"FUNCTIONAL OUTCOME IN ACL RECONSTRUCTION WITH PERONEUS LONGUS GRAFT: A HOSPITAL BASED PROSPECTIVE SUDY"

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LIST OF ABBREVATIONS

ACL	Anterior cruciate ligament
IKDC	International Knee Documentation Committee
FADI	Foot and Ankle Disability Index
AOFAS	American Orthopaedic Foot & Ankle Society
BPTB	Bone Patellar Tendon Bone
IKDC	International Knee Documentation Committee
FADI	Foot and Ankle Disability Index
AM	Anteromedial
PL	Posterolateral
PCL	Posterior Cruciate Ligament
MCL	Medial Collateral Ligament
LCL	Lateral Collateral Ligament

ABSTRACT

Background: - The anterior cruciate ligament (ACL) is a critical stabilizer of the knee joint, primarily restraining anterior tibial translation on the femur and preventing hyperextension. It also acts as a secondary stabilizer against rotational and varus/valgus stresses. Composed of anteromedial and posterolateral fiber bundles, the ACL originates from the anterior intercondylar tibial area and inserts into the posteromedial aspect of the lateral femoral condyle15. Injuries to the ACL, often caused by sudden pivoting movements or direct trauma during sports like football or basketball, frequently result in knee instability, meniscal damage, and early osteoarthritis.

Arthroscopic ACL reconstruction is strongly recommended for active patients, offering advantages such as smaller incisions, improved visualization of attachment sites, reduced postoperative pain, and faster rehabilitation. Clinical evaluations using the **International Knee Documentation Committee (IKDC)** and **Lysholm knee scoring scales** assess symptoms like pain, stiffness, and functional limitations, while the **Foot and Ankle Disability Index (FADI)** and **AOFAS hindfoot score** evaluate associated lower-extremity impacts. Studies emphasize the importance of restoring rotational stability through anatomic graft placement to replicate native ACL biomechanics.

Despite advancements, debates persist regarding optimal graft selection and surgical techniques. Further research is needed to establish evidence-based criteria for rehabilitation progression and long-term outcomes. ACL reconstruction remains vital for restoring pre-injury function, enabling activities like squatting and stair climbing, and mitigating secondary joint degeneration in active populations.

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INTRODUCTION

ACL injuries present a great clinical challenge and commonly occur in sports requiring sudden stops, pivoting, or changes in the direction of movement [1]. The ACL is one of the important stabilizers of the knee joint; it prevents the forward translation of the tibia with respect to the femur and also helps in the rotational control [2]. The insufficiency due to ACL damage may cause significant functional impairments, repeated instability, and further injury to the meniscus or cartilage, ultimately increasing the risk for early-stage osteoarthritis [3]. Surgical treatment to repair the ACL is often recommended for active patients who want to regain high-level involvement in physical activity and avoid degenerative progression [4].

Over the past few years, arthroscopic surgical techniques have significantly improved, offering smaller incisions, reduced postoperative pain, and faster rehabilitation [5]. Nonetheless, the best graft choice is still debatable because the graft is a critical factor in determining postoperative stability and success [6]. BPTB and hamstring tendon grafts are the most commonly used autografts. While BPTB grafts have an excellent record of bone-to-bone healing and a heap of good results, they can also cause problems at the donor site like anterior knee pain and, less commonly, patellar fractures [7]. Hamstring grafts tend to give superior cosmetic results and less irritation at the anterior knee, but harvesting the grafts does weaken hamstring function and increase graft stretching during early recovery [8]. Surgeons therefore continuously seek grafting options that are likely to circumvent such liabilities without compromising on mechanical integrity.

Recent interest has been generated in the use of the peroneus longus tendon as an autograft for ACL reconstruction because it provides adequate length, competitive tensile strength, and acceptable diameter [9]. Early reports suggest harvesting this tendon has a relatively low incidence of significant ankle dysfunction, largely because the peroneus brevis and other supportive structures can compensate for the partial loss of peroneus longus function [10]. It also sidesteps BPTB harvest-specific complications and preserves hamstring tendons, which could be an advantage for patients who strongly depend on hamstring strength or have small hamstring tendons [11]. However, only future long-term studies will be able to tell conclusively whether peroneus longus autografts are superior to conventional grafts for the majority of outcomes, including long-term stability rates and return to sport ratios [12].

ACL injuries occur from noncontact events, wherein the knee could twist or hyperextend during contact sports that demand quick changes of direction, for example, soccer or skiing [1].Risk factors can be classified as intrinsic and extrinsic. Intrinsic aspects include anatomical differences and muscle activation patterns, while extrinsic elements relate to the athletic environment, kind of footwear, and contact level in a particular sport [13]. Younger individuals who remain physically active have a heightened likelihood of experiencing an ACL tear. For this group, prompt intervention is essential to prevent instability and help maintain normal function in routine tasks and athletic pursuits.

