and when primary signs include diffuse increased signal intensity in the ligament, making individual fibres unrecognisable, the ACL is diagnosed as torn.

A lateral notch fracture and bone contusions or bruising are among the related ailments that an MRI can identify[115]. A bone bruise is identified when a confined region of low signal intensity on T1 and an area of increased signal intensity on T2-weighted images are seen in trabecular bone without cortical fracture128. Bone bruise is a collection of abnormalities in medullary signal intensity caused by subcortical infarction, oedema, or haemorrhage. About 40% of acute ACL injuries result in bone bruising in the lateral compartment[122 129]

In research by Adriaensen130 et al., 94% of patients were able to see the anteromedial and posterolateral bundles of the ACL when they underwent three-tesla field strength MRIs."

Primary Signs of ACL Injury[138]:

1. ACL not visible at its normal location
2. Interruption in Continuity
3. Nonlinearity or Angulation
4. Abnormal Axis of the ACL: Proximal poor visualization with a flattened distal ligament axis

On the sagittal plane, the "Blumensaat line" (intercondylar roof line) is typically parallel to the axis of the ACL. It is deemed abnormal if the ACL axis appears horizontal in relation to Blumensaat's line.

Fig. 13[122]: Normal ACL on oblique sagittal T2 weighted image (arrow)

Fig. 14[122]: Ill-defined and lax ACL within intercondylar notch on T2 Weighted image (arrow points to complete tear)

Secondary signs:

Secondary indicators are those that indicate ACL damage in addition to the actual abnormalities of the ACL.

1. Bone bruising & osteochondral fracture from pivot shift in the condyles (Fig. 15)
2. Counter-coup medial tibial bone bruising
3. The tibia's anterior translation (sagittal MRI)
4. LCL that is vertical
5. Segond's fracture (Fig. 16)
6. fractured tibial spine
7. Redundant or oddly curved PCL 8. Arcuate fibular head fracture

Fig. 15[126]: T1 image coronal view with arrow pointing at Segond fracture

Fig. 16[122]: T1 coronal image showing the lateral compartment Bone contusions

Chronic ACL tears:

"Although all symptoms of acute ACL injuries may be present, bone bruises and knee oedema are indicators of chronicity.

Although this is not always the case, patients may describe a history of instability. Traditionally, instability happens during turning, but the symptoms might vary greatly. An ACL injury should be considered and assessed by the orthopaedician at the first sign of instability[115]

The empty notch sign describes a condition where the ACL is absent, and the lateral intercondylar notch on the MRI shows only fat.

The MRI has sensitivity and specificity of 92 to 94% and 95 to 100%[131] for identifying ACL injuries."

INSTRUMENTATION

Arthroscopic ACL reconstruction necessitates specialized equipment both for knee arthroscopy and for the procedure itself.

1. Camera
2. Television monitor
3. Light source & fiber-optic cable
4. Endoscope (4mm 30^0)
5. Shaver systems and handpiece
6. Pneumatic Tourniquet

Instruments needed for the surgery includes :

- 2.4 mm drill tip guide pins
- Beathed Pin (Extra-long 2.4 mm long with sutured eye)
- Trocar (5 mm)
- Cannula
- Probe
- Burrs and shaver system (motorized instruments)
- Tibial aimer
- Cannulated reamers (4.5 to 10 mm)
- Femoral aiming guide (6-7mm off-set)
- Depth-gauge
- Graft preparation board

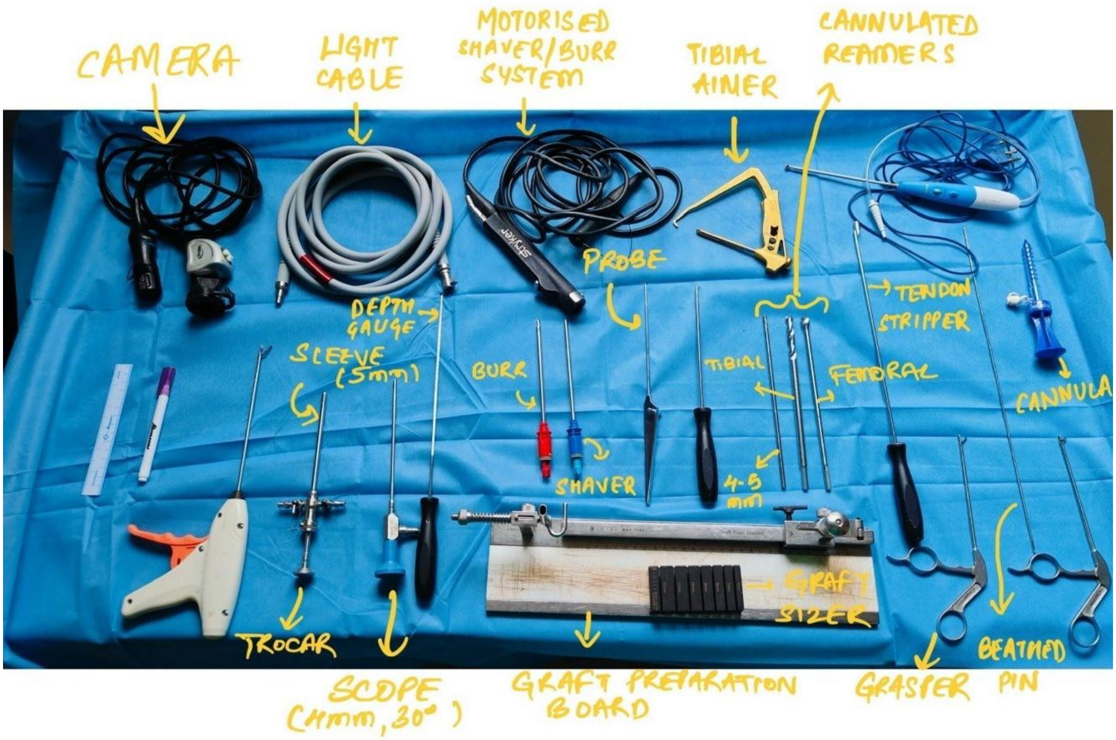


Fig. 17: Specialised equipment and instruments required for ACL reconstruction

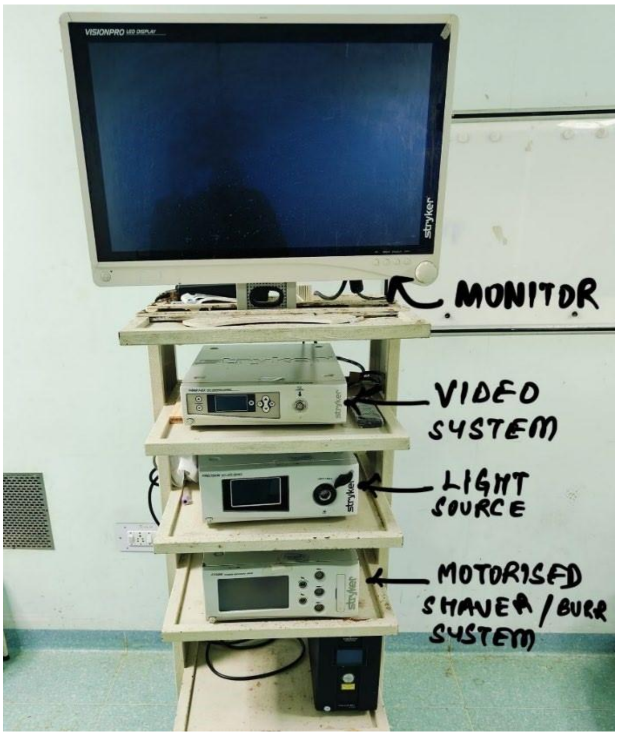


Fig. 18: Tower with monitor, light source, video system and motorized device system

AVAILABLE GRAFT OPTIONS

The most commonly used grafts for ACL reconstruction are chosen for their easy availability, the downside being donor-site morbidity:

1. Patellar Tendon with attached bone plugs (BPTB)
2. Semitendinosus/Semitendinosus + Gracilis tendons (HT)
3. Quadriceps tendon (QT)
4. Peroneus longus tendon (PL)

Semitendinosus:

ACL repair frequently involves hamstring grafts[132]. The strength of a four-strand semitendinosus is 280% that of the ACL. The strongest grafts currently in use are quadrupled semitendinosus and doubled semitendinosus with gracilis[133]

"Semitendinosus tendon autograft has the following benefits: a small incision (only a 3 cm incision is needed to harvest it), no compromise of the extensor apparatus (quadriceps muscle, patellar tendon, and tibial tuberosity intact), unaffected kneeling after surgery, and favourable elastic modulus (four-strand graft elastic modulus equal to normal ACL)."

Semitendinosus[115]

Disadvantages of semitendinosus tendon autograft donor site morbidity: intraoperative graft preparation is time-consuming and can prolong surgery time, and it is difficult to identify and harvest the tendon.[115]

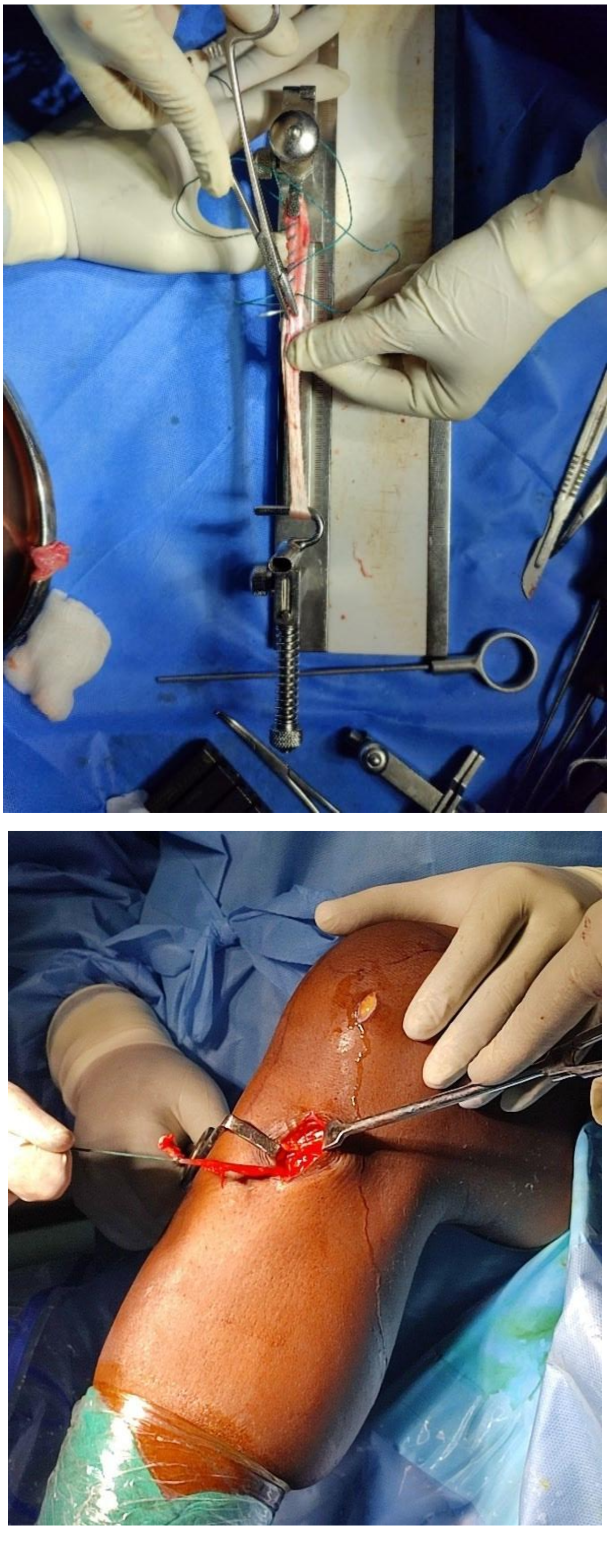


Fig. 19: Semitendinosus graft harvesting and preparation

Fig. 20: Peroneous longus graft harvest and preparation

Allografts :

A viable substitute for synthetic materials, grafts (BPTB/HT/QT/PL) taken from cadavers are especially advantageous in cases involving numerous ligament damage or revision procedures. Easy availability and the lack of donor-site morbidity are two of their benefits. The risk of immunological reactions that result in synovitis, however, as well as the expenses related to purchase and storage, are drawbacks.

Synthetic Materials:

Usually, different polymeric materials are used to weave and braid prosthetic ligaments. But because of a number of drawbacks, such as their high cost, low biocompatibility that might cause rupture, and the need for further fixation inside the tunnel using interference screws—which frequently calls for an additional lateral incision for screws or staples—they have mostly been stopped.

Materials used by different manufacturers have included:

- Nylon
- Dacron
- Teflon
- Carbon Fiber

These materials were used in attempts to create durable synthetic ligaments, but their limitations and complications have led to their decreased usage in favor of autografts or allografts in ACL reconstruction surgery.

FIXATION METHOD AND IMPLANTS

There are three primary types of fixation methods for soft-tissue grafts, including:

1. Headless Interference Screws:

These fixation devices are used to secure the graft in place by being placed between the bone tunnel and the graft itself. There are two main types available: titanium interference screws and bio-absorbable interference screws.

Advantages:

- Low-profile design
- Enables intra-articular placement

Disadvantages:

- The possibility of graft injury during screw advancement
- The possibility of graft position change during screw advancement
- The possibility of the screw falling into the posterolateral recess during insertion
- The possibility of posterior condylar cortex blow-out
- The challenge of finding the screw during revision if it was inserted deeply into the tunnel

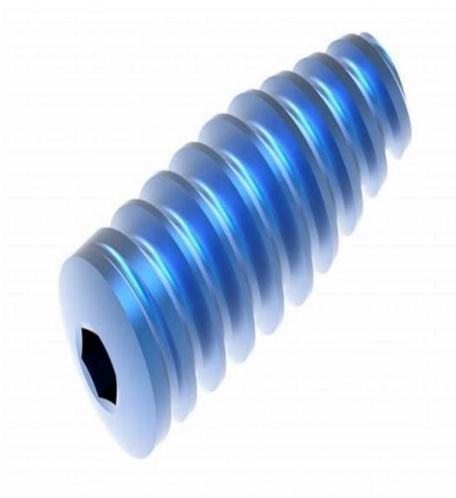



Fig. 20: Titanium and Fig Bio-degradable interference screw

Bio-degradable Screws:

These bio-screws have a fixation strength comparable to titanium screws while also ensuring controlled resorption and osteointegration to form structural bone through hydrolysis. They are typically composed of 75% PLDLLA (Poly-d, l-lactic Acid) and 25% BCP (Bathocuproine).

Advantages of Bio-screws:

- Removal is not necessary as they degrade over time
- MRI compatible

Disadvantages of Bio-screws:

- Potential for immune reactions
- Visco-plastic deformation can weaken the strength of fixation over time

2. Suspensory Extra Cortical buttons

Endobuttons and tibial base plates are types of fixation solutions commonly used in ACL reconstruction.

Advantages:

- Small size
- Stable fixation
- Ease of placement
- Compatible with most autografts
- Revision possible without complications to the tunnel

Disadvantages:

- Wide separation between fixation points
- Tunnel widening due to the "windshield wiper effect" (graft movement in the same direction as the tunnel) and the "bungee effect" (graft movement at right angles to the tunnel)

These fixation devices provide effective stabilization of the graft but may lead to tunnel widening over time due to the described mechanical effects.

Endobutton:

The endobutton is designed to retain the majority of graft within tunnel during ACL restoration. With the loop for a quadrupled graft created by the two in the centre, it often has four holes. If necessary, flipping the endobutton is made easier by the two holes on the periphery that allow sutures to pass through. They prevent a lateral incision, are tiny, and are simple to insert[115].

In general, the endobutton is more robust than an interference screw when it comes to cyclical stress. The endobutton's ability to minimise graft movement within the tunnel during knee motion and preserve graft stability is a result of both its strength and design.

Fig. 21: Adjustable Loop Endobutton

3. Cross Pins:

In addition to interference screws and endobuttons, other fixation tools used in ACL reconstruction include:

- Staples
- Polyester tapes
- Suture-posts
- Screws with washers

\

4. Suture Disc (Fixation Button)[115]:

"To accomplish tibial fixation, a unique circular button with two apertures is used. The graft fixation sutures are threaded from the holes and tied over the button, which is positioned at the tibial tunnel's intake[115]."

Unlike a screw, the suture disc is tiny and contains a depression for burying the suture knots. Even after the sutures have been tied, the fixation can be further tightened by carefully moving the button to enhance tension[115]

Fig. 22: Suture Disc

DIFFERENT FEMORAL TUNNEL PREPARATION TECHNIQUES

It is preferred in tunnel preparation for modern ACL reconstruction procedures to position the graft in an isometric posture with respect to knee motions. This implies that during knee flexion and extension, there should be very little change in the distance between the graft's femoral and tibial attachments—ideally, no more than 1-2 mm.

Placing the femoral tunnel too far anteriorly can lead to a non-isometric condition, where the graft experiences different tensions throughout the range of motion. This non-isometric placement can cause difficulties, particularly during knee flexion, affecting the stability and function of the reconstructed ACL. Therefore, precise placement of the femoral tunnel is crucial to achieving optimal isometric conditions and functional outcomes post-surgery.

Access for Femoral tunneling:

1. **Trans Tibial:** Trans-tibial tunnelling is a technique used in ACL reconstruction that uses drilling through the tibia to guide the placement of the femoral tunnel. However, it may lead to less-than-ideal positioning (11 or 1 o'clock) as opposed to preferred positions (10 or 2 o'clock), which could compromise knee stability and biomechanics.