Opting to reconstruct the ACL is not merely about relieving pain; neglecting a torn ACL may lead to additional meniscal and chondral damage, which can precipitate arthritic changes [14]. By re-establishing knee stability, patients are better protected against further harm, preserving overall joint health [15]. Decisions about which graft to use hinge on elements such as a patient's lifestyle, personal preferences, age, and anatomical traits. Allografts can be convenient but carry higher risks of immune response or slower tissue integration [16]. Consequently, autografts are commonly used to avoid those complications, though they require retrieving tissue from a donor site, with the attendant possibility of postoperative morbidity. The peroneus longus tendon may address some of these concerns, although ensuring no significant weakness or instability occurs at the ankle level is critical [10]. Accurate and cautious surgical technique is vital, as the lateral compartment of the leg houses vulnerable neurovascular structures [17]. Furthermore, the peroneus longus may not be sufficient for larger patients if the tendon diameter is too small [9].

Evaluating outcomes following ACL re-construction with peroneus longus auto-graft involves both subjective and objective metrics. Clinicians routinely perform the Lachman test and pivot shift test to assess mechanical stability [18]. Yet, patientreported assessments are equally crucial for understanding how the surgery influences day-to-day life. The International Knee Documentation Committee (IKDC) questionnaire measures variables like pain, stiffness, swelling, and giving-way symptoms, as well as the impact on sports and daily tasks [19]. Another frequently employed instrument, the Lysholm score, focuses on limitations such as difficulties in climbing stairs, squatting, and walking [20]. Because the donor site is located near the ankle, the Foot and Ankle Disability Index (FADI) and the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scoring system can provide valuable insight into any unforeseen deficits [21,22]. These methods can highlight even minor issues in ankle function or alignment that would not be captured by knee-specific assessments alone [23].

Preliminary investigations suggest that functional and stability outcomes using peroneus longus tendons can mirror those of traditional hamstring grafts in the short and medium term [12]. Reported ankle-related complications appear minimal when the graft is harvested properly [24]. Nevertheless, larger sample sizes and extended followup are needed to establish whether peroneus longus grafts truly measure up to conventional choices in durability, retear rates, and prevention of degenerative changes. Patient requirements must also be considered, given certain sports that rely heavily on lateral ankle stability could be more vulnerable to a partial loss of peroneal strength [25]. Future randomized studies or meta-analyses comparing different grafts— peroneus longus, hamstring, and BPTB—will be instrumental in precisely defining the advantages, disadvantages, and ideal indications for each [26,27].

As ACL reconstruction becomes more widespread, and as surgeons refine minimally invasive methods, it is crucial to continue building evidence on new graft options like the peroneus longus tendon. A carefully designed, hospital-based prospective study can yield reliable insights by employing uniform operative methods, standardized rehabilitation regimens, and thorough postoperative assessments at multiple time points. This design would allow clinicians to closely monitor patient progress using consistent outcome measures, and facilitate objective conclusions. Adopting validated scales such as IKDC, Lysholm, FADI, and AOFAS ensures a comprehensive capture of both knee and ankle function [21,22]. Collectively, these findings can guide rehabilitation milestones, refine surgical decisions, and inform patients about realistic postoperative expectations.

In summary, the ACL remains a crucial anatomical structure for knee stability, and its repair is one of the cornerstones of modern orthopedics in addressing instability and limiting joint damage. Although autografts such as BPTB and hamstring tendons remain the mainstays, their drawbacks, from anterior knee pain to reduced hamstring strength, have driven the search for graft alternatives. Interest has been shown for the peroneus longus tendon due to its favorable biomechanical properties and promising early clinical outcomes. Yet, proper long-term research studies are required to confirm whether these advantages of this tendon surpass those of the well-established procedures. A proper, in-hospital-based study, which targets the functional outcome following ACL reconstruction using a peroneus longus graft, would further help support its place. If robust evidence supports sustained knee stability, minimal ankle impairment, and strong return-to-sport rates, the peroneus longus tendon could become a valuable addition to the surgeon's array of graft choices.

ANATOMY ON FUNCTIONAL OUTCOME IN ACL ECONSTRUCTION WITH PERONEUS LONGUS GRAFT: A HOSPITAL BASED PROSPECTIVE STUDY

BONY FRAMEWORK OF THE KNEE

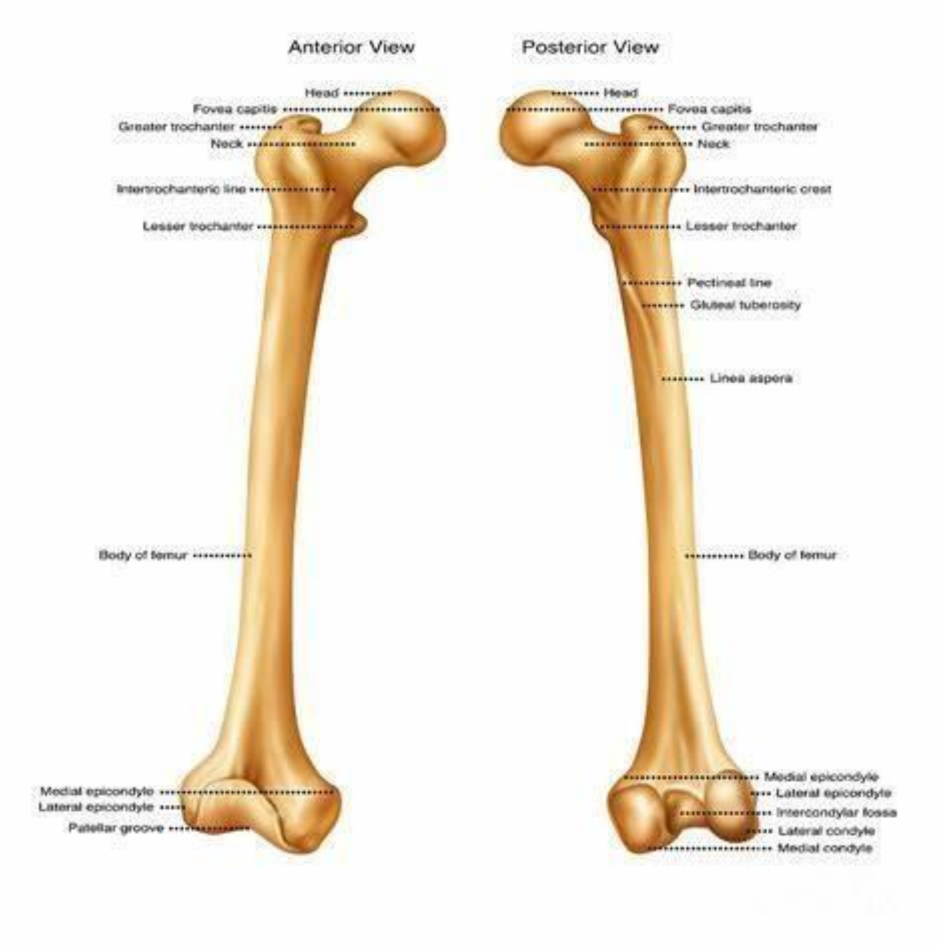
Distal Femur

The distal end of the femur widens into two curved condyles, one medial and one lateral, forming the primary articulating surfaces with the upper tibia. These condyles are separated posteriorly by the **intercondylar notch**, where the cruciate ligaments are anchored.

- **Medial femoral condyle**: Generally taller in the anteroposterior direction and slightly more curved.
- **Lateral femoral condyle**: Typically broader mediolaterally yet shorter in length from front to back.

Between these condyles lies the **femoral trochlea**, a groove where the patella engages during knee flexion and extension.