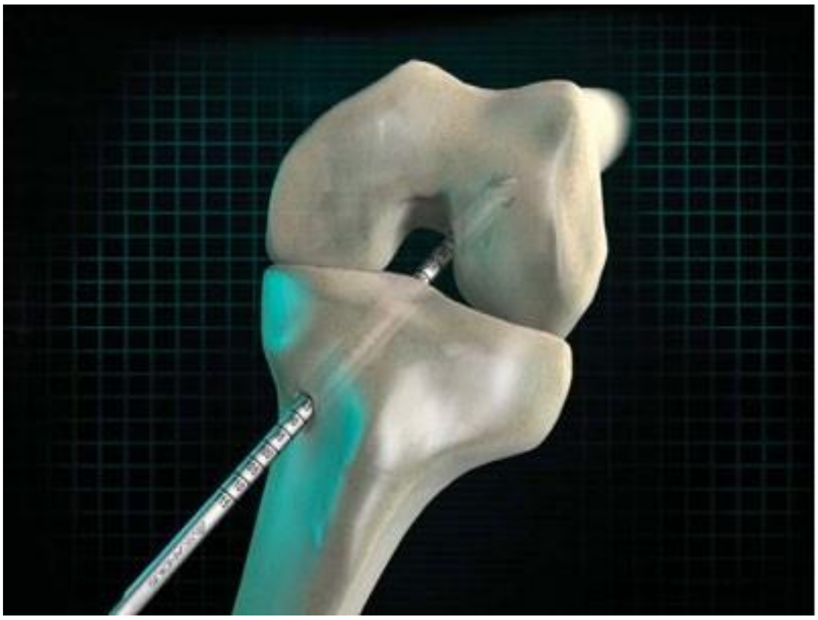


Fig. 23: Transtibial Femoral Drilling

2. **Trans Portal**: The technique of trans-tibial tunneling in ACL reconstruction involves knee hyperflexion and utilizes either the medial instrumental portal or accessory far medial portal, which poses risks of damaging the Vastus medialis obliquus. Additionally, there is a potential for injury to the medial femoral condyle and its cartilage during the drilling process.

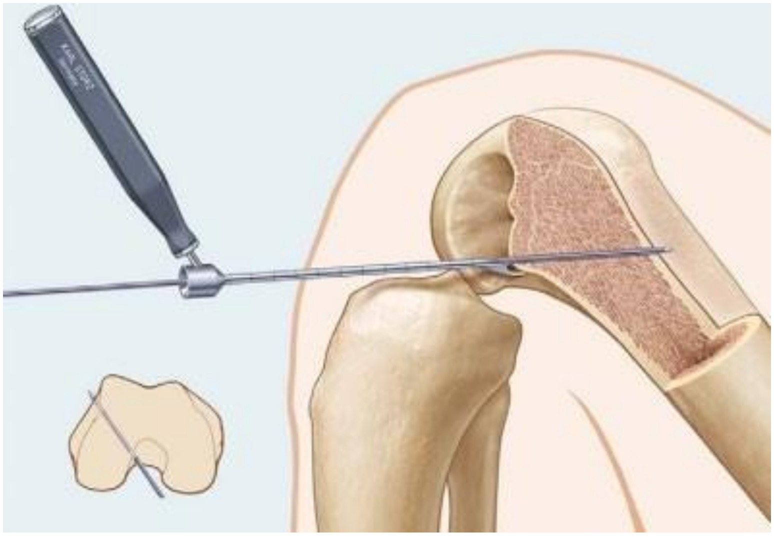


Fig. 24: Trans Portal tunnel technique, the femoral tunnel is created in 120-130 degrees of flexion

3. **Tunnel placement through lateral incision:** Old practice is not in use nowadays. Smaller incisions are required for interference screws, while longer incisions for headed screws with washers might be necessary.

POST OPERATIVE REHABILITATION PROTOCOL

Our post-operative rehabilitation protocol consists of six phases:

Phase 1 (0-14 Days):

- Initiation of quadriceps strengthening (static), dynamic exercises, and straight leg raises as tolerated; consideration of electric stimulation for inadequate quadriceps strength.
- Patellar mobilization (superior-inferior).
- Ankle pumps.
- Gradual increase in range of motion up to 90 degrees by the end of the second week, with emphasis on achieving full extension using ankle support and passive techniques.
- Initiation of partial weight-bearing with crutches, progressing to full weightbearing as tolerated.

Phase 2 (2-10 weeks):

- Gradual increase in range of motion up to 120 degrees by the end of the sixth week, with emphasis on cycling to enhance flexibility.
- Discontinuation of crutches and achievement of full weight-bearing without a limp by the fourth week.
- Progressive quadriceps strengthening through dynamic exercises, straight leg raises with weights and hamstring curls.
- Therapist-assisted extension from 90 to 40 degrees with manual resistance.
- Introduction of lunges by the eighth week.

Phase 3 (3-4 months):

- Knee extension exercises with high repetitions or low weight.
- Isokinetic quadriceps exercises until full extension is achieved.

- Implementation of slow and controlled drills for lateral sports.

Phase 4 (4-5 months):

- Commencement of jogging and jump rope exercises if there is no effusion, the full range of motion, and the stable knee with sufficient quadriceps strength.

Phase 5 (5-8 months):

- Initiate sports-specific drills, including cutting and figure-of-eight exercises.
- Agility testing.

Phase 6 (> eight months):

- Full return to sports contingent upon achieving 0-130 degrees of range of motion, with at least 90% strength in hamstrings and 85% strength in quadriceps.
- Completion of sports-specific agility training.
- Continuation of exercises three times weekly.
- Time frames are approximate, and any phase may be extended based on associated lesions or individual circumstances.

POSTOPERATIVE COMPLICATIONS

Complications following ACL reconstruction can be categorized into early, delayed, and late phases:

Early Complications:

- Risk of pulmonary embolism with prolonged tourniquet use.
- Hematoma formation at the graft harvest site.
- Infection.
- Metallosis from implant or instrument breakage.
- Potential for residual laxity due to graft advancement in the tunnel or advancement of endobutton into soft tissue.

Delayed Complications:

- Continued risk of residual laxity from partial or complete graft tears.
- Formation of ganglion cysts, detachment, and soft tissue migration of endobutton.
-
- Reduction in range of motion due to arthrofibrosis or graft impingement.
- Potential for deep vein thrombosis.
- Persistent pain result from the complex regional pain syndrome (CRPS), untreated meniscal tears, or articular surface laceration of the femoral condyle from drilling.
- Diminished hamstring strength due to inadequate rehabilitation.
- Extension lag.
- Synovitis leading to recurrent knee effusion.

Late Complications:

- Graft or implant failure necessitating revision surgery.
- Biceps femoris tendinopathy, due to increased load on the tendon due to inadequate hamstring function.

METHODOLOGY

“We have done a “Prospective Clinical Study” conducted on patients admitted in the Department of Orthopaedics in B.L.D. E (DEEMED TO BE UNIVERSITY) Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura, with diagnosed Anterior cruciate ligament rupture from january 2023- january 2025

In our study, 24 patients were involved, of whom 21 were male and 3 were female. fourteen- patients sustained a right-side injury, whereas ten patients sustained a left-side injury. A minimum of 6 months and a maximum of 21 months of follow-up were achieved.

Young and middle-aged patients visiting the orthopedic emergency and outpatient departments at B.L.D. E (Deemed to be University) Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura, with complaints of knee pain as well as instability after a history of twisting or injury to the same side, underwent a thorough examination. The affected knee was evaluated following assessment of the unaffected knee while the patient lay supine to diagnose ligament injuries.

To identify an ab-normal ACL, the following particular tests were carried out:

1. Lachman’s test
2. Anterior Drawer
3. Pivot-shift test

Associated structure injuries of the knee were examined by:

1. Apley’s grind test and McMurray’s test (to test Meniscus)
2. Varus and valgus stress test (to test collateral ligaments)
3. Posterior Drawer test (for Posterior cruciate ligament)

Regular X-rays of the afflicted knee were taken in both lateral and anteroposterior views. For confirmation, an MRI of the knee was performed in every case of ACL tears.

INCLUSION CRITERIA:

1. Patient aged between 18-45 years.

2. Clinically, an MRI confirmed the diagnosis of Anterior cruciate ligament ruptures.
3. Associated meniscal injury who have undergone repair.

EXCLUSION CRITERIA:

1. Anterior cruciate ligament ruptures, which needs meniscectomy
2. Multi Ligament knee injuries.
3. Associated neurovascular injury.
4. Polytrauma.
5. Patients medically unfit for surgery.
6. Ligament reconstruction of the contralateral knee.”

SAMPLING:

SAMPLE S IZE

- **The anticipated Mean±SD of graft diameter in Anterior cruciate ligament injury patients in Peroneus longus 8.71±0.4 and in Hamstring 7.65±0.6 resp.** [ref] **the required minimum sample size is 12 per group (i.e. a total sample size of 24, assuming equal group sizes) to achieve a power of 99% and a level of significance of 5% (two sided), for detecting a true difference in means between two groups.**

$$\boldsymbol{N = 2\left[\frac{\left(Z_{\propto} + z_{\beta}\right) * S}{d}\right]^{2}}$$

$Z_{\propto}$ Level of significance=95%

Z_{β}--power of the study=99%

d=clinically significant difference between two parameters

SD= Common standard deviation

- **Statistical Analysis**

- The data obtained will be entered in a Microsoft Excel sheet, and statistical analysis will be performed using statistical package for the social sciences (Verson 20).
- Results will be presented as Mean±SD, counts and percentages and diagrams.
- For normally distributed continuous variables between two groups will be compared using Independent t test For not normally distributed variables Mann Whitney U test will be used. Categorical variables between two groups will be compared using Chi square test.
- .$p<0.05$ will be considered statistically significant. All statistical tests will performed two tailed.

-Operative work-up:

"Patients with Anterior Cruciate Ligament tears that have been clinically and radiologically confirmed were admitted to the Orthopaedics Department at the B.L.D. E (DEEMED TO BE UNIVERSITY) Shri B.M Patil Medical College, Hospital and Research Centre, in Vijayapura. Routine tests such as complete blood count, Blood sugar, CXR & Electro Cardiography were checked, and a pre anaesthetic examination was done."

Pre-Operative Rehabilitation:

1. The knee joint's pre-operative strength & ROM recorded.
2. Patients were taught static and dynamic quadriceps exercises while they were waiting for surgery.
3. Post-operative rehabilitation was explained to all patients

Consent:

Every study participant was given a thorough explanation of their injury, diagnosis, available treatments, complications related to both non-operative care and surgical intervention, intraoperative and post-operative complications, damage to surrounding structures, infections, and limitations on their range of motion.

Prior to surgery, all study subjects provided their consent. All consents were received prior to the operation. Patients and attendees were fully informed about the treatment's advantages and disadvantages. The risk-benefit ratio was described.

Examination after anaesthesia & positioning:

Patients in our study underwent either epidural or supine spinal anaesthesia. Lachman, anterior drawer, posterior drawer, and the pivot shift tests were all made easier to conduct under anaesthesia. A pneumatic tourniquet was applied and placed over the proximal thigh after the proper padding had been placed. The patient was lying supine, and the knee was placed just past the usual distal edge of the operating table[132]. An upright position was maintained for the unaffected limb. Prior to tourniquet inflation, each patient got a preoperative 1.5 g dosage of ceftriaxone + sulbactam as a preventative antibacterial treatment. To aid in exsanguination, the limb was raised before the tourniquet was inflated.

Fig. 25: Examination being done after anaesthesia

Arthroscopy Portals[134]:

Prior to joint distension, the portal entry locations must be accurately marked. This includes marking both femoral condyles, the patella, its tendon, the tibial tuberosity, and the tibial plateaus. The surgeon should draw these landmarks and portals to ensure proper positioning.

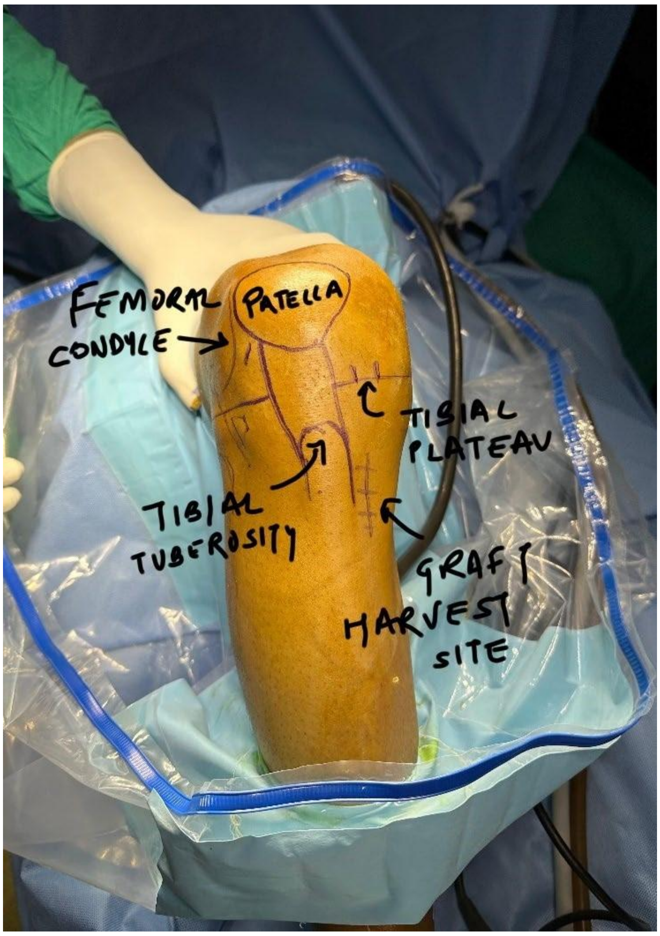


Fig. 26: Skin Marking Portals

used:

Antero-lateral portal[140]:

"The anterolateral portal is situated at the highest feasible position, situated immediately off the inferior border of the patella and lateral edge of the patellar tendon[140]. In addition to providing an excellent panoramic view of the intraarticular structures, including the intercondylar notch, this portal enables the surgeon to avoid the infrapatellar fat pad (IFFP) and is typically used for diagnostic arthroscopy[140].

Antero-medial portal:

This portal is primarily used to provide additional views of the lateral compartment and to utilize a probe for palpating both the medial and lateral compartments. It is positioned 1 cm medial to the patellar tendon, 1 cm distal to the inferior pole of the patella, and 1 cm superior to the medial joint line. A spinal needle can be inserted percutaneously to precisely locate the portal while being visualized through the anterolateral portal.

Accessory anteromedial portal:

An accessory portal was created medial to the anteromedial portal, ensuring at least a 1 cm skin bridge between the two portals to facilitate trans-portal drilling of the femoral tunnel."

Diagnostic Arthroscopy[134]:

Prior to graft harvesting, a diagnostic arthroscopy was performed. Skin markings were made, and an anterolateral portal (viewing portal) was created using a no. 11 blade with the knee flexed at 90 degrees at the patella's inferior pole level, immediately lateral to the patellar tendon, Scope was then inserted for diagnostic arthroscopy, allowing visualization of all intra-articular structures to identify any abnormalities. The presence of an ACL tear was confirmed, and other lesions, such as meniscal tears or loose bodies, were noted.

Once all abnormalities were documented, the anteromedial (working) portal was established. Probing was conducted to confirm the diagnosis. Concurrent pathologies were addressed accordingly, including the removal of loose bodies and meniscal repair for meniscal tears.

"**Semitendinosus tendon autograft Harvest & Preparation**:

An oblique incision, preferred for its reduced risk of damaging the infrapatellar branch of the saphenous nerve, is made one finger breadth medial to the tibial tuberosity. This approach allows for a broader exposure of the pes anserinus. Through this incision, both graft harvesting and tibial tunnelling are performed.

To locate the superior boundary of the pes anserinus, fingertips are used. The fascia is incised and elevated along this superior border. The tendons are palpated from top to bottom, with the semitendinosus tendon being the least palpable. The sartorius fascia is incised in line with semitendinosus tendon, ensuring the preservation of the inner layer containing the MCL. The semitendinosus tendon is hooked out using right-angled artery forceps. A double-loop knot is used to secure the tendon end for traction.

The tendon is dissected proximally up to the musculotendinous junction using blunt dissection with fingers while the knee is flexed to 90 degrees. This allows for the removal of adhesions and vinculae while preserving constant traction along the thread. Usually, scissors are used to cut the main band that connects the gastrocnemius' medial head. Pulling the tendon distally confirms that there is no posterior dimpling across the gastrocnemius.

A surgical blade is used to remove the tendon's distal end from the periosteum's sleeve. Next, a tendon stripper is moved along the tendon, grabbing the threads and delivering delicate, steady, and strong pressure to provide traction. If resistance is found, the stripper is retracted, adhesions are cut, and the stripper is advanced once again to complete the tendon harvest. After harvesting the semitendinosus graft, it is placed on the graft master board, and the blunt end of a blade is used to remove any remaining muscle fibres from the tendons.