Figure 1: Anterior view of the distal femur

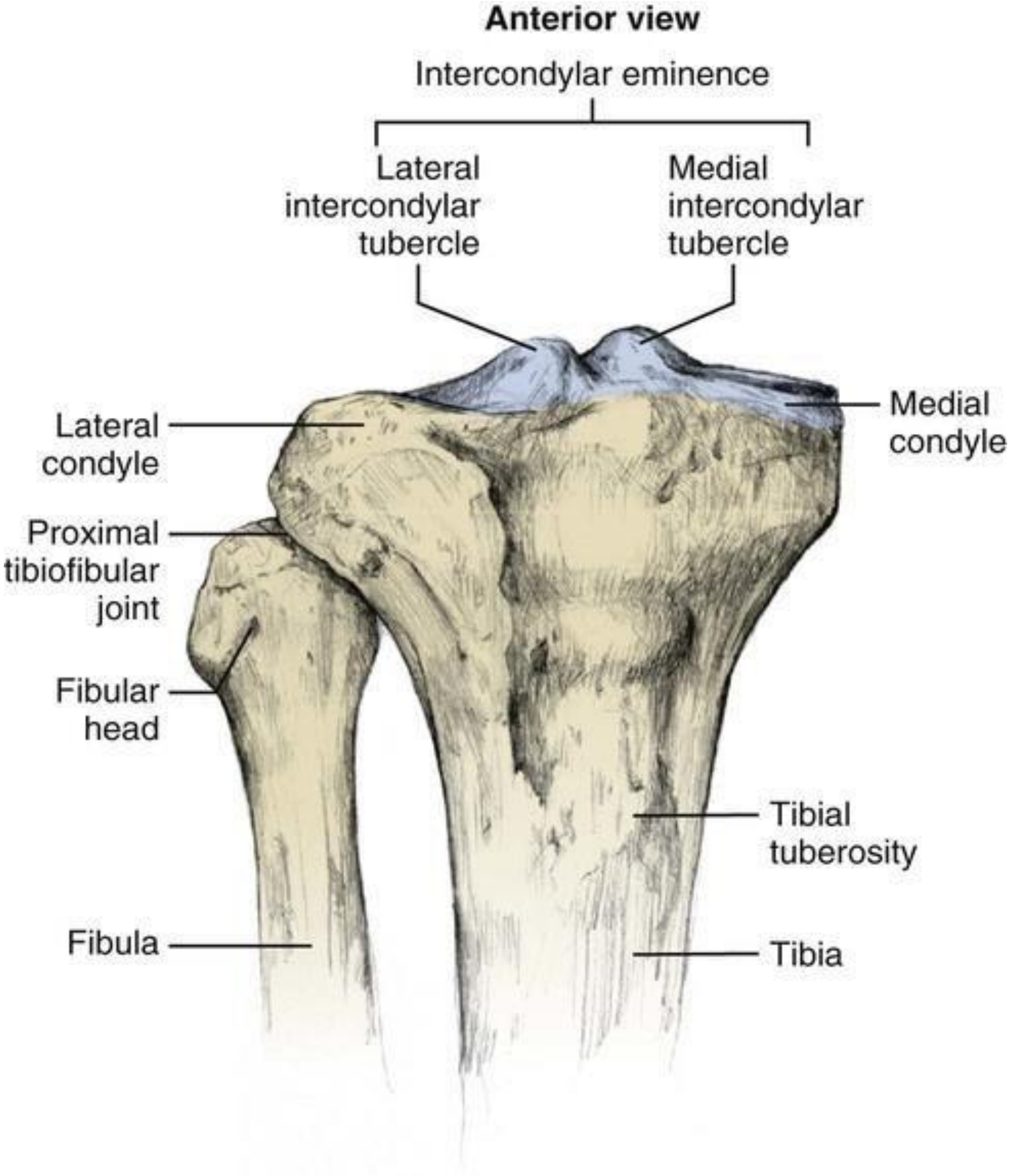


Proximal Tibia

The upper portion of the tibia includes two flat surfaces called the **medial** and **lateral tibial plateaus**. In the center of these plateaus stands the **intercondylar eminence**, composed of medial and lateral tibial spines. Cruciate ligaments and menisci attach in this region.

- **Medial tibial plateau**: Usually larger and slightly concave.
- **Lateral tibial plateau**: Somewhat more convex and smaller.
- **Tibial tuberosity**: Positioned on the anterior surface, offering a site for patellar tendon attachment.

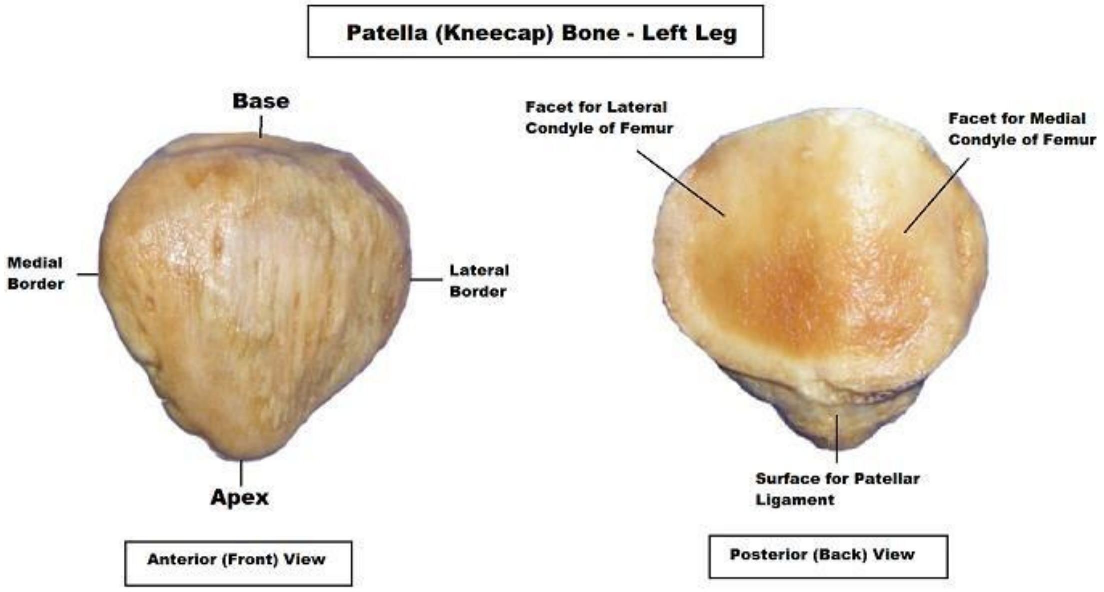
Figure 2: Proximal tibia with tibial plateau and intercondylar eminence



Patella

The patella is a sesamoid bone nested within the quadriceps tendon. It articulates with the femoral trochlea and improves the mechanical leverage of the quadriceps, contributing significantly to knee extension. By altering the angle of pull, it lowers friction and protects the front of the knee joint.

Figure 3: Anterior view of the patella



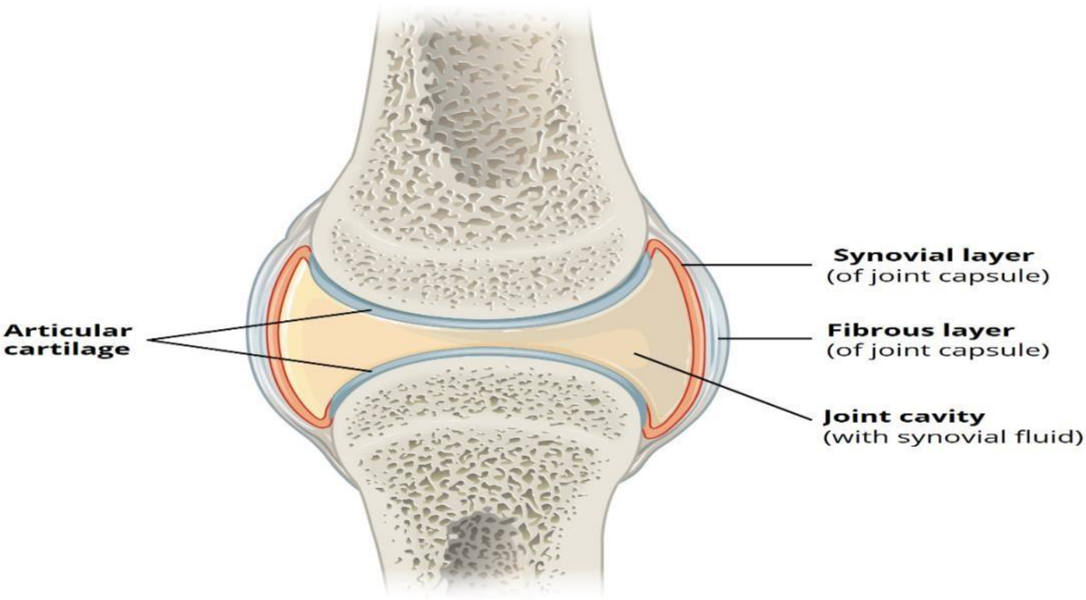
JOINT CAPSULE AND SYNOVIAL MEMBRANE

A fibrous **joint capsule** completely encases the knee. Its interior surface is lined by a **synovial membrane**, which produces a lubricating fluid vital for proper joint health.

- **Anterior capsule**: Relatively thin and reinforced by expansions from both the quadriceps tendon (above) and the patellar tendon (below).
- **Posterior capsule**: Strengthened by the oblique popliteal ligament, derived partly from the semimembranosus tendon, and the arcuate popliteal ligament.

The **synovial cavity** features multiple recesses and bursae, reducing friction around the joint. In particular, bursae located near tendons minimize wear during knee movement.

Figure 4: Lateral section of the knee joint capsule and synovial folds



MENISCI

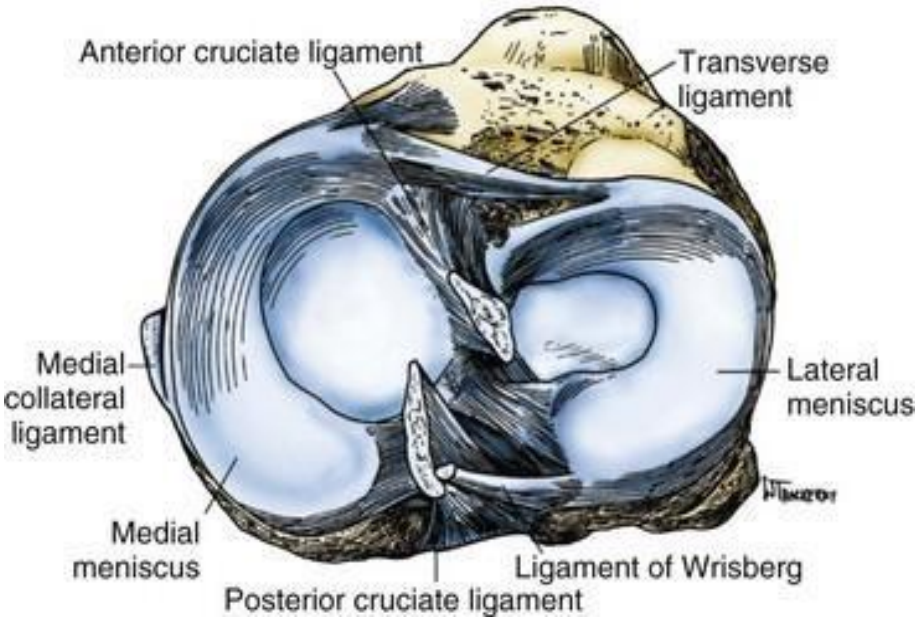
Menisci are fibrocartilaginous wedges positioned on the tibial plateau to enhance joint stability, dissipate loads, and aid in shock absorption. They also have a role in knee proprioception.

- **Medial meniscus**: C-shaped, broader in the back portion, and strongly attached to the medial collateral ligament and the joint capsule. This tight connection frequently predisposes it to injury.

- **Lateral meniscus**: More circular (O-shaped) and relatively more mobile. Although it can sustain isolated damage, it is often torn along with the ACL.

Each meniscus has anterior and posterior horns, which secure it to the tibial plateau. The posterior horn endures increased stress during knee flexion, frequently correlating with certain tear patterns.