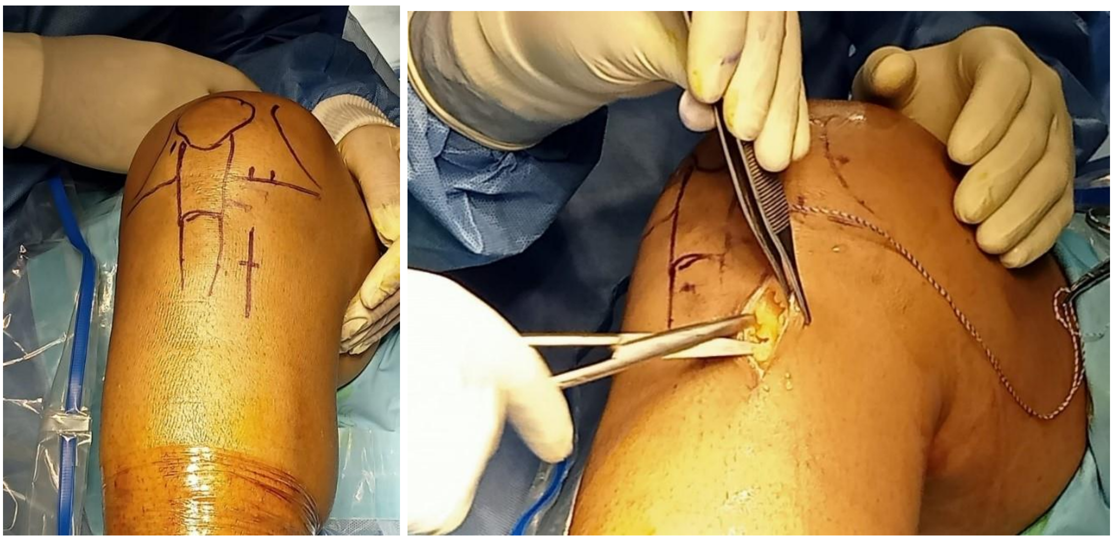
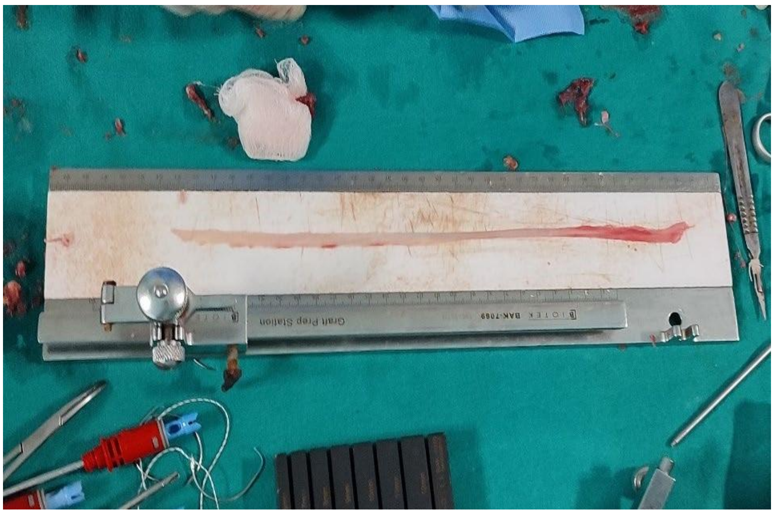


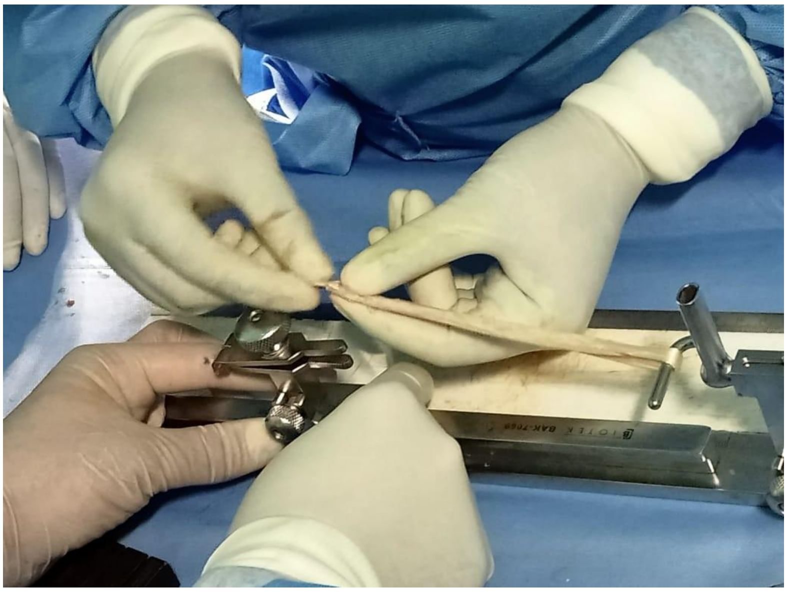
Fig. 27: Semitendinosus graft harvest incision and exposure of tendon

Fig. 28: Tendon identified and adhesions removed

To ensure uniform size, the ends of the tendon are trimmed. Each end of the tendon is secured with a whipstitch. The two ends of the tendons are then sewn together over a length of approximately 3–4 cm. Umbilical tape is looped over the combined tendons. The composite graft is then measured using a graft sizer. The tunnel diameter should match the smallest sleeve size to allow the quadrupled graft to pass through with minimal resistance.

The length of the graft to be inserted into the tunnel is measured to ensure correct placement when viewed arthroscopically.





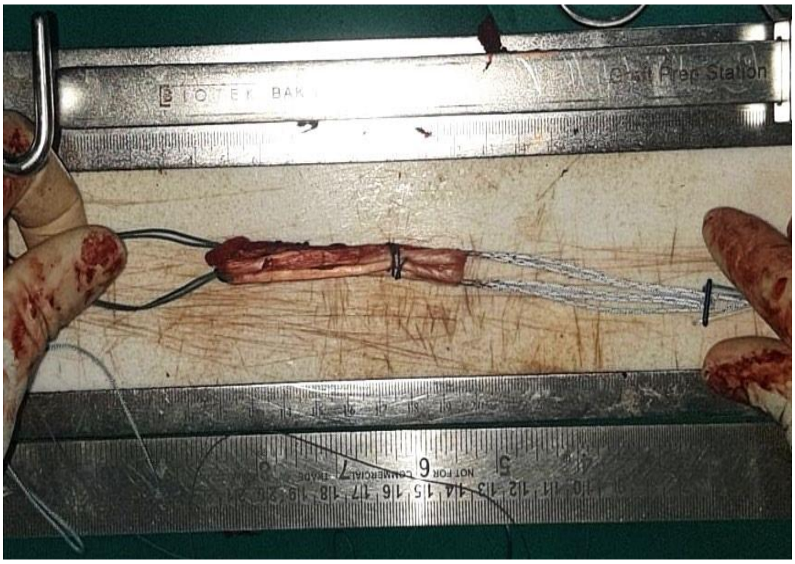


Fig. 29: Semitendinosus graft preparation Intra-articular preparation:

Inserting the arthroscope through the anterolateral portal allowed for the visualisation of the joint cavity. The ligamentum-plicae, fat pad, and synovial reflection that prevented a thorough evaluation of the medial side of the lateral femoral condyle and the tibial footprint of the ACL were removed, and the shaver blade was introduced through the anteromedial portal. During the joint debridement, care was taken to ensure that the intact PCL was not harmed.

Identification of anatomical landmarks is performed, including the distal aspect of the fibula and the posterior border of the fibula, 2 cm above the tip of the bone. A longitudinal incision is made along the posterior border of the fibular bone, from 2cm above the tip of the fibula. Care is taken to identify the tendon sheath that covers the longus and brevis approximately 2 cm above the superior extensor retinaculum, and the peroneus longus is stitched to the peroneus brevis.

With the help of the scissors, the tendon's distal end is released. Then, in-line with tendon, tendon stripper is advanced across it, exerting traction by grasping the threads and keeping firm, constant, and gentle pressure. The stripper is retracted if resistance is encountered and adhesions are cut, the stripper is once again advanced to harvest the tendon. Graft master board is then covered with the Harvested graft with blunt end of blade any remaining muscle fibre are removed from temdons"

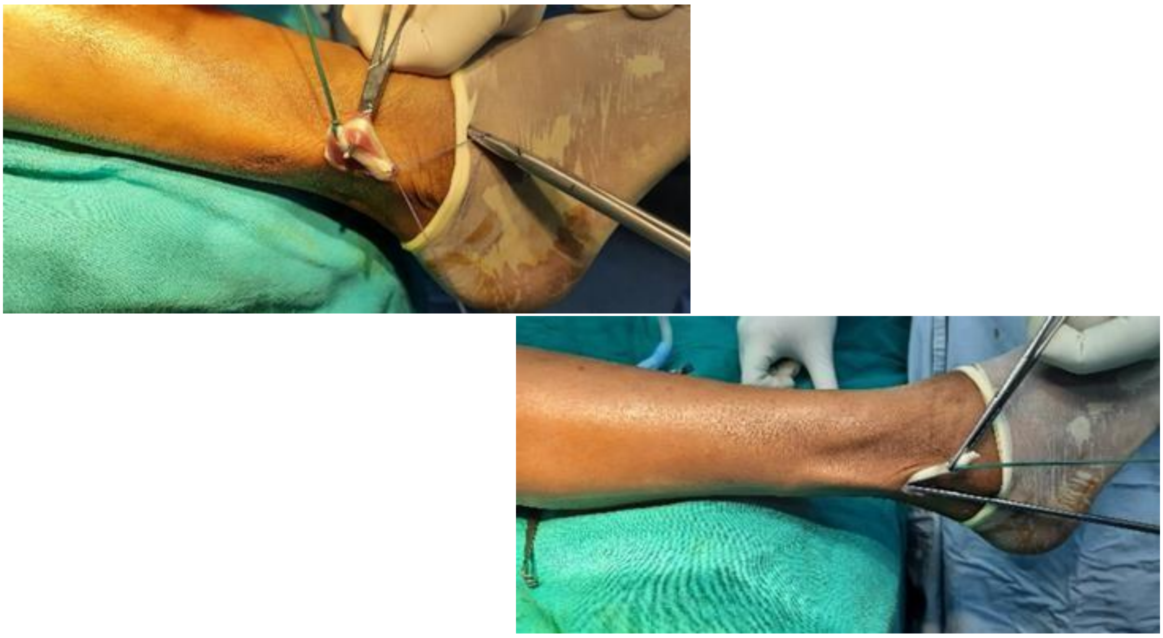


Fig. 30: Peroneus graft harvest incision and Tendon Exposure

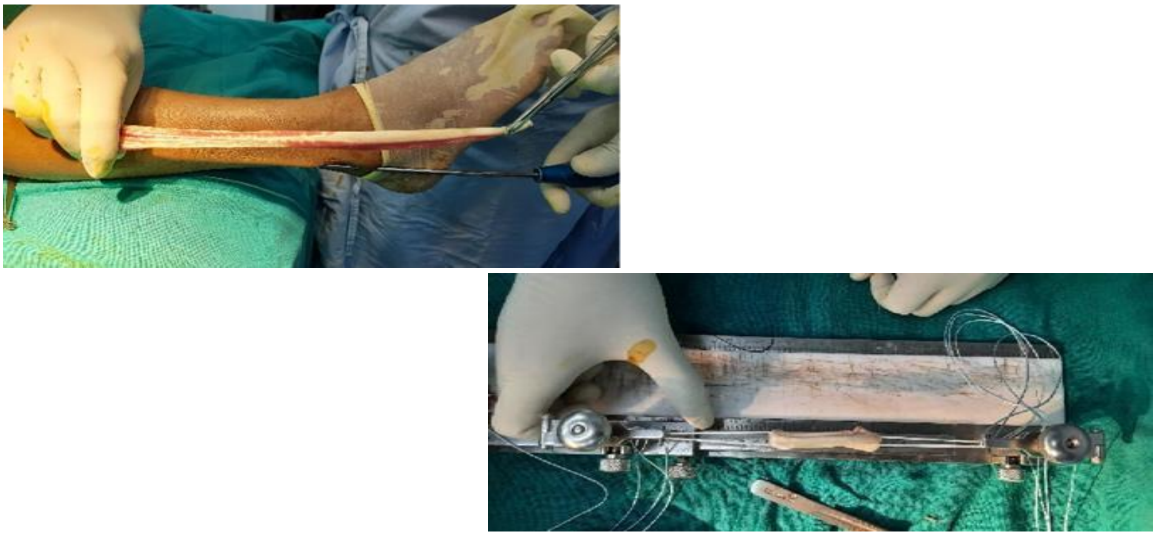


Fig. 31: Pernoeus graft preparation

Femoral tunnel preparation:

"With the knee flexed at 90 degrees, the entry location of the ACL can be seen on the medial surface of the lateral femoral condyle. To achieve the anatomical insertion point on the lateral femoral condyle, the Resident's Ridge (Lateral Intercondylar Ridge) is identified, and the Bifurcate Ridge is visualized. The proximal and posterior cartilage margins are also taken into consideration. Using a femoral aimer or a freehand beath pin, the entry point is marked below the Resident's Ridge and behind the Bifurcate Ridge, ensuring the correct distance from the posterior cartilage margin.

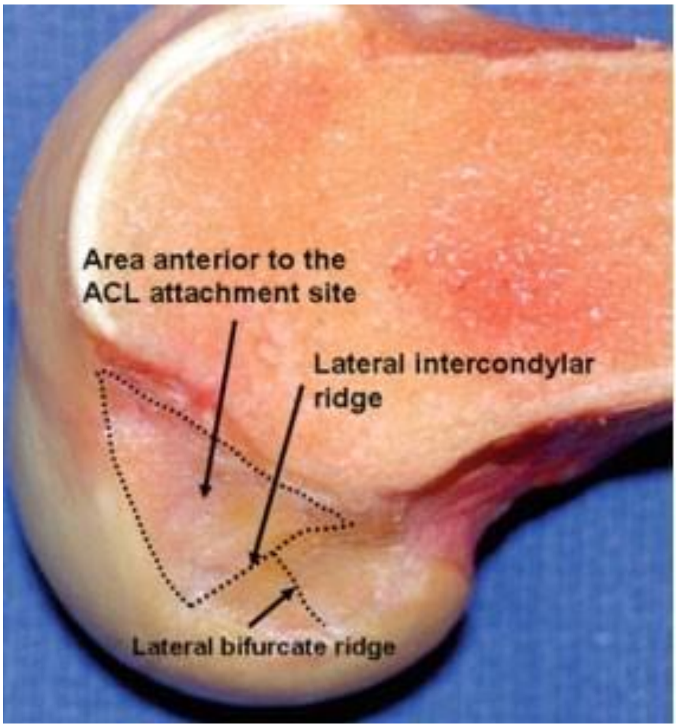


Fig. 30[135]: ACL femoral attachment site

Fig. 31[135]: ACL attachment is seen inferior to in the inner wall of lateral femoral condyle lateral intercondylar ridge

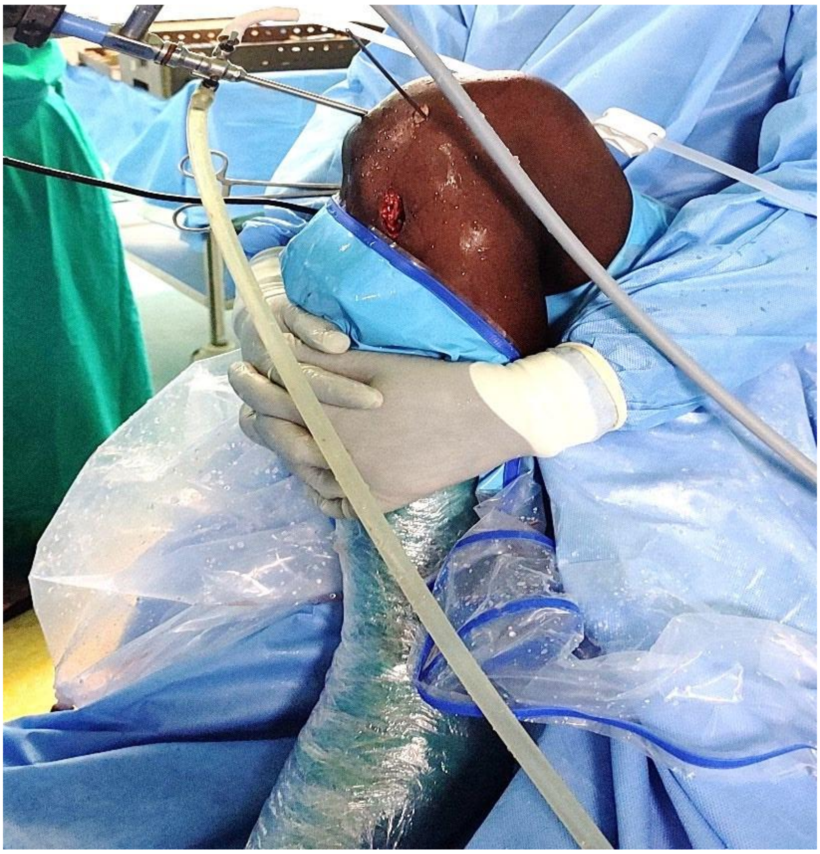


Fig. 32: Femoral Tunnel preparation

Using a femoral offset aimer device inserted through the anteromedial portal, the entry site is then drilled with a beath pin while the knee is in 120 degrees of hyperflexion. Until the tip of the guide wire is visible through the skin, drilling continue.

Using a 4.5mm cannulated reamer, the femoral tunnel is initially prepared by reaming it over the guiding pin, which is always bored through the accessory anteromedial portal and extends straight to the distant cortex of the lateral femoral condyle. The length of the tunnel is then measured with a depth gauge. Sequential reaming is done until the graft size diameter is achieved. The length of the femoral socket is calculated using the measured graft length (intra-articular length of at least 25 mm) and the remaining 4.5 mm of the distant cortex.

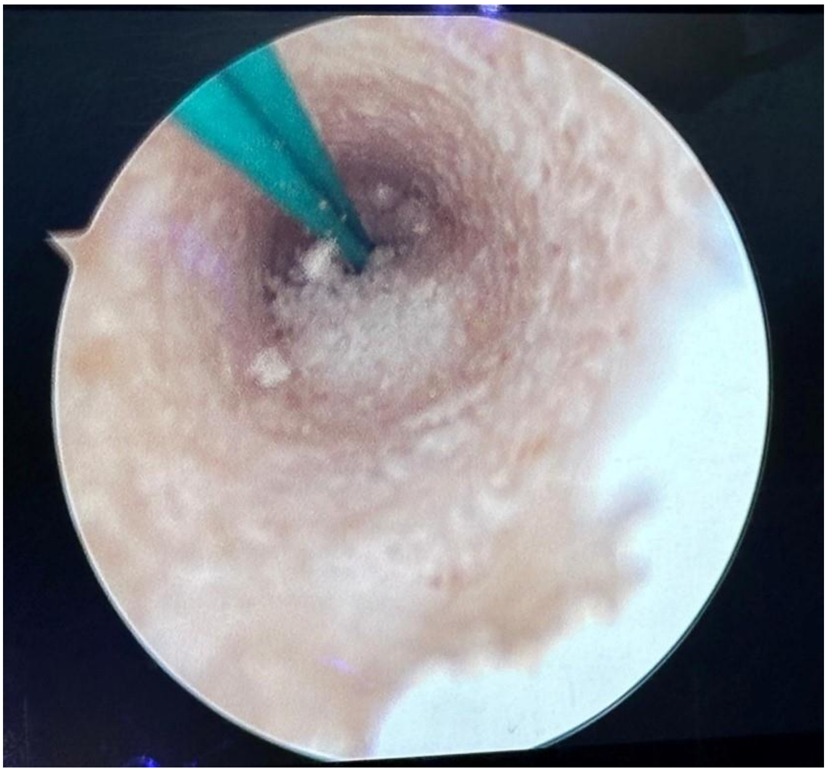


Fig. 33: Femoral tunnel seen post-reaming by Antero medial portal

Tibial tunnel preparation:

The tibial guide aids in the formation of the tibial tunnel. When the knee is bent to a 90-degree angle, the tip of the tibial guide is situated 2-3 mm posterior to the posterior border of the anterior horn of the lateral meniscus and somewhat medial to the midline of the tibial attachment point of the ACL. After that, the tibial tube is reamed to the transplant's diameter. The edges of the tunnel are smoothed with a shaver to enhance proprioception, preserving any remaining tibial tissue at the ACL attachment site."

FIG. 34[136]: Position of the tibial guide wire and director guide

Fig. 35: Tibial Guide set at 55 degrees

“**Graft passage and fixation:**

Once the femoral socket is ready, the graft is attached to an adjustable loop endobutton by passing the quadrupled semitendinosus graft through the loop. In all cases, an adjustable loop endobutton was used. The graft is cynched into the femoral tunnel by marking the length of the femoral tunnel with a pencil marker, and the adjustable loop is marked with the length of the femoral tunnel. Usually, about 20 mm of the graft was placed inside the femoral tunnel.

The graft is given 20–30 cycles of knee flexion and extension before being progressively pulled into the tibial tube. The next step is arthroscopic visualisation, which checks for alignment, impingement, and other factors. A tibial base plate is used to secure the tibial side of the graft while the leg is in a neutral posture with the posterior drawer and the knee flexed by 10 degrees.

Subsequently, the wounds and portals are closed in layers, followed by the application of a sterile dressing. A knee brace is utilized to immobilize the affected limb.”

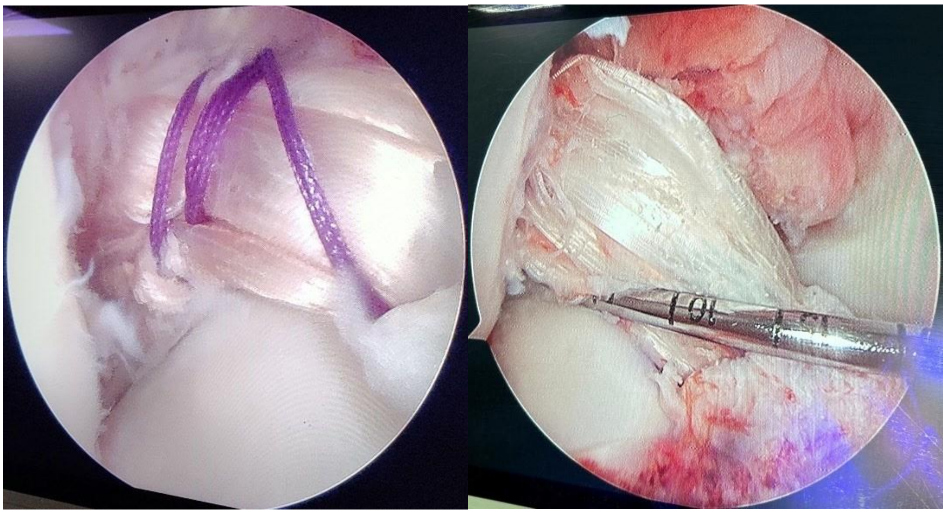


Fig. 36: Hamstring graft pulled into the femoral tunnel

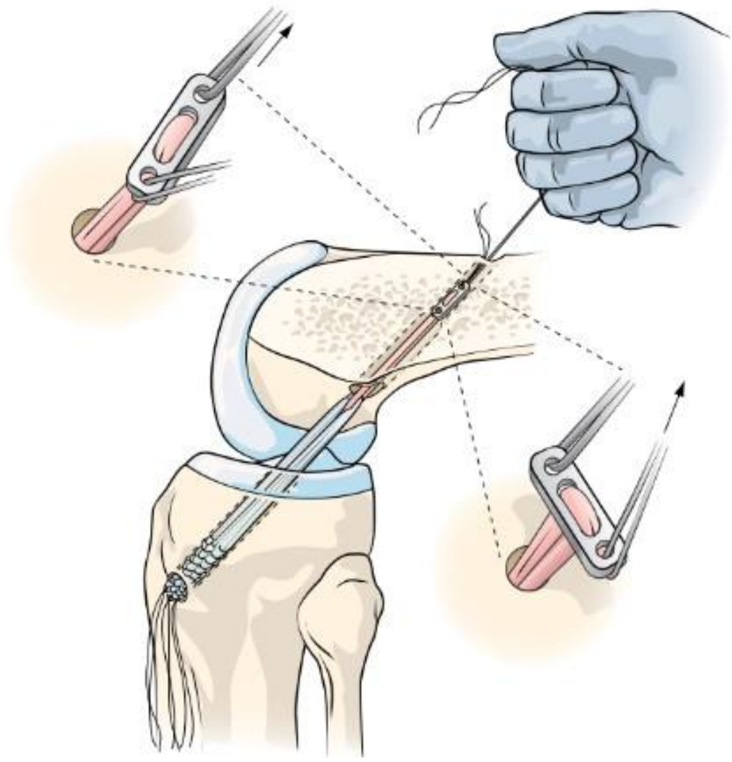


Fig. 37[137]: Endobutton passage in the femoral tunnel

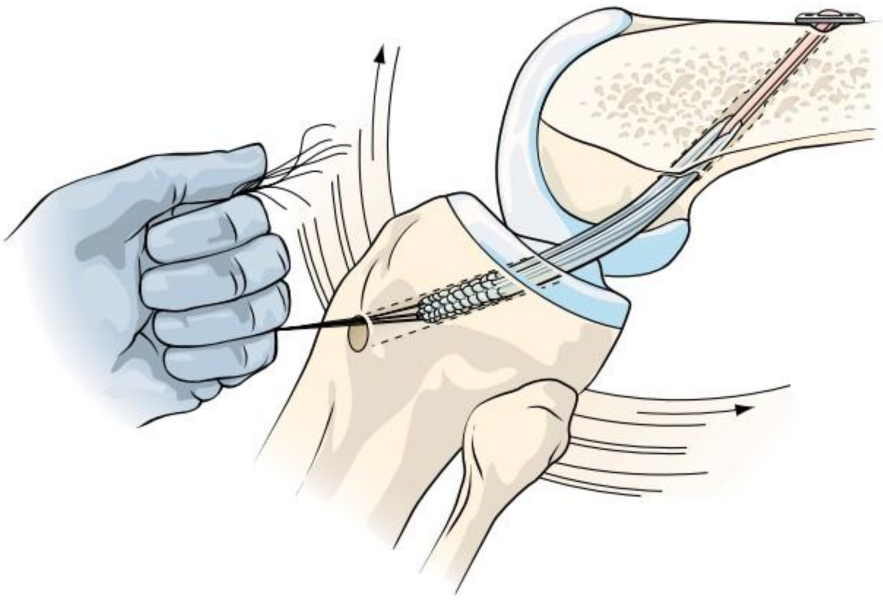


Fig. 38[137]: Strong retrograde tension not able to dislodge graft once fixed with Endo button

Fig.39: Fixation with a suture disc

Post-operative management:

Leg elevation was maintained and the patient's knee was immobilised with a knee brace in the early days after surgery.FOR Three days after surgery, intravenous antibiotics were given. On days two and seven following surgery, the incision was examined, and on day twelve, the sutures were taken out. Rehabilitation started as soon as the sutures were taken out.

“**Evaluation:**

To confirm the placement of tunnels and positions of implants, all patients underwent postoperative anteroposterior and lateral radiographs. Functional outcomes were assessed at six weeks, three months, six months, and one year post-operatively.

The evaluation was conducted using the **IKDC** (International Knee Documentation Committee) and **Lysholm** Knee Scoring Scale.”

IKDC Subjective Score:

- Parameters: This score includes various subjective parameters assessed through a well-prepared questionnaire. These parameters contribute to a total score of 87 when summed.
- Conversion: To assess knee function, the overall score is transformed into a percentage format. A score of 100% denotes t absence of symptoms and no limitations on the daily activities or athletic pursuits.

- **Lysholm Knee Scoring Scale:**

Parameters: The Lysholm score evaluates knee function based on eight parameters:

1. Limp
2. Walking aid
3. Locking of knee
4. Instability
5. Pain
6. Swelling
7. Ability to climb stairs
8. Ability to squat

A higher score denotes better function, and each parameter is graded according to the patient's capacity to function. Based on the total score obtained, scores are usually divided into four categories: excellent, good, fair, and poor.
When evaluating the results of knee surgeries, the advancement of rehabilitation, and the general function of the knee over time, both of these scoring systems are useful.

CASE ILLUSTRATION

CASE 1

Three month old case of Complete ACL deficiency was operated with adjustable loop endobutton on femoral side and suture disc on tibial side.

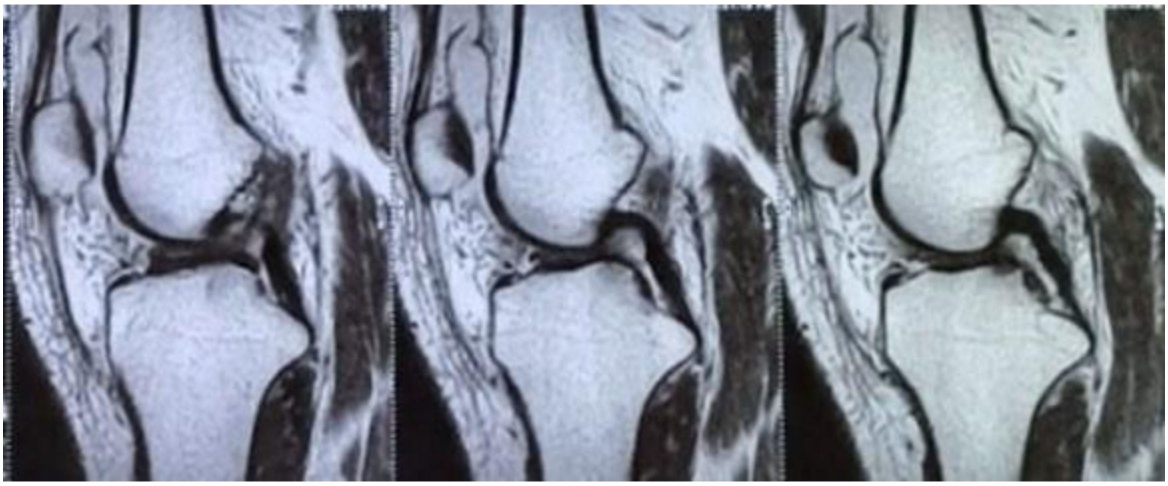


Fig. 40A: Preop MRI showing ACL deficiency

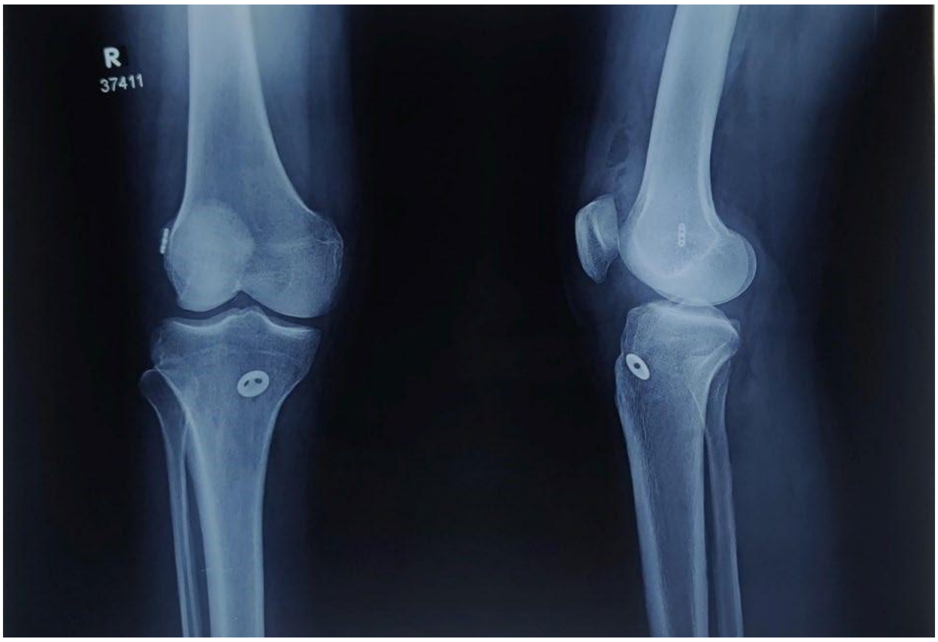


Fig.40B: Post-operative radiograph with adjustable loop endo button and suture disc

Fig. 40C: Post-operative knee range of motion and SLRT

CASE 2

One-month-old case of complete ACL deficiency operated with adjustable loop endobutton on the femoral side and on the suture disc on the tibial side.

Fig. 41A: Preoperative MRI showing ACL deficiency

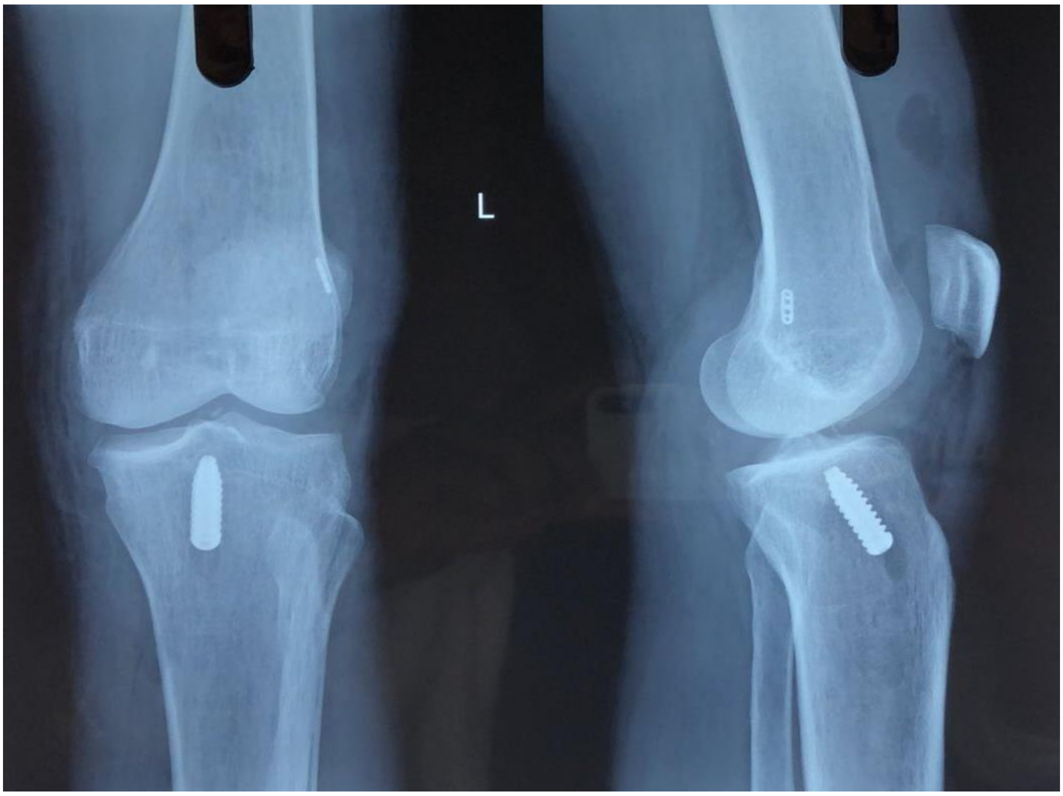


Fig. 41B: Postoperative radiograph with Adjustable loop endo button and interference screw

Fig.41C: Postoperative Knee range of motion and SLRT

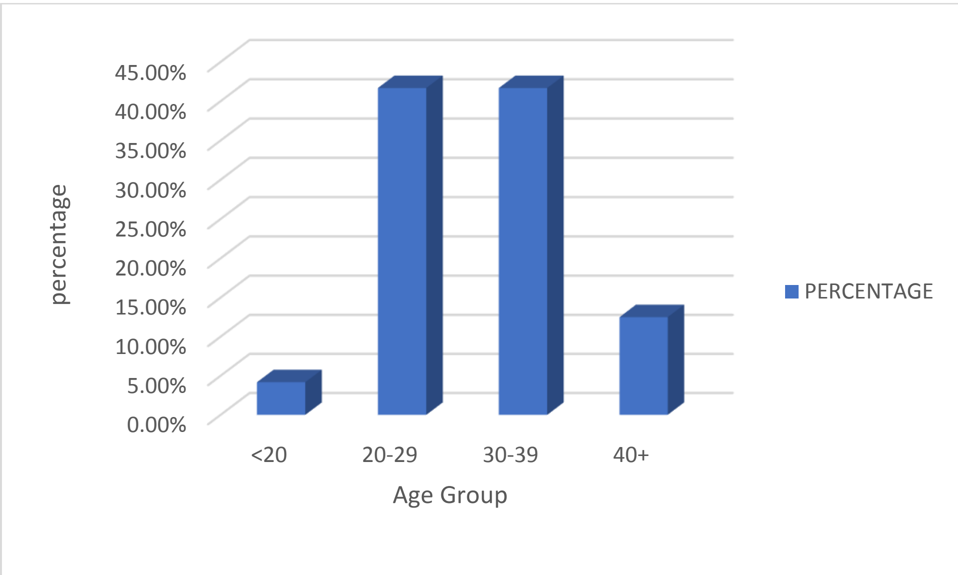
RESULTS

“Twenty four cases of arthroscopic ACL reconstruction with semitendinosus and peroneus longus autograft were followed up regularly for a period of 24 months and 12 months minimum in B. L. D. E (DEEMED TO BE UNIVERSITY) Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura (from August 2023 to January 2025).”