Figure 5: Top view of the tibial plateau illustrating medial and lateral menisci



CRUCIATE LIGAMENTS

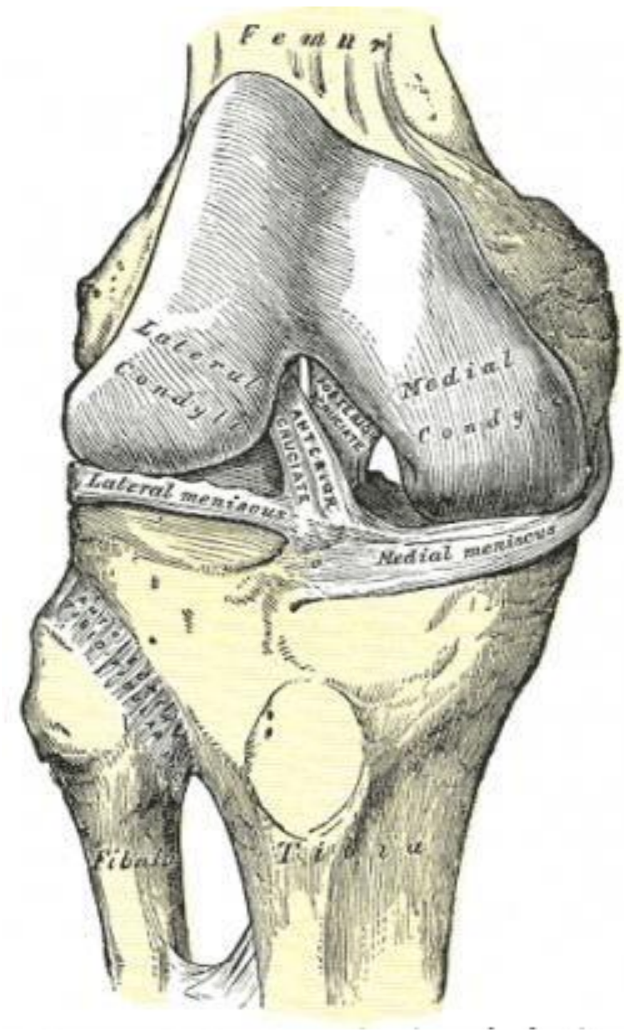
Anterior Cruciate Ligament (ACL)

The ACL's primary tasks include preventing the tibia from slipping too far forward relative to the femur and limiting excessive rotation during pivoting activities. The ACL is typically described by its two main fiber bundles:

- **Femoral origin**: Located on the posteromedial surface of the lateral femoral condyle within the intercondylar notch.
- **Tibial insertion**: Anchors on the anteromedial aspect of the intercondylar area, in front of the tibial spines.
- **Anteromedial (AM) bundle**: Tends to tighten during flexion.
- **Posterolateral (PL) bundle**: More taut in knee extension.

Blood supply to the ACL is primarily through small branches of the middle genicular artery, which limits its healing capacity when torn.

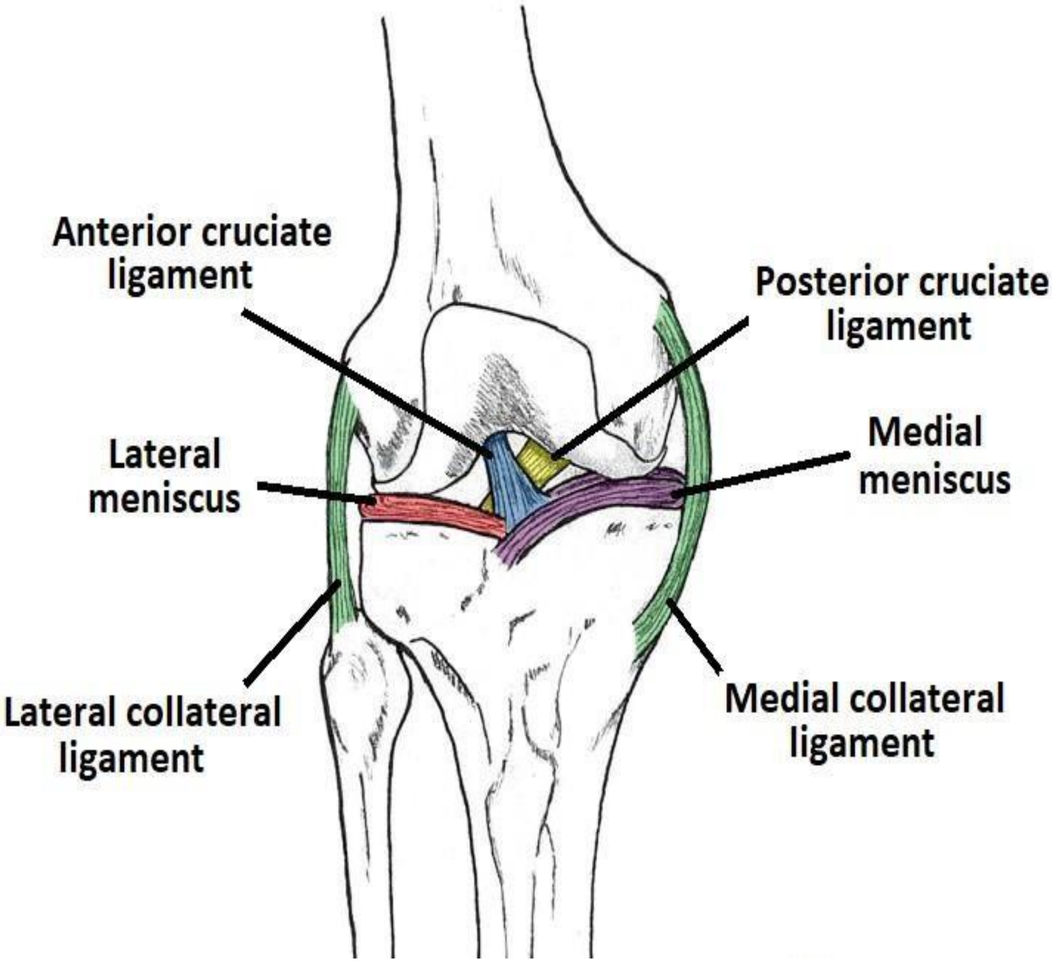
Figure 6: Anterior cruciate ligament demonstrating anteromedial and posterolateral bundles