Age Distribution:

AGE	FREQUENCY	PERCENTAGE
<20	1	5%
20-29	10	40%
30-39	10	40%
40+	3	15%
TOTAL	24	100.0

Table 1. Age Distribution

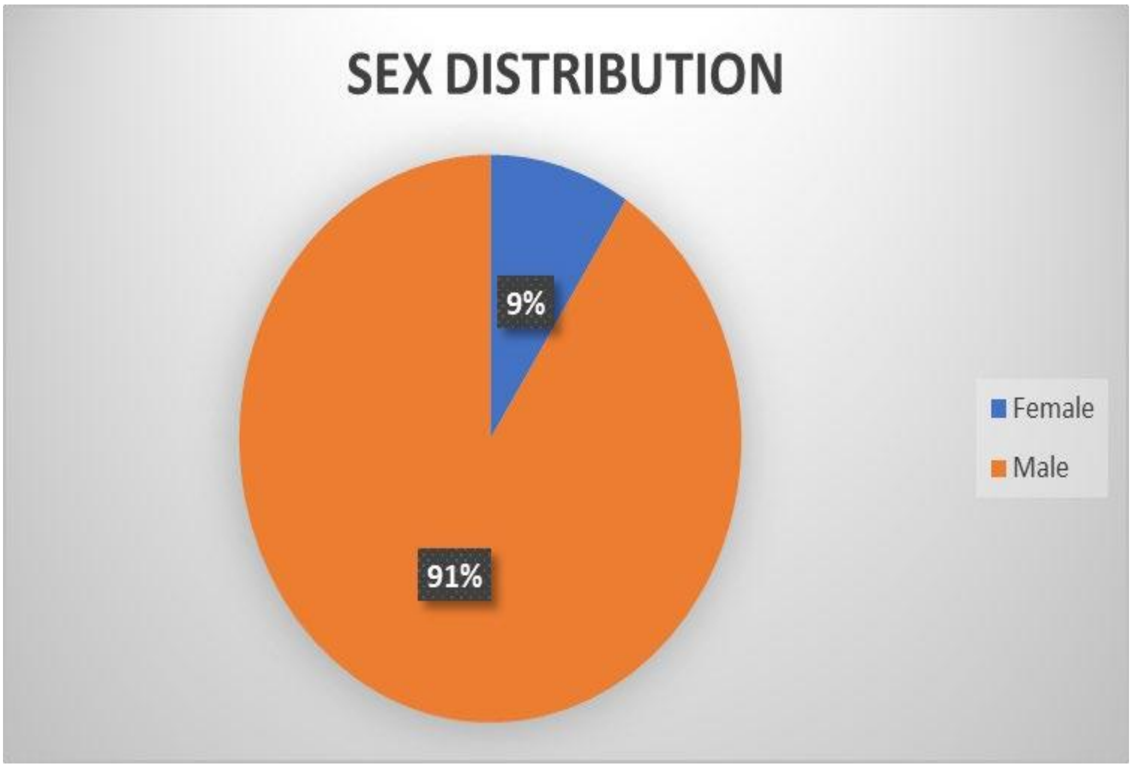


“Most patients presented to us were young, with below 20 years comprising one patients in the age group of 20-29 years 10, (40%) patients, 10 patients in age group of 30-39(40%), and 3 patients above 40 years(15%).”

Sex distribution:

SEX	FREQUENCY	PERCENTAGE
MALE	20	91
FEMALE	4	9
TOTAL	24	100.0

Table 2. Sex Distribution

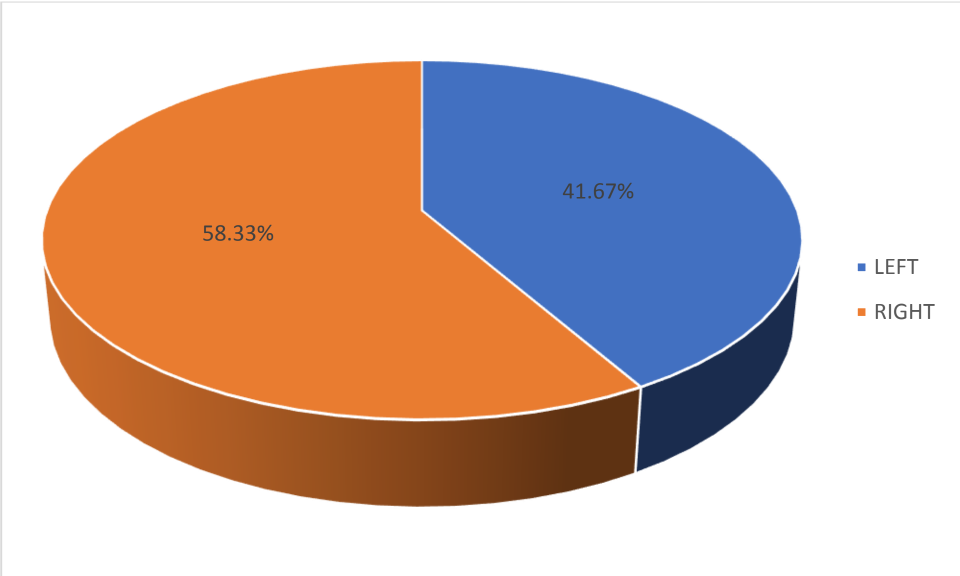


Males experienced this injury significantly more often than females. 20 out of 24 operated for ACL reconstruction with quadrupled semitendinosus autograft were males, and 4 were females

Side of injury:

SIDE	FREQUENCY	PERCENTAGE
LEFT	10	41.67%
RIGHT	14	58.33%
TOTAL	24	100%

Table 3. Side of Injury

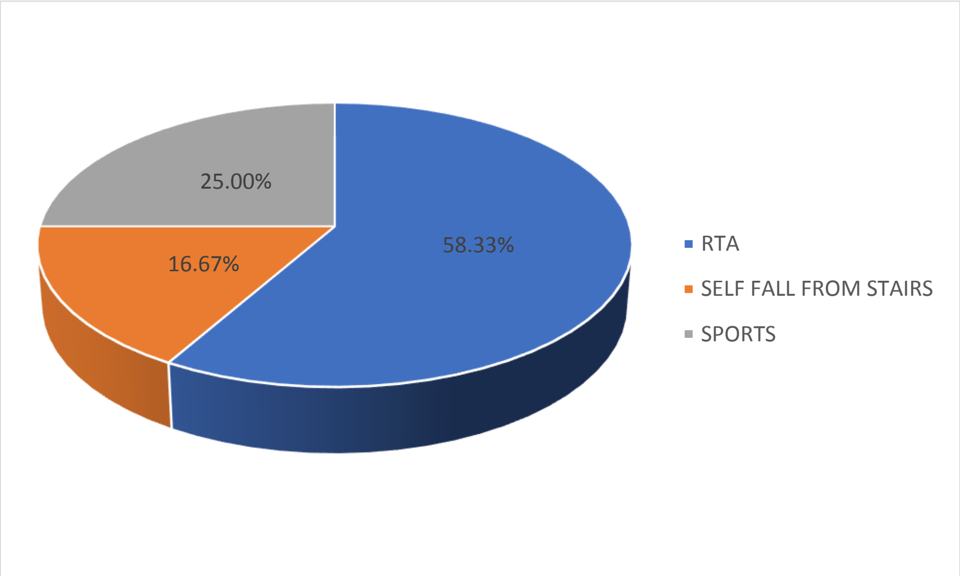


58.3% of the injuries occurred on the right side, while 41.67% occurred on the left side

Mode of injury:

MODE OF INJURY	FREQUENCY	PERCENTAGE
RTA	14	58.33%
SELF FALL FROM STAIRS	4	16.67%
SPORTS	6	25.00%
TOTAL	24	**100%**

Table 4. Mode of Injury

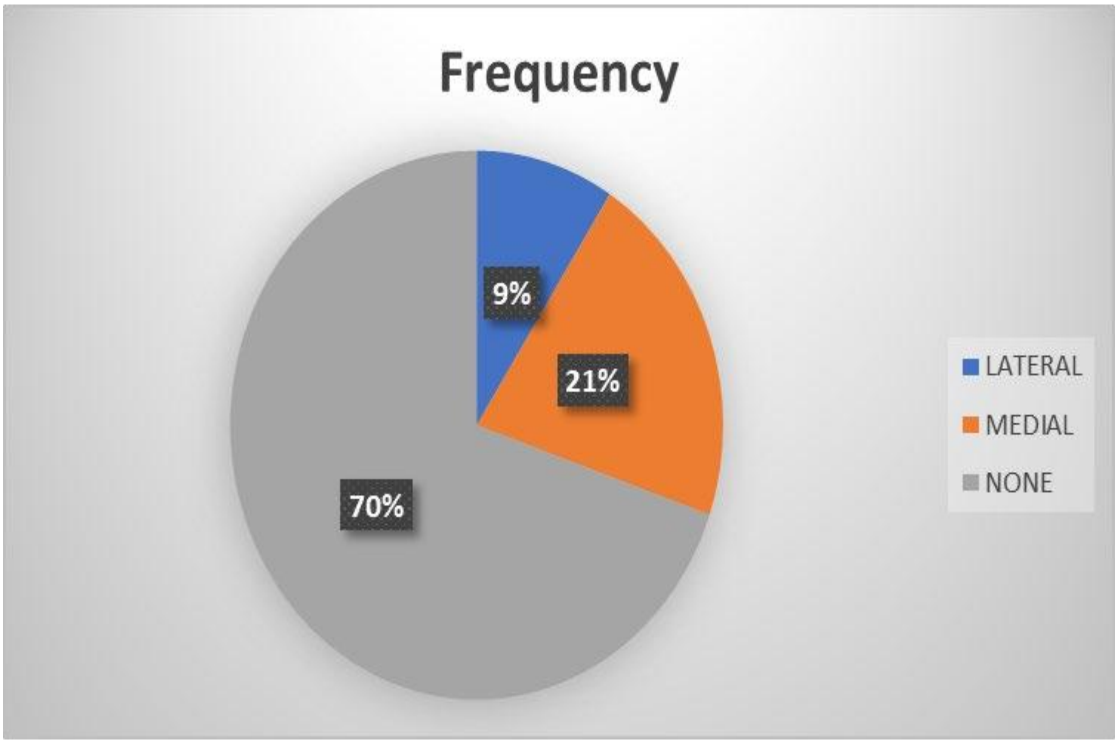


In our study, Road Traffic Accidents (58.33%) were a most common mode of the injury, followed by the sports-related injuries (16.67%). Additionally, 25.% of injuries resulted from fall from stairs.

Meniscal injury:

SIDE	FREQUENCY	PERCENTAGE
MEDIAL	6	21
LATERAL	3	9
NONE	16	70
TOTAL	24	100.0

Table 5. Meniscal injury



In our study, 9 out of 24 patients (30.3%) had an associated meniscal injury. The medial meniscus was injured more frequently (21%) compared to the lateral meniscus (9%). The cases that underwent repair involved simple tears and did not necessitate changes in the rehabilitation protocol. Additionally, 16 patients (70%) presented with isolated ACL tears.

Group Statistics

	GROUPS	N	Mean	Std. Deviation
AGE	1	12	29.92	8.174
	2	12	30.17	7.095
INJURY TOSURGERY TIME	1	12	3.083	2.2747
	2	12	5.250	6.8174
LYSHOLM PRE OP	1	12	46.08	5.696
	2	12	44.17	5.357
LYSHOLM Post op 6 Month	1	12	97.00	4.156
	2	12	98.50	2.355
IKDC Pre Op Pencentage	1	12	44.358	5.7362
	2	12	46.500	8.9967
IKDC post Op 6 monthsPencentage	1	12	94.383	3.3710
	2	12	95.658	2.4861

LYSHOLM score comparrison

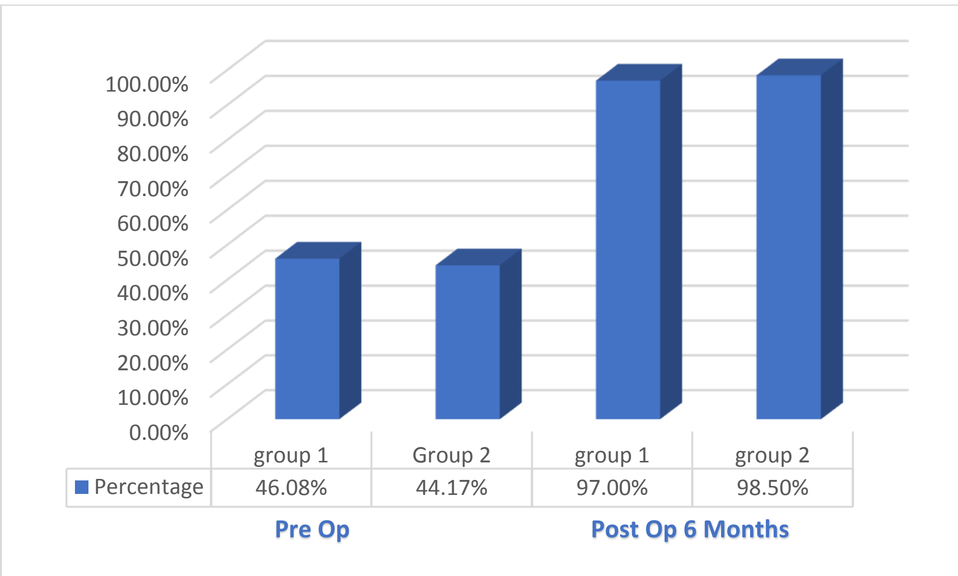
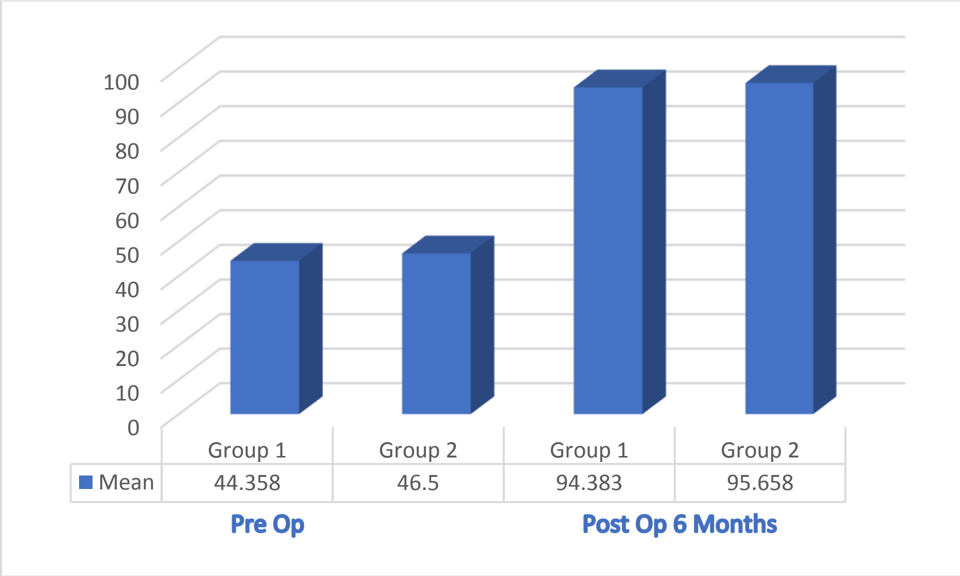


Table 7. IKDC score comparison



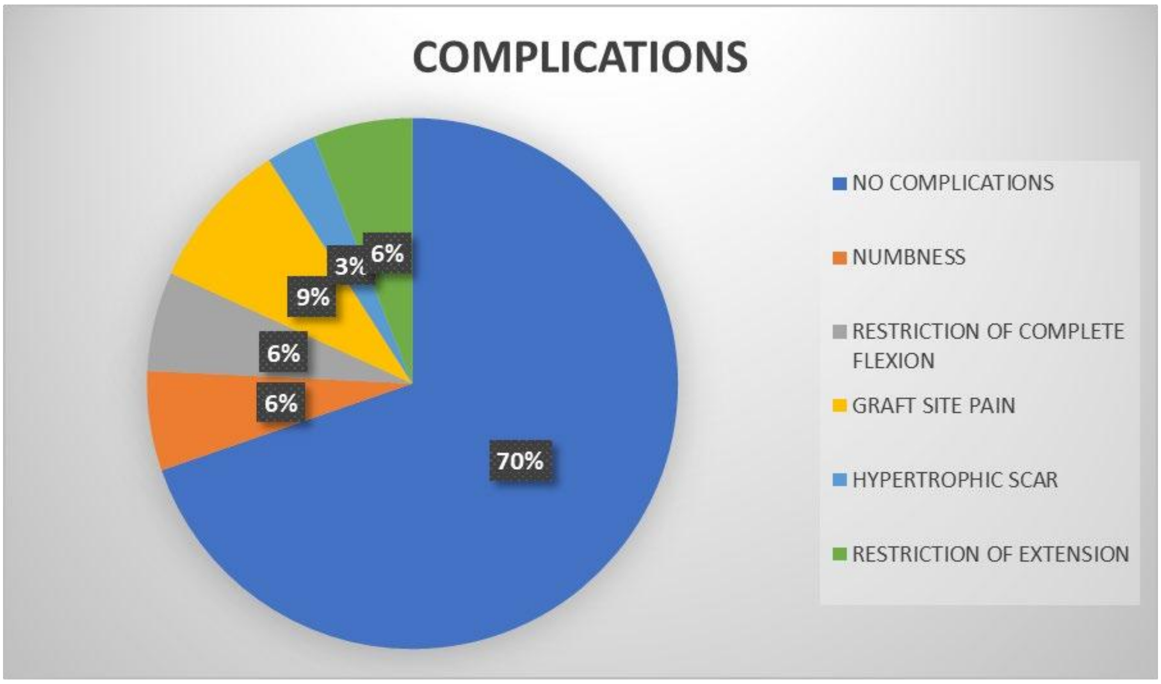
IKDC scores showed significant differences at pre op and 6 months postoperatively.

POSTOPERATIVE REHABILITATION

Phase	Duration	Activities
1	0-14 Days	• Quadriceps strengthening (static, dynamic) • Straight leg raises • Patellar mobilization (superior-inferior) • Ankle pumps • Gradual increase in range of motion (up to 90°) • Partial weight-bearing with crutches
2	2-10 Weeks	• Gradual increase in range of motion (up to 120°) • Discontinuation of crutches • Progressive quadriceps strengthening • Therapist-assisted extension (90-40°) • Introduction of lunges
3	3-4 Months	• Knee extension exercises (high reps/low weight) • Isokinetic quadriceps exercises • Slow and controlled drills for lateral sports
4	4-5 Months	• Jogging and jump rope exercises (if no effusion, full ROM, and stable knee)
5	5-8 Months	• Sports-specific drills (cutting, figure-of-eight) • Agility testing
6	> 8 Months	• Full return to sports (contingent on achieving 0-130° ROM, 90% hamstring strength, and 85% quadriceps strength) • Completion of sports-specific agility training • Continuation of exercises (3 times/week)

COMPLICATIONS

- "Three patients showed poor compliance with post-operative rehabilitation, and Progressive, vigorous physiotherapy demonstrated full recovery to preoperative levels
- one patients who had preoperative restriction of complete flexion by 20 degrees had restricted terminal flexion of 10 degrees at the 6 month follow up, and 1 patients had 10 degrees of restriction of extension, which gradually showed improvement with physiotherapy.
- one patients reported numbness over the anteromedial aspect of the leg.
- two patients complained of graft site pain in latter follow-ups.
- One patient complained of an undesirable cosmetic appearance after developing a hypertrophic scar at the graft harvest site.
- By the end of a year, none of the cases involved implant or fixation failure that required removal or revision.
-
- No patient reported to have instability symptoms.
- None of the cases had a superficial or deep infection."



DISCUSSION

"Only a few studies are available for comparative study of peroneus longus tendon versus hamstring tendon graft in arthroscopic reconstruction of anterior cruciate ligament **.**

Out of Twenty four patients with confirmed ACL tears 12 patient underwent arthroscopic ACL reconstruction with semitendinosus graft and 12 patient underwent arthroscopic ACL reconstruction with peroneus longus graft were prospectively followed up for minimum of 6 months. A similar prospective study by Sohrab kehyani et al. [141] in 2017 was followed up for two years. Another study was done by dr Anurag singh et al.[142] in 2019, where patients were followed up for up to 2 years.

The most important discovery of this study was that the peroneus longus tendon did not significantly affect the ankle joint, produced good functional results, avoided potential complications of the autograft harvested from the knee region, and appeared to be a suitable autograft option for ACLR.

Because there was no notable postoperative morbidity linked to biomechanical inconvenience to the donor site, Wiradiputra et al. determined that the peroneus longus tendon may be regarded as the first option graft in ACLR[143].

Patients with peroneus longus tendon autograft ACLR had comparable functional outcomes (Lysholm score, IKDC subjective score) to those with hamstring tendon autografts, according to a systematic study by He et al.[144].

In a large cohort analysis of patients, Snaebjornsson et al. found that the diameter of the peroneus longus tendon was bigger than that of the hamstring tendon, and that an increase of 0.5 mm in graft diameter decreased the likelihood of revision surgery by 0.86 times [145].

One donor site complication in hamstring tendon harvesting that may lower quality of life is hypoesthesia brought on by damage to the saphenous nerve's infrapatellar branch [146]. The two groups' thigh hypotrophy varied significantly, according to the current study.

Potential complications at the donor site include reduced peak torque eversion, inversion, and decreased ankle function and stability [147].Following the harvesting of the peroneus longus tendon, the present study found no significant pain or donor site complications near the lateral malleolus; additionally, no significant differences were found in the ankle's range of motion (flexion/extension, inversion/eversion, and angle of rotation) at the donor site compared to the contralateral healthy ankle side; and autograft harvesting had little effect on the foot and ankle.

Peroneus longus tendon autograft harvesting had little impact on foot and ankle function, according to Rathomy et al.[148]

Bi et al. were reluctant to completely remove the peroneus longus tendon for fear of causing irreversible functional impairment [149]

MRI compatibility and ease of revision surgery are two advantages of the titanium suture disc over metal screws. Areas of sensory change over the front of the knee were detectable in 50% of patients in a research by D.D.M. Spicer et al.[52], and 86% of these showed sensory abnormalities in the distribution of the saphenous nerve's infra-genicular branch. In our study, 1 participants (6%) reported experiencing numbness across their anteromedial leg.

In our study, according to the IKDC scale, for group 1 (hamstring tendon) 94.3% of patients had a normal postoperative recovery, and 5.7% of patients had an abnormal recovery.and for group 2 (peroneus longus tendon) 95.6%of patient had a normal postoperative recovery, and 4.4% of patient had an abnormal recovery . according to lysholm knee score,for group 1(hamstring tendon) 97% of patients showed excellent results, 3% of patients got fair results.and for group 2(peroneus longus tendon) 98.50% of patient had normal postoperative recovery and 1.5 % of patient had fair result.These findings can be compared with the study done by soharab et al., where for group 1(hamstring tendon) IKDC score 93.2% of patients showed normal postoperative recovery, 6.8% of patients were abnormal and related to knee stiffness and IKDC score for group 2 (peroneus longus tendon)92.5 % of patients showed normal postoperative recovery and 7.5% patient showed fair result .according to lysholm knee scores ~~showed~~ for group 1 (hamstring tendon) showed 94.9% excellent to good results and ~~6.7~~5 % with fair result."

CONCLUSION

- “The current study showed that peroneus longus tendon autograft might be regarded as a safe and useful autograft source for arthroscopic anterior cruciate ligament reconstruction. With regard to its strength, greater graft diameter, satisfactory ankle function, and avoidance of potential complications of hamstring autograft obtained from the knee region
- Peroneus longus is superficial in location and easy to harvest compare to hamstring tendon

- Because it exhibits better functional outcomes than the hamstring tendon and has lower donor site morbidity, the peroneus longus as an alternate graft in ACLR can be advised, according to the current study's therapeutic relevance.

- More then 95% of our cases had excellent to good outcome.
- There are no specific complications related to our study.

Limitations of this study are:

- The findings might not apply to a broader population because of the small sample size.

- We were unable to assess the long-term clinical efficacy or long-term consequences due to the comparatively brief follow-up time.

- Assessment was done by subjective scores only.”

2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

Name: ______ (First) ______ (Last) **Date:** ______

Physician: ______ **Date of Injury:** ______

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1.What is the highest level of activity that you can perform without significant knee pain?

- ◯ Very strenuous activities like jumping or pivoting as in basketball or soccer
- ◯ Strenuous activities like heavy physical work, skiing or tennis
- ◯ Moderate activities like moderate physical work, running or jogging
- ◯ Light activities like walking, housework or yard work
- ◯ Unable to perform any of the above activities due to knee pain

2.During the past 4 weeks, or since your injury, how often have you had pain?

	0	1	2	3	4	5	6	7	8	9	10	
Never	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Constant

3.If you have pain, how severe is it?

	0	1	2	3	4	5	6	7	8	9	10	
No pain	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Worst pain imaginable

4.During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

- ◯ Not at all
- ◯ Mildly
- ◯ Moderately
- ◯ Very
- ◯ Extremely

5.What is the highest level of activity you can perform without significant swelling in your knee?

- ◯ Very strenuous activities like jumping or pivoting as in basketball or soccer
- ◯ Strenuous activities like heavy physical work, skiing or tennis
- ◯ Moderate activities like moderate physical work, running or jogging
- ◯ Light activities like walking, housework or yard work
- ◯ Unable to perform any of the above activities due to knee swelling

6.During the past 4 weeks, or since your injury, did your knee lock or catch?

◯ Yes ◯ No

7.What is the highest level of activity you can perform without significant giving way in your knee?

- ◯ Very strenuous activities like jumping or pivoting as in basketball or soccer
- ◯ Strenuous activities like heavy physical work, skiing or tennis
- ◯ Moderate activities like moderate physical work, running or jogging
- ◯ Light activities like walking, housework or yard work
- ◯ Unable to perform any of the above activities due to giving way of the knee

SPORTS ACTIVITIES:

8.What is the highest level of activity you can participate in on a regular basis?

- ◯ Very strenuous activities like jumping or pivoting as in basketball or soccer
- ◯ Strenuous activities like heavy physical work, skiing or tennis
- ◯ Moderate activities like moderate physical work, running or jogging
- ◯ Light activities like walking, housework or yard work
- ◯ Unable to perform any of the above activities due to knee

9.How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a.	Go up stairs	◯	◯	◯	◯	◯
b.	Go down stairs	◯	◯	◯	◯	◯
c.	Kneel on the front of your knee	◯	◯	◯	◯	◯
d.	Squat	◯	◯	◯	◯	◯
e.	Sit with your knee bent	◯	◯	◯	◯	◯
f.	Rise from a chair	◯	◯	◯	◯	◯
g.	Run straight ahead	◯	◯	◯	◯	◯
h.	Jump and land on your involved leg	◯	◯	◯	◯	◯
i.	Stop and start quickly	◯	◯	◯	◯	◯

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

	0	1	2	3	4	5	6	7	8	9	10	
Couldn't perform daily activities	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	No limitation in daily activities

CURRENT FUNCTION OF YOUR KNEE:

	0	1	2	3	4	5	6	7	8	9	10	
Cannot perform daily activities	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	No limitation in daily activities

IKDC EVALUATION FORM

Parameter	Finding	Score	Parameter	Finding	Score
Limp	None	5	Pain	None	25
	Slight or periodic	3		Inconstant and slight during strenuous activities	20
	Severe and constant	0		Marked during or after walking >2 km	10
Support	None	5		Marked during or after walking <2 km	5
	Stick or crutch needed	2		Constant	0
	Weight bearing impossible	0	Swelling	None	10
Locking	None	15		After strenuous activities	6
	None, but catching sensation present	10		After ordinary activities	3
	Occasional	6		Constant	0
	Frequent	2	Squatting	No problem	5
	At examination	0		Slight problem	4
Stairs	No problem	10		Not beyond 90 degrees of knee flexion	2
	Slight problem	6		Impossible	0
	One step at a time	3			
	Impossible	0			
Instability	Never	25			
	Rarely during athletic activities	20			
	Frequently during athletic activities	15			
	Occasionally during daily activities	10			
	Often during daily activities	5			
	Every step	0			

LYSHOLM KNEE SCORING SCALE

LIST OF REFERENCES

1. KENNEDY JC, WEINBERG HW, WILSON AS. The anatomy and function of the anterior cruciate ligament: as determined by clinical and morphological studies. JBJS. 1974 Mar 1;56(2):223-35.
2. Apostolopoulos A, Nakos A, Nikolopoulos D, Theofanopoulos F, Liarokapis S, Mihos I. Anterior cruciate ligament reconstruction with hamstring tendon autografts. EEXOT. 2009;60:48-52.
3. Abbott LC, John B, Saunders M, Bost FC, Anderson CE. Injuries to the ligaments of the knee joint. JBJS. 1944 Jul 1;26(3):503-21.
4. Onggo JR, Nambiar M, Pai V. Fixed-versus adjustable-loop devices for femoral fixation in anterior cruciate ligament reconstruction: a systematic review. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2019 Aug 1;35(8):2484-98.
5. Elmholt SB, Nielsen TG, Lind M. Fixed-loop vs. adjustable-loop cortical button devices for femoral fixation in ACL reconstruction–a systematic review and meta-analysis. Journal of Experimental Orthopaedics. 2022 Oct 21;9(1):106.
6. Schützenberger S, Keller F, Grabner S, Kontic D, Schallmayer D, Komjati M, Fialka C. ACL reconstruction with femoral and tibial adjustable versus fixedloop suspensory fixation: a retrospective cohort study. Journal of Orthopaedic Surgery and Research. 2022 Apr 19;17(1):244.
7. International Journal of Orthopaedics Sciences 2018, Volume 4 Issue 1, Comparative study on fixed versus adjustable-length loop device for femoral fixation of graft in anterior cruciate ligament reconstruction
8. Maletis GB, Cameron SL, Tengan JJ, Burchette RJ. A prospective randomized study of anterior cruciate ligament reconstruction: a comparison of patellar tendon and quadruple-strand semitendinosus/gracilis tendons fixed with

bioabsorbable interference screws. The American Journal of Sports Medicine. 2007 Mar;35(3):384-94.

9. Schimoler PJ, Braun DT, Miller MC, Akhavan S. Quadrupled hamstring graft strength as a function of clinical sizing. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2015 Jun 1;31(6):1091-6.
10. Wagner M, Kääb MJ, Schallock J, Haas NP, Weiler A. Hamstring tendon versus patellar tendon anterior cruciate ligament reconstruction using biodegradable interference fit fixation: a prospective matched-group analysis. The American journal of sports medicine. 2005 Sep;33(9):1327-36.
11. Chen L, Cooley V, Rosenberg T. ACL reconstruction with hamstring tendon Orthop Clin North Am. 2003;34(1):9-18.
12. Lawhorn KW, Howel SM. Principles for using hamstring tendons for anterior cruciate ligament reconstruction. Clin in Sports Med. 2007;26(4):567- 85.
13. Pokharel B, Bhalodia M, Raut A, Gajjar SM. Comparative study on fixed versus adjustable-length loop device for femoral fixation of graft in anterior cruciate ligament reconstruction. Int J Orthop Sci. 2018;4: 889-92.
14. Balijepalli SP, Thakkallapalli ZM, Thakkallapalli ZH. Functional outcome in arthroscopic anterior cruciate ligament reconstruction by suspensory fixation in comparison with aperture fixation method. International Journal of Orthopaedics. 2021;7(3):743-7.
15. Abdulwahab AM, Kotb HA, Safaa MM, El Azab MS. ... Functional Outcomes After Anterior Cruciate Ligament Reconstruction Using Adjustable Femoral Cortical Suspensory Fixation Device. Fayoum University Medical Journal. 2024 Jan 1;13(1):1-0.
16. Houck DA, Kraeutler MJ, McCarty EC, Bravman JT. Fixed-versus adjustableloop femoral cortical suspension devices for anterior cruciate ligament reconstruction: a systematic review and meta-analysis of biomechanical studies. Orthopaedic journal of sports medicine. 2018 Oct 17;6(10):2325967118801762.
17. Colombet P, Saffarini M, Bouguennec N. Clinical and functional outcomes of anterior cruciate ligament reconstruction at a minimum of 2 years using adjustable suspensory fixation in both the femur and tibia: a prospective study. Orthopedic journal of sports medicine. 2018;6(10):2325967118804128.

18. Choi NH, Yang BS, Victoroff BN. Clinical and radiological outcomes after hamstring anterior cruciate ligament reconstructions: comparison between fixed-loop and adjustable-loop cortical suspension devices. The American Journal of Sports Medicine. 2017 Mar;45(4):826-31.
19. Gamboa JT, Shin EC, Pathare NP, McGahan PJ, Chen JL. Graft re-tensioning technique using an adjustableloop fixation device in arthroscopic anterior cruciate ligament reconstruction. Arthroscopy techniques. 2018;7(2):e185-191
20. LIFENG
21. Vaishya R, Agarwal AK, Ingole S, Vijay V. Current Trends in Anterior Cruciate Ligament Reconstruction: A Review. Cureus. 2015;7(11):e378.
22. Bosco F, Giustra F, Ghirri A, Cacciola G, Massè A, Capella M. All-Inside Anterior Cruciate Ligament Reconstruction Technique: Tips and Tricks. Journal of Clinical Medicine. 2023;12(18):5793.
23. Diermeier T, Tisherman R, Hughes J, Tulman M, Baum Coffey E, Fink C, Lynch A, Fu FH, Musahl V. Quadriceps tendon anterior cruciate ligament reconstruction. Knee Surgery, Sports Traumatology, Arthroscopy. 2020;28:2644-2656.
24. Hashem AM, Soliman HM, Abdelhalim KM, Rashwan AS, Soliman AA. A Study Comparing the Effectiveness of Hamstring Tendon Graft Versus Quadriceps Tendon Graft in Press Fit Anterior Cruciate Ligament Reconstruction. Journal of Advanced Zoology. 2023;44(S-3):50-62.
25. Chahla J, Dean CS, Cram TR, Civitarese D, O'Brien L, Moulton SG, LaPrade RF. Two-stage revision anterior cruciate ligament reconstruction: bone grafting technique using an allograft bone matrix. Arthroscopy Techniques. 2016;5(1):e189-95.
26. Prodromos CC, Han YS, Keller BL, Bolyard RJ. Stability results of hamstring anterior cruciate ligament reconstruction at 2- to 8-year follow-up. Arthroscopy. 2005;21(2):138–46.
27. Ishibashi Y, Rudy TW, Livesay FA, Stone JD, Fu FH, Woo SL. The effect of anterior cruciate ligament graft fixation sites at the tibia on knee stability: Evaluation using a robotic testing system. Arthroscopy. 1997;13(2):177-82.

28. Browning III WM, Kluczynski MA, Curatolo C, Marzo JM. Suspensory versus aperture fixation of a quadrupled hamstring tendon autograft in anterior cruciate ligament reconstruction: a meta-analysis. The American journal of sports medicine. 2017 Aug;45(10):2418-27.
29. Jagtap V, Gorgile N, Shah Y, Rokade V, Bartakke G. Functional outcome of an arthroscopic anatomical single-bundle anterior cruciate ligament reconstruction using semitendinosus graft with fixation using endo-button on femoral side and suture disc on tibial side: a prospective clinical study. Int J Res Orthop. 2017 Nov;3(6):1175-9.
30. Galen. On the usefulness of the parts of the body. Clin Orthop Relat Res. 2003;411:4– 12.
31. Stark J. Two Cases of Rupture of the Crucial Ligament of the Knee-Joint. Edinb Med Surg J. 1850 Oct 1;74(185):267–71.
32. Paul Segond. Recherches cliniques et expérimentales sur les épanchements sanguins du genou par entorse. 1879. 297–421 p.
33. Mayo Robson AW. RUPTURED CRUCIAL LIGAMENTS AND THEIR REPAIR BY OPERATION.1 Consulting Surgeon to the General Infirmary at Leeds.
34. W ME, Ernest Whey Groves B, Eng F. OPERATION FOR THE REPAIR OF THE CRUCIAL LIGAMENTS.
35. Saran R. Evaluation of Anterior Cruciate Ligament repair with Iliotibial Band. Vol. 3, People's Journal of Scientific Research. 2010.
36. Galway HR, MacIntosh DL. The lateral pivot shift: a symptom and sign of anterior cruciate ligament insufficiency. Clin Orthop Relat Res. (147):45–50.
37. Rubin RM, Marshall JL, Wang J. Prevention of knee instability. Experimental model for prosthetic anterior cruciate ligament. Clin Orthop Relat Res. (113):212–36.
38. Torg JS, Conrad W, Kalen V. Clinical I diagnosis of anterior cruciate ligament instability in the athlete.
39. Marshall JL, Warren RF, Wickiewicz TL, Reider B. The anterior cruciate ligament: a technique of repair and reconstruction. Clin Orthop Relat Res. 1979 Sep;(143):97–106.