Posterior Cruciate Ligament (PCL)

Though not the chief focus in ACL reconstruction, the PCL stabilizes the tibia against excessive backward movement. It originates from the anterolateral aspect of the medial femoral condyle and inserts on the posterior intercondylar region of the tibia.

Figure 7: Posterior cruciate ligament in situ



COLLATERAL LIGAMENTS

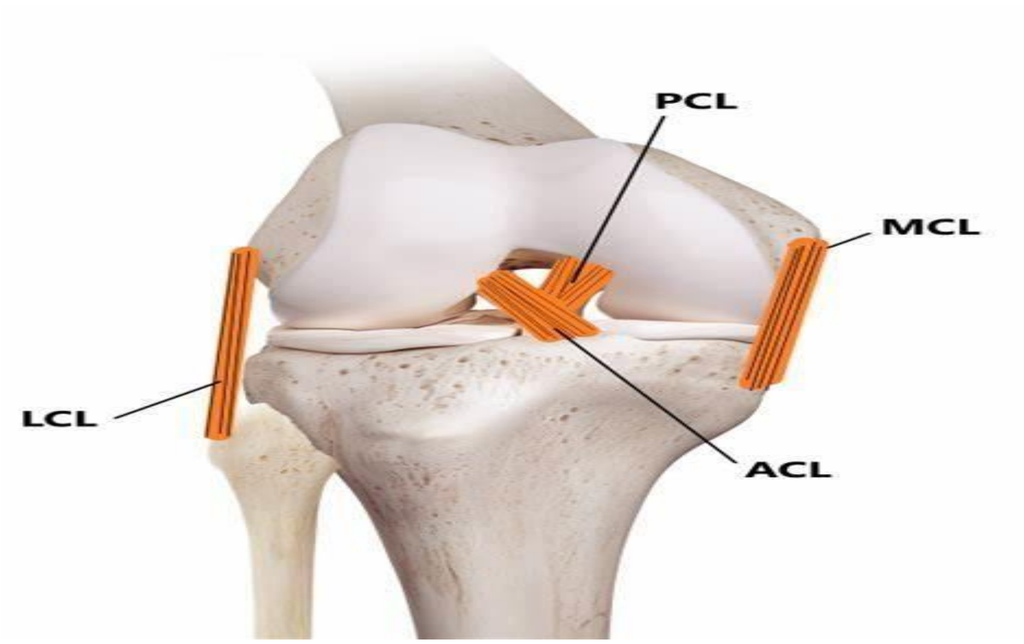
Medial Collateral Ligament (MCL)

Situated along the inside aspect of the knee, the MCL endures valgus stress. It includes a superficial band and a deeper segment that merges with the joint capsule and the medial meniscus. Because of this connection, an MCL tear sometimes occurs in conjunction with a meniscal injury.

Lateral Collateral Ligament (LCL)

Also termed the fibular collateral ligament, this cordlike ligament runs from the lateral epicondyle of the femur to the head of the fibula. Its main function is to counteract varus stress (i.e., forces pushing the knee medially). The LCL remains separate from the lateral meniscus.