40. Lipscomb AB, Johnston RK, Snyder RB, Warburton MJ, Pressly Gilbert P. Evaluation of hamstring strength following use of semitendinosus and gracilis tendons to reconstruct the anterior cruciate ligament.
41. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. The American journal of sports medicine. 1982 May;10(3):150-4.
42. Grood E. Biomechanical analysis of human ligament gras used in kneeligament repairs and reconstructions Related papers [Internet]. Available from:
www.jbjs.org
43. Slappey GS, Friedman MJ. Arthroscopic Anterior Cruciate Ligament Reconstruction: Semitendinosus/Gracilis Technique. In: Advanced Arthroscopy. New York, NY: Springer New York; 2001. p. 419–33.
44. Paulos LE, Cherf J, Rosenberg TD, Beck CL. Anterior cruciate ligament reconstruction with autografts. Clin Sports Med. 1991 Jul;10(3):469–85
45. Hefti F, Müller W, Jakob RP, Stäubli HU. Evaluation of knee ligament injuries with the IKDC form. Knee Surgery, Sports Traumatology, Arthroscopy. 1993 Sep;1(3-4):226-34.
46. Noyes FR, Grood ES, Torzilli PA (1989) The definition of terms for motion and position of the knee and injuries of the ligaments. Current concepts review. J Bone Joint Surg [Am] 71 : 465-472
47. Barrett GR, Papendick L, Miller C. Endobutton button endoscopie fixation technique in anterior cruciate ligament reconstruction. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 1995 Jun 1;11(3):340-3.
48. Aglietti P, Buzzi R, Zaccherotti G, De Biase P. Patellar tendon versus doubled semitendinosus and gracilis tendons for anterior cruciate ligament reconstruction. The American journal of sports medicine. 1994 Mar;22(2):211-8.
49. L'Insalata JC, Klatt B, Fu FH, Harner CD. Tunnel expansion following anterior cruciate ligament reconstruction: a comparison of hamstring and patellar tendon autografts. Knee Surgery, Sports Traumatology, Arthroscopy. 1997 Nov;5:234-8.

50. Simonian PT, Harrison SD, Cooley VJ, Escabedo EM, Deneka DA, Larson R v. Assessment of morbidity of semitendinosus and gracilis tendon harvest for ACL reconstruction. Am J Knee Surg. 1997;10(2):54–9.
51. Nebelung W. Bone tunnel enlargement after anterior cruciate ligament reconstruction with semitendinosus tendon using Endobutton fixation on the femoral side. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 1998 Nov 1;14(8):810-5.
52. Spicer DD, Blagg SE, Unwin AJ, Allum RL. Anterior knee symptoms after four-strand hamstring tendon anterior cruciate ligament reconstruction. Knee Surgery, Sports Traumatology, Arthroscopy. 2000 Sep;8(5):286-9.
53. Cooley V, Deffner K, Rosenberg T. Quadrupled semitendinosus anterior cruciate ligament reconstruction: 5-year results in patients without meniscus loss. Arthroscopy. 2001;17: 795-800
54. Chen L, Cooley V, Rosenberg T. ACL reconstruction with hamstring tendon. Orthopedic Clinics. 2003 Jan 1;34(1):9-18.
55. Freedman KB, D'Amato MJ, Nedeff DD, Kaz A, Bach BR. Arthroscopic anterior cruciate ligament reconstruction: a metaanalysis comparing patellar tendon and hamstring tendon autografts. The American journal of sports medicine. 2003 Jan;31(1):2-11.
56. Rose T, Engel T, Bernhard J, Hepp P, Josten C, Lill H. Differences in the rehabilitation period following two methods of anterior cruciate ligament replacement: semitendinosus/gracilis tendon vs. ligamentum patellae. Knee Surgery, Sports Traumatology, Arthroscopy. 2004 May;12:189-97.
57. Ibrahim SA, Al-Kussary IM, Al-Misfer AR, Al-Mutairi HQ, Ghafar SA, El Noor TA. Clinical evaluation of arthroscopically assisted anterior cruciate ligament reconstruction: patellar tendon versus gracilis and semitendinosus autograft. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2005 Apr 1;21(4):412-7.
58. Sajovic M, Vengust V, Komadina R, Tavcar R, Skaza K. A prospective, randomized comparison of semitendinosus and gracilis tendon versus patellar tendon autografts for anterior cruciate ligament reconstruction: five-year follow-up. The American journal of sports medicine. 2006 Dec;34(12):1933-40.

59. Data N. The International Knee Documentation Committee Subjective Knee Evaluation Form. The American Journal of Sports Medicine. 2006;34(1).
60. Irrgang JJ, Anderson AF, Boland AL, Harner CD, Neyret P, Richmond JC, Shelbourne KD, International Knee Documentation Committee. Responsiveness of the international knee documentation committee subjective knee form. The American journal of sports medicine. 2006 Oct;34(10):1567-73.
61. Laxdal G, Kartus J, Hansson L, Heidvall M, Ejerhed L, Karlsson J. A prospective randomized comparison of bone-patellar tendon-bone and hamstring grafts for anterior cruciate ligament reconstruction. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2005 Jan 1;21(1):34-42.
62. Liden M, Ejerhed L, Sernert N, Laxdal G, Kartus J. Patellar tendon or semitendinosus tendon autografts for anterior cruciate ligament reconstruction. The American Journal of Sports Medicine. 2007 May;35(5):740-8.
63. SUSAN L. A 6-Year Follow-up of the Effect of Graft Site on Strength, Stability, Range of Motion, Function, and Joint Degeneration After Anterior Cruciate Ligament Reconstruction Patellar Tendon Versus Semitendinosus and Gracilis Tendon Graft. Am J Sports Med. 2007;35:729-39.
64. Buchner M, Schmeer T, Schmitt H. Anterior cruciate ligament reconstruction with quadrupled semitendinosus tendon—minimum 6 year clinical and radiological follow-up. The Knee. 2007 Aug 1;14(4):321-7.
65. Mascarenhas R, Tranovich MJ, Kropf EJ, Fu FH, Harner CD. Bone-patellar tendon-bone autograft versus hamstring autograft anterior cruciate ligament reconstruction in the young athlete: a retrospective matched analysis with 2–10 year follow-up. Knee Surgery, Sports Traumatology, Arthroscopy. 2012 Aug;20:1520-7.
66. Bourke HE, Gordon DJ, Salmon LJ, Waller A, Linklater J, Pinczewski LA. The outcome at 15 years of endoscopic anterior cruciate ligament reconstruction using hamstring tendon autograft for 'isolated' anterior cruciate ligament rupture. The Journal of Bone & Joint Surgery British Volume. 2012 May 1;94(5):630-7.
67. Han DL, Nyland J, Kendzior M, Nawab A, Caborn DN. Intratunnel versus extratunnel fixation of hamstring autograft for anterior cruciate ligament

reconstruction. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2012 Oct 1;28(10):1555-66.

68. Eguchi A, Ochi M, Adachi N, Deie M, Nakamae A, Usman MA. Mechanical properties of suspensory fixation devices for anterior cruciate ligament reconstruction: comparison of the fixed-length loop device versus the adjustable-length loop device. The Knee. 2014 Jun 1;21(3):743-8.

69. Conte EJ, Hyatt AE, Gatt Jr CJ, Dhawan A. Hamstring autograft size can be predicted and is a potential risk factor for anterior cruciate ligament reconstruction failure. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2014 Jul 1;30(7):882-90.

70. Chidanand KJ, Ballal M, Gupta S. Suspensory fixation of grafts in anterior cruciate ligament fixation using endobutton and suture disc–A Prospective study of 30 cases. International Journal of Scientific and Research Publications. 2015 Sep;5(9):1-3.

71. Mohtadi N, Barber R, Chan D, Paolucci EO. Complications and Adverse Events of a Randomized Clinical Trial Comparing 3 Graft Types for ACL Reconstruction. Clin J Sport Med. 2016 May;26(3):182–9

72. Sheth H, Salunke AA, Barve R, Nirkhe R. Arthroscopic ACL reconstruction using fixed suspensory device versus adjustable suspensory device for femoral side graft fixation: What are the outcomes?. Journal of clinical orthopaedics and trauma. 2019 Jan 1;10(1):138-42.

73. Cavaignac E, Coulin B, Tscholl P, Nik Mohd Fatmy N, Duthon V, Menetrey J. Is Quadriceps Tendon Autograft a Better Choice Than Hamstring Autograft for Anterior Cruciate Ligament Reconstruction? A Comparative Study with a Mean Follow-up of 3.6 Years. American Journal of Sports Medicine. 2017 May 1;45(6):1326–32.

74. Wise BT, Patel NN, Wier G, Labib SA. Outcomes of ACL reconstruction with fixed versus variable loop button fixation. Orthopedics. 2017 Mar 1;40(2):e275-80.

75. Singh VB, Bhaskarwar A. Comparative study between aperture and suspensary fixation of hamstring autografts on femoral side in ACL reconstruction: clinical and radiological outcome assessment. International Journal of Research in Orthopaedics. 2017 Mar;3(2):298.

76. Asmussen CA, Attrup ML, Thorborg K, Hölmich P. Passive knee stability after anterior cruciate ligament reconstruction using the Endobutton or ToggleLoc With ZipLoop as a femoral fixation device: a comparison of 1654 patients from the Danish Knee Ligament Reconstruction Registry. Orthopaedic Journal of Sports Medicine. 2018 Jun 9;6(6):2325967118778507.
77. Ranjan R, Gaba S, Goel L, Asif N, Kalra M, Kumar R, Kumar A. In vivo comparison of a fixed loop (EndoButton CL) with an adjustable loop (TightRope RT) device for femoral fixation of the graft in ACL reconstruction: A prospective randomized study and a literature review. Journal of Orthopaedic Surgery. 2018 Sep 19;26(3):2309499018799787.
78. Sharma B, Parmar RS. Early outcome analysis of arthroscopic anterior cruciate ligament reconstruction using fixed closed loop and adjustable loop techniques: A prospective case series. Journal of Orthopaedics and Spine.

2018 Jul 1;6(2):74-8.
79. Nyland J, Collis P, Huffstutler A, Sachdeva S, Spears JR, Greene J, et al. Quadriceps tendon autograft ACL reconstruction has less pivot shift laxity and lower failure rates than hamstring tendon autografts. Vol. 28, Knee Surgery, Sports Traumatology, Arthroscopy. Springer; 2020. p. 509–18
80. Sebaie A, Alim AA, Abulsoud MI, Salem AM. Outcome of adjustable suspensory fixation for femoral graft in ACL reconstruction. The Egyptian Journal of Hospital Medicine. 2019 Jul 1;76(7):4533-7.
81. Ahn HW, Seon JK, Song EK, Park CJ, Lim HA. Comparison of clinical and radiologic outcomes and second-look arthroscopic findings after anterior cruciate ligament reconstruction using fixed and adjustable loop cortical suspension devices. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2019 Jun 1;35(6):1736-42.
82. SJ KABIR
83. Mohamed RS, El-Shafie MH, El-Sheikh MA. Clinical Outcome of Fixed Versus Adjustable Loop Cortical Suspension Devices in Arthroscopic Anterior Cruciate Ligament Reconstruction. Ortopedia Traumatologia Rehabilitacja. 2020 Jun 30;22(3):181-5.

84. Asif N, Khan MJ, Haris KP, Waliullah S, Sharma A, Firoz D. A prospective randomized study of arthroscopic ACL reconstruction with adjustable-versus fixed-loop device for femoral side fixation. Knee Surgery & Related Research. 2021 Dec;33(1):1-7.

85. Kim Y, Kubota M, Muramoto K, Kunii T, Sato T, Inui T, Ohno R, Ishijima M. Clinical and radiographic results after ACL reconstruction using an adjustableloop device. Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology. 2021 Oct 1;26:32-8.

86. Ono Y, Sato Y, Mukai H, Enomoto T, Kimura S, Nakagawa R, Akagi R, Inaba Y, Kawasaki Y, Ohtori S, Sasho T. Randomized comparative study of suspension femoral fixation device in graft position maintenance in anterior cruciate ligament reconstruction: EndoButton CL vs TightRope RT. AsiaPacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology. 2021 Jul 1;25:42-6.

87. Kumar R, Kalra M, Garg AK, Choudhary R, Venishetty N, Verma S, Kumar A. Clinical Reliability of Adjustable Femoral Cortical Suspensory Fixation in Anterior Cruciate Ligament Reconstruction and Correlation of Clinical Outcomes With Demographic and Perioperative Factors. Cureus. 2021 May;13(5).

88. Brinkman JC, Tummala S v, Hassebrock JD, McQuivey KS, Makovicka JL, Economopoulos KJ. Mid-Term Outcomes of the All-Soft Quadriceps Tendon Autograft are Non-Inferior to Hamstring Autograft in Primary Anterior Cruciate Ligament Reconstruction: Comparison with Minimum 5-year Follow up. Arthroscopy. 2022 Nov 4;

89. Pandey SK, Khare R, Yadav AK, Deswal D, Jaiswal S. Functional outcome of arthroscopic anterior cruciate ligament reconstruction using variable loop cortical suspensory fixation. Journal of Bone and Joint Diseases. 2022 May 1;37(2):70-5.

90. Heng CH, Wong JY, Tan AH. Both Adjustable and Fixed Loop Hamstring Tendon Graft Fixation Have Similar Clinical and Patient-Reported Outcomes in Anterior Cruciate Ligament Reconstruction. Arthroscopy, Sports Medicine, and Rehabilitation. 2023 Oct 1;5(5):100775.

91. Khatri RY, Patil V, Kulkarni S, Naik S, Nandi S. Functional Outcomes of

Quadriceps Tendon versus Hamstring Tendon Autograft using Suspensory Fixation at Femoral and Tibial Sites for Primary Anterior Cruciate Ligament Reconstruction: A Randomised Controlled Study.

92. Singh RP, Karuppiah KS, Jayaraman P, Gopi T, Kumar AH. FIXED VERSUS ADJUSTABLE CORTICAL BUTTON LOOP DEVICE-A COMPARATIVE STUDY ON CLINICAL OUTCOME OF FEMORAL SIDE GRAFT FIXATION IN PRIMARY ACL RECONSTRUCTION. Int J Acad Med Pharm. 2024;6(1):1998-2001.

93. Kaarre J, Benvegnu NA, Engler ID, Nazzal EM, Zsidai B, Senorski EH, Musahl V, Samuelsson K. Metal interference screw fixation combinations show high revision rates in primary hamstring tendon ACL reconstruction. BMC Musculoskeletal Disorders. 2024 Jan 2;25(1):2.

94. W Norman S. Insall & Scott surgery of the knee. 6th ed. David R D, Richard I, William J L, editors. Vol. 1. 2018. 1217–1218 p.

95. Ratajczak W. Early development of the cruciate ligaments in staged human embryos. Folia Morphol [Internet]. 2000;59(4):285–90. Available from: www.fm.viamedica.pl

96. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, James S. Starman Mario Ferretti Timo Järvelä Anthony Buoncristiani Freddie H. F, pg no 5

97. W NORMAN SCOTT. Insall & Scott surgery of the knee. David R D, Richard I, William J L, editors. Vol. 1. 2018. 24–27 p.

98. FAKHRY G GIRGIS) 00003086-197501000-00033.

99. Harner CD, Baek H, Vogrin TM, Carlin GJ, Kashiwaguchi S, Woo SLY. Quantitative Analysis of Human Cruciate Ligament Insertions.

100. Fu FH, Bennett CH, Lattermann C, Ma CB. Current Concepts Current Trends in Anterior Cruciate Ligament Reconstruction Part 1: Biology and Biomechanics of Reconstruction. 1999.

101. Defroda SF, Karamchedu NP, Budacki R, Wiley T, Fadale PD, Hulstyn MJ, et al. Evaluation of Graft Tensioning Effects in Anterior Cruciate Ligament Reconstruction between Hamstring and Bone-Patellar Tendon Bone

Autografts. Journal of Knee Surgery. 2021 Jun 1;34(7):777–83

102. Petersen W, Tillmann B. Anatomie und funktion des vorderen kreuzbandes. Orthopade. 2002;31(8):710–8.

103. Chhabka A, Bs JSS, Feiîìïktti M, Vidal AF, Zantop T;, Fu FH. KINEMATIC EVALUATION OF THE ANTERIOR CRUCIATE LIGAMENT AND ITS TWO FUNCTIONAL BUNDLES. 2006.

104. Zantop T, Herbort M, Raschke MJ, Fu FH, Petersen W. The role of the anteromedial and posterolateral bundles of the anterior cruciate ligament in anterior tibial translation and internal rotation. American Journal of Sports Medicine. 2007 Feb;35(2):223–7.

105. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, James S. Starman Mario Ferretti Timo Järvelä Anthony Buoncristiani Freddie H. F, pg no 6

106. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, James S. Starman Mario Ferretti Timo Järvelä Anthony Buoncristiani Freddie H. F, pg no 7

107. Toy BJ, Yeasting RA, Morse DE, McCann P, Morse are professors in the DE. Arterial Supply to the Human Anterior Cruciate Ligament.

108. Hogervorst T, Brand RA. Mechanoreceptors in joint function. J Bone Joint Surg Am. 1998 Sep;80(9):1365–78.

109. Strocchiv R, de Pasquale' V, Gubellini1 P, Facchini1 A, Marcacci2 M, Buda2 R, et al. The human anterior cruciate ligament: histological and ultrastructural observations. Vol. 180, J. Anat. 1992.

110. Smith BA, Livesay GA, Woo SL. Biology and biomechanics of the anterior cruciate ligament. Clin Sports Med. 1993 Oct;12(4):637–70.

111. Woo LY, Gomez MA, Seguchi T, Endo CM, Akeson WH. Measurement of Mechanical Properties of Ligament Substance From a B one-Ligament-B one Preparation. Vol. 1, Journal of Orthopaedic Research. Orthopaedic Research Society; 1983.

112. Butt U, Khan ZA, Zahir N, Khan Z, Vuletic F, Shah I, Shah JA, Siddiqui AM, Hudetz D. Histological and cellular evaluation of anterior cruciate ligament. The Knee. 2020 Oct 1;27(5):1510-8.

113. L-y Woo S, Marcus Hollis J, Adams DJ, Lyon RM, Takai S. Tensile properties of the human femur-anterior cruciate ligament-tibia complex The effects of specimen age and orientation*. 1990

114. Siebold R, Dejour D, Zaffagnini S, editors. Anterior Cruciate Ligament Reconstruction: A Practical Surgical Guide. Berlin: Springer; 2014. ISBN 978-3-642-45348-9. DOI: 10.1007/978-3-642-45349-6, Milos Dordevic and Michael T. Hirschmann p 50

115. Strobel MJ. Manual of Arthroscopic Surgery. Berlin: Springer Berlin Heidelberg; 2013. ISBN 9783540874102.

116. Azar Frederick BJ. CAMPBELL'S OPERATIVE ORTHOPAEDICS. THIRTEENTH. Kay Daugherty, Linda Jones, editors. Vol. THIRD. 2017. 2156–2171 p.

117. W. NORMAN SCOTT. Insall & Scott SURGERY of the KNEE. SIXTH EDITION. Justin B. Jones, Aaron Althaus, Jason P. Hochfelder, editors. Vol. 1. 2018. 65–78 p.

118. McMurray TP: The semilunar cartilages. *Br J Surg* 29:407, 1942.

119. Randelli P, Dejour D, van Dijk CN, Denti M, Seil R, editors. Arthroscopy: Basic to Advanced. Berlin: Springer Berlin Heidelberg; 2016. ISBN 9783662493762., Rainer Siebold and Georgios karidakis, 209-216 p

120. Milch H. Cortical avulsion fracture of the lateral tibial condyle. J Bone Joint Surg. 1936;18(1):159–64.

121. Stallenberg B, Gevenois PA, Sintzoff SA Jr, et al. Fracture of the posterior aspect of the lateral tibial plateau: radiographic sign of anterior cruciate ligament tear. Radiology 1993;187:821–825.

122. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, Chadwick C. Prodromos, Brian J. Murphy editors, 53-59 p

123. Pao DG. The lateral femoral notch sign. Radiology. 2001;219(3):800–1

124. Warren RF, Kaplan N, Bach BR. The lateral notch sign of anterior cruciate ligament insufficiency. Am J Knee Surg. 1988;1:119–24
125. Kendall NS, Hsu SY, Chan KM. Fracture of the tibial spine in adults and children. A review of 31 cases. J Bone Joint Surg Br. 1992;74(6):848–52
126. W. NORMAN SCOTT. Insall & Scott SURGERY of the KNEE. SIXTH EDITION. Samuel D. Madoff, Jarett S.Burak, Kevin R. Math, Daniel M. Walz editors. Vol. 1. 2018. 98-99 p
127. Vahey T, Broome D, Kayes K, Shelbourne K. Acute and chronic tears of the anterior cricuate ligament: differential features at MR imaging. Radiology 1991; 181:251-253.
128. Tung GA, Davis LM, Wiggins ME, et al. Tears of the anterior cruciate ligament: primary and secondary signs at MR imaging. Radiology 1993;188:661–667.
129. Dimond PM, Fadale PD, Hulstyn MJ, et al. A comparison of MRI findings in patients with acute and chronic ACL tears. Am J Knee Surg 1998;11:153–159
130. Adriaensen MEAPM, Hogan B, Al-Bulushi HIJ, Kavanagh EC. Double-bundle depiction of the anterior cruciate ligament at 3 Tesla. Skeletal Radiol. 2012 Jul;41(7):831–4.
131. Fischer SP, Fox JM, del Pizzo W, Friedman MJ, Snyder SJ, Ferkel RD. Accuracy of diagnoses from magnetic resonance imaging of the knee. A multicenter analysis of one thousand and fourteen patients. J Bone Joint Surg Am. 1991 Jan;73(1):2–10
132. Siebold R, Dejour D, Zaffagnini S, editors. Anterior Cruciate Ligament Reconstruction: A Practical Surgical Guide. Berlin: Springer; 2014. ISBN 978-3-642-45348-9. DOI: 10.1007/978-3-642-45349-6
133. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, Chadwick C. Prodromos, Brian T. Joyce editors, 84-87 p
134. Azar Frederick BJCST. CAMPBELL'S OPERATIVE ORTHOPAEDICS. THIRTEENTH. Daugherty Kay, Jones Linda, editors. Vol. THIRD. 2017. 2486–2492 p

135. Siebold R, Dejour D, Zaffagnini S, editors. Anterior Cruciate Ligament Reconstruction: A Practical Surgical Guide. Berlin: Springer; 2014. ISBN 978-3-642-45348-9. DOI: 10.1007/978-3-642-45349-6. Tim spalding, Curtis cobb and Charles H. Brown Jr. editors, 159-180 p

136. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, Anthony buoncristiani, Fotios Paul Tjoumakaris, James S. Starman, Freddie H. Fu editors, 168-178 p

137. Prodromos C, Brown C, Fu FH, Georgoulis AD, Gobbi A, Howell SM, et al. The Anterior Cruciate Ligament: Reconstruction and Basic Science E-Book. Philadelphia: Elsevier Health Sciences; 2007. ISBN 9781437721218, Chadwick C. Prodromos, 218-226 p

138. Bula Ratnakumar. A Comparative Study of Clinical and Functional Outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Graft with Aperture Fixation Versus Suspensory Device Fixation. India: Rajiv Gandhi University of Health Sciences (India); 2020.

139. Wiertsema SH, Van Hooff HJ, Migchelsen LA, Steultjens MP. Reliability of the KT1000 arthrometer and the Lachman test in patients with an ACL rupture. The Knee. 2008 Mar 1;15(2):107-10.

140. Siebold R, Dejour D, Zaffagnini S, editors. Anterior Cruciate Ligament Reconstruction: A Practical Surgical Guide. Berlin: Springer; 2014. ISBN 978-3-642-45348-9. DOI: 10.1007/978-3-642-45349-6. Bertrand SonneryCottet, Philippe Colombet, Rainer Siebold, Pooler Archbold, Pierre Chambat, Jacopo Conteduca, and Mathieu Thaunat. 89-98 p

141. Peroneus Longus Tendon Autograft versus Hamstring Tendon Autograft in Anterior Cruciate Ligament Reconstruction: A Comparative Study with a Mean Follow-up of Two Years . Sohrab Keyhani, MD, PhD1; Mohamad Qoreishi, MD1; Maryam Mousavi, MSc2; Hossein Ronaghi, MD3; Mehran Soleymanha, MD3 Research performed at the Poursina Hospital Orthopaedic Research center, Guilan University of medical sciences, Rasht, Iran

142.Comparative Study of Autologous Peroneus Longus Versus Hamstring Tendon for Anterior Cruciate Ligament Reconstruction in Knee Dr. Anurag Singh, Dr. Rohan Krishnan *, Dr. Jaiveer Singh SR, PGIMSR, New Delhi *Corresponding author: Dr. Rohan Krishnan

143. Wiradiputra A, Febyan, Aryana G. Peroneus longus tendon graft for anterior cruciate ligament reconstruction: A case report and review of literature. International Journal of Surgery Case Reports. 2021:38:106028.

144. He J, Tang Q, Ernst S, Linde M, Smolinski P, Wu S, et al. Peroneus longus tendon autograft has functional outcomes comparable to hamstring tendon autograft for anterior cruciate ligament reconstruction: a systematic review and meta-analysis. Knee Surg Sport Traumatol Arthrosc 2020; Sep27.

145. Snaebjörnsson T, Hamrin Senorski E, Ayeni OR, Alentorn-Geli Eduard, Krupic F, Norberg F, et al. Graft Diameter as a Predictor for Revision Anterior Cruciate Ligament Reconstruction and KOOS and EQ-5D Values: A Cohort Study From the Swedish National Knee Ligament Register Based on 2240 Patients. Am J Sport Med 2017; 45(9):2092-2097.

Kjaergaard J, Faunø LZ, Faunø P. Sensibility Loss after ACL Reconstruction with Hamstring Graft. Int J Sports Med 2008; 29:507-11

146. Kjaergaard J, Faunø LZ, Faunø P. Sensibility Loss after ACL Reconstruction with Hamstring Graft. Int J Sports Med 2008; 29:507-11.

147. Angthong C, Chernchujit B, Apivatgaroon A, Chaijenkit K, Nualon P, Suchao-in K. The Anterior Cruciate Ligament Reconstruction with the Peroneus Longus Tendon: A Biomechanical and Clinical Evaluation of the Donor Ankle Morbidity. J Med Assoc Thai 2015; 98(6)555-60.

148. Rhatomy S, Hartoko L, Setyawan R, Soekarno NR, Zainal Asikin AI, Pridianto D, et al. Single bundle ACL reconstruction with peroneus longus tendon graft: 2-years follow-up. J Clin Orthop Trauma 2020; 11(Suppl 3):S332-S336.

149. Bi M, Zhao C, Zhang Q, Cao L, Chen X, Kong M, et al. All-Inside Anterior Cruciate Ligament Reconstruction Using an Anterior Half of the Peroneus Longus Tendon Autograft. Orthop J Sport Med. 2021;9(6):2325967121991226.

ANNEXURE –I

SCHEME OF CASE TAKING:

CASE NO. :

FOLLOW UP NO. :

NAME :

AGE/SEX :

IP NO :

DATE OF ADMISSION :

DATE OF SURGERY :

DATE OF DISCHARGE :

OCCUPATION :

RESIDENCE :

Presenting complaints with duration :

History of presenting complaints :

Family History :

Personal History :

Past History :

Vitals

PR:

RR:

BP:

TEMP:

Systemic Examination:

Respiratory system -

Cardiovascular system -

Per abdomen - Central nervous system -

Local examination:

Right/ Left Leg Gait:

Inspection:

a) Attitude
b) Abnormal swelling
c) Skin condition
d) Compound injury, if any

Palpation:

a) Swelling
b) Local tenderness
c) Bony irregularity
d) Abnormal movement
e) Crepitus/ grating of fragments
f) Absence of transmitted movements
g) Wound

Movements:	Active	Passive
Flexion		
Extension		

Clinical tests:

Anterior drawer test

Posterior drawer test

Lachman's test

McMurray's test

Varus test

Valgus test

Investigations: MRI of the affected knee

Intra Operative details:

Post Operative:

- Rehabilitation protocol as per the guidelines
- Functional outcome evaluation with:
    1. IKDC scores
    2. Lysholm score

ANNEXURE –II

INFORMED CONSENT FORM FOR PARTICIPATION IN DISSERTATION / RESEARCH

I, the undersigned, _______________, S/O D/O W/O ________________, aged ____years, ordinarily resident of ____________ do hereby state/declare that **DR. ANANT ASHTEKAR** of Shri. B. M. Patil Medical College Hospital & Research Centre has examined me thoroughly on ______________ at ______________ (place) and it has been explained to me in my own language that I am suffering from ________________ disease (condition) and this disease/condition mimic following diseases. Further**, Dr. ANANT S ASHTEKAR** informed me that he/she is conducting dissertation/research titled **" COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT**

" under the guidance of **Dr. ASHOK NAYAK** requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, operative, post-operative, and follow-up observations will be utilized for the study as reference data.

The doctor has also informed me that during the conduct of this procedure, adverse results might encounter. Most of them are treatable but are not anticipated; hence there is a chance of aggravation of my condition. In rare circumstances, it may prove fatal despite the expected diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study will help in the evaluation of the results of the study, which is a useful reference for the treatment of other similar cases in the near future, and also, I may be benefited from getting relieved from suffering or a cure of the disease I am suffering.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by a person other than my legal hirer or me except for academic purposes.

The Doctor informed me that though my participation is purely voluntary, based on the information given by me, I can ask for any clarification during the course of treatment/study related to diagnosis, the procedure of treatment, the result of treatment, or prognosis. I've been informed that I can withdraw from my participation in this study at any time if I want, or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt _______________________________________ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of the patient:

Signature of doctor:

Witness: 1.

2.

Date:

Place:

ANNEXURE -III

Azadi Ka Amrit Mahotsav

BLDE

(DEEMED TO BE UNIVERSITY)

Declared as Deemed to be University u/s 3 of UGC Act, 1956

Accredited with 'A' Grade by NAAC (Cycle-2)

The Constituent College

SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 974/2022-23 10/4/2023

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Saturday, 18th March, 2023 at 11.30 a.m. in the CAL Laboratory, Dept. of Pharmacology,** scrutinizes the Synopsis/ Research Projects of Post Graduate Student / Under Graduate Student /Faculty members of this University /Ph.D. Student College from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OFANTERIOR CRUCIATE LIGAMENT."

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR.ANANT ASHTEKAR

NAME OF THE GUIDE: DR. ASHOK NAYAK, PROFESSOR AND HOD, DEPT. OF ORTHOPAEDICS

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA

MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103. Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.
BLDE (DU): Phone: +918352-262770, Fax: +918352-263303, Website: www.bldedu.ac.in, E-mail:office@bldedu.ac.in
College: Phone: +918352-262770, Fax: +918352-263019, E-mail: bmpmc.principal@bldedu.ac.in

MASTER CHART

SERIAL NO	NAME	AGE	SEX	PATIENT ID	SIDE OF INJURY	MODE OF INJURY	INJURY TO SURGERY TIME MONTHS	GRAFT USED	MENISCAL INJURY	LYSHOLM PREOP (%)	LYSHOLM POSTOP 6 WEEKS (%)	LYSHOLM POSTOP 3 MON (%)	LYSHOLM POSTOP 6 MONTHS	IKDC PREOP (%)	IKDC POSTOP 6 WEEKS (%)	IKDC POSTOP 3 MON (%)	IKDC POSTO 6 MON (%
1	RUSHIKESH	24	M	279459	RIGHT	RTA	2	SEMITENDINOSUS	MEDIAL	54	80	94	100	41.4	59.8	74.7	95.4
2	SHVANAND	30	M	310467	RIGHT	SPORTS	1	SEMITENDINOSUS	LATERAL	47	84	95-	99	44.8	59.8	86.2	96.6
3	GOVINDA	22	M	340498	LEFT	RTA	6	SEMITENDINOSUS	LATERAL	42	80	90	100	41	61.9	66.7	95.2
4	REKHA	45	F	320068	RIGHT	SELF FALL FROM STAIRS	2	SEMITENDINOSUS	MEDIAL	38	84	90	100	45	61.9	66.7	95.4
5	GOVINDAPPA	35	M	001408	LEFT	RTA	3	SEMITENDINOSUS AND GRACILIS	MEDIAL	54	80	94	100	60.9	64	79	96
6	SHEKAPPA	36	M	485309	LEFT	RTA	3	SEMITENDINOSUS	LATERAL	47	64	86	99	44.8	66.7	86.2	92.6
7	SANDESH	20	M	361838	LEFT	SPORTS	2	SEMITENDINOSUS	MEDIAL	38	61	81	86	47.1	61.9	74.7	91
8	PRAKASH	38	M	396002	LEFT	RTA	3	SEMITENDINOSUS	NONE	42	69	94	95	41.4	65.5	80	96.6
9	ANNAPURNA	35	F	289043	RIGHT	RTA	2	SEMITENDINOSUS	NONE	42	85	95	100	38.9	59.8	86.2	96.6
10	SHASHANK	30	M	15528	RIGHT	RTA	9	SEMITENDINOSUS	MEDIAL	51	80	90	95	41.1	66.7	85.1	95.4
11	PURUSHOTTAM	18	M	73785	RIGHT	SPORTS	1	SEMITENDINOSUS	NONE	51	84	95	95	41.1	60.8	66.7	85.2
12	VIKAS	26	M	103951	RIGHT	SELF FALL FROM STAIRS	3	SEMITENDINOSUS	NONE	47	85	90	95	44.8	59.8	86.1	96.6
13	CHIDANAND	38	M	294651	RIGHT	RTA	0.5	PERONEUS LONGUS	NONE	38	66	86	99	42	60.9	74.7	97.7
14	SHRINIVAS	23	M	380376	RIGHT	RTA	1	PERONEUS LONGUS	NONE	42	84	94	100	60.9	64	85.1	96.6
15	SANJEEV	38	M	89600	LEFT	SELF FALL FROM STAIRS	24	PERONEUS LONGUS	NONE	47	85	95	100	37.9	61.9	77.2	95.4

16	VENKATESH	20	M	201488	RIGHT	SPORTS	6	PERONEUS LONGUS	MEDIAL	54	80	90	100	60.9	64	79	95.4
17	SUNITA	38	F	216843	LEFT	RTA	2	PERONEUS LONGUS	NONE	49	80	86	95	38.9	60.9	85.1	96.6
18	RAJSHEKHAR	25	M	185474	LEFT	SPORTS	0.5	PERONEUS LONGUS	NONE	42	64	86	94	45	60.9	66.7	90.7
19	GOURAPPA	27	M	230657	RIGHT	RTA	1.5	PERONEUS LONGUS	NONE	38	80	95	100	41	59.8	85.1	96.6
20	LALITHA	24	F	276651	RIGHT	SELF FALL FROM STAIRS	6	PERONEUS LONGUS	NONE	51	84	90	100	38.9	60.8	86.1	95.6

21	APPASAB	40	M	246784	LEFT	RTA	2	PERONEUS LONGUS	NONE	42	84	90	95	100	60.9	64	85.1	91	98
22	VIKAS	27	M	256078	RIGHT	RTA	1.5	PERONEUS LONGUS	NONE	47	84	90	94	95	44.8	65.5	80	96	98
23	SABEERA	35	M	22541	LEFT	RTA	12	PERONEUS LONGUS	NONE	38	76	86	94	100	44.8	59.8	86.2	96.6	96.6
24	SHIVKUMAR	27	M	278740	RIGHT	SPORTS	6	PERONEUS LONGUS	NONE	42	80	90	95	99	42	60.9	85.1	90.7	90.7

PLAGIARISM CERTIFICATE

DR. ASHTEKAR ANANT

"COMPARATIVE STUDY OF PERONEUS LONGUS TENDON VERSUS HAMSTRING TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT ."

ANANT ASHTEKAR

ASHTEKAR THESIS.docx

BLDE University

Document Details

Submission ID
trn:oid:::3618:89351769

Submission Date
Apr 3, 2025, 9:29 AM GMT+5:30

Download Date
Apr 3, 2025, 9:32 AM GMT+5:30

File Name
ASHTEKAR THESIS.docx

File Size
13.3 MB

109 Pages

19,696 Words

113,475 Characters

iThenticate Page 1 of 113 - Cover Page Submission ID trn:oid:::3618:89351769

iThenticate Page 2 of 113 - Integrity Overview Submission ID trn:oid:::3618:89351769

3% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography
- Quoted Text
- Small Matches (less than 10 words)

Exclusions

- 1 Excluded Website

Match Groups

- 32 Not Cited or Quoted 3%
  Matches with neither in-text citation nor quotation marks
- 0 Missing Quotations 0%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

- 2% Internet sources
- 2% Publications
- 0% Submitted works (Student Papers)

Integrity Flags

1 Integrity Flag for Review

Hidden Text
67 suspect characters on 3 pages
Text is altered to blend into the white background of the document.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.