Figure 8: Medial (MCL) and Lateral (LCL) collateral ligaments



<u>NEUROVASCULAR STRUCTURES AT THE KNEE</u>

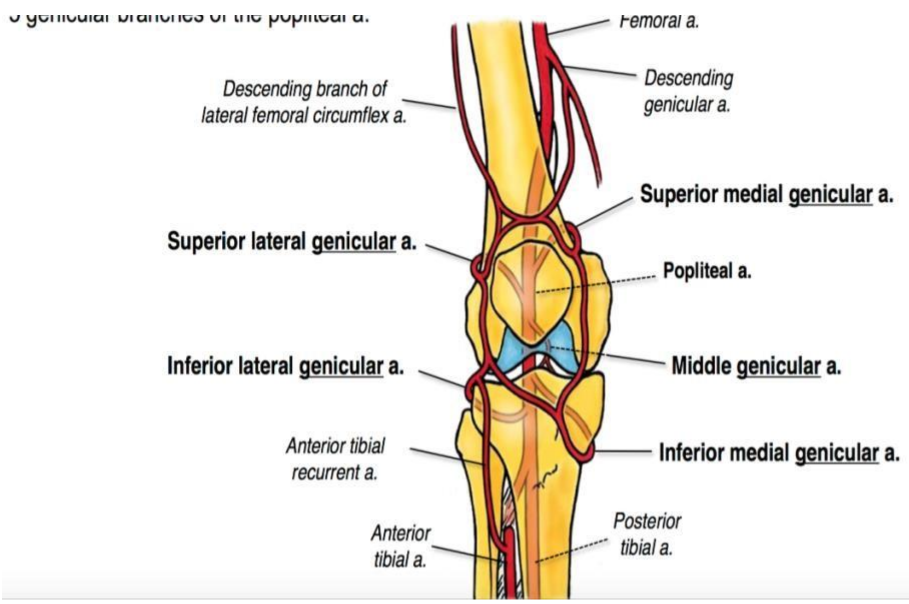
Thorough knowledge of neurovascular structures is essential to minimize damage during knee surgery, including ACL repair or reconstruction.

- **Popliteal artery and vein**: Travel through the popliteal fossa, dividing into genicular branches that supply surrounding tissues. Any surgical approach to the posterior knee must consider these vessels.

- **Tibial nerve**: A branch of the sciatic nerve located in the posterior compartment, giving motor innervation to calf muscles and sensory innervation to the foot's plantar surface.

- **Common peroneal (fibular) nerve**: Wraps around the head of the fibula on the lateral aspect. It innervates muscles in the anterior and lateral compartments of the leg. Special attention is required during peroneus longus harvesting to avoid inadvertently injuring this nerve.

Figure 9: Neurovascular bundle in the popliteal region

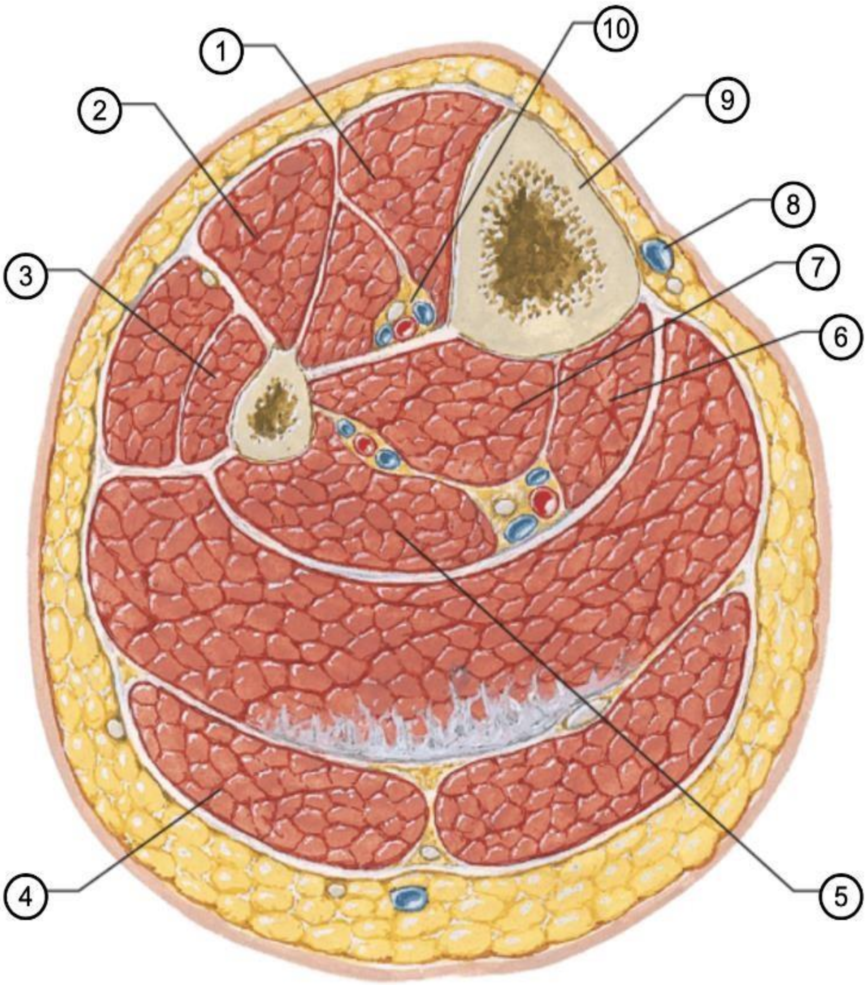


<u>**PERONEUS LONGUS MUSCLE AND TENDON**</u>

Leg Compartments

The lower leg is divided into four fascial compartments: anterior, lateral, deep posterior, and superficial posterior. The **lateral compartment** contains the peroneus longus and peroneus brevis muscles, primarily responsible for everting the foot.

Figure 10: Cross-sectional anatomy of the leg showing the compartments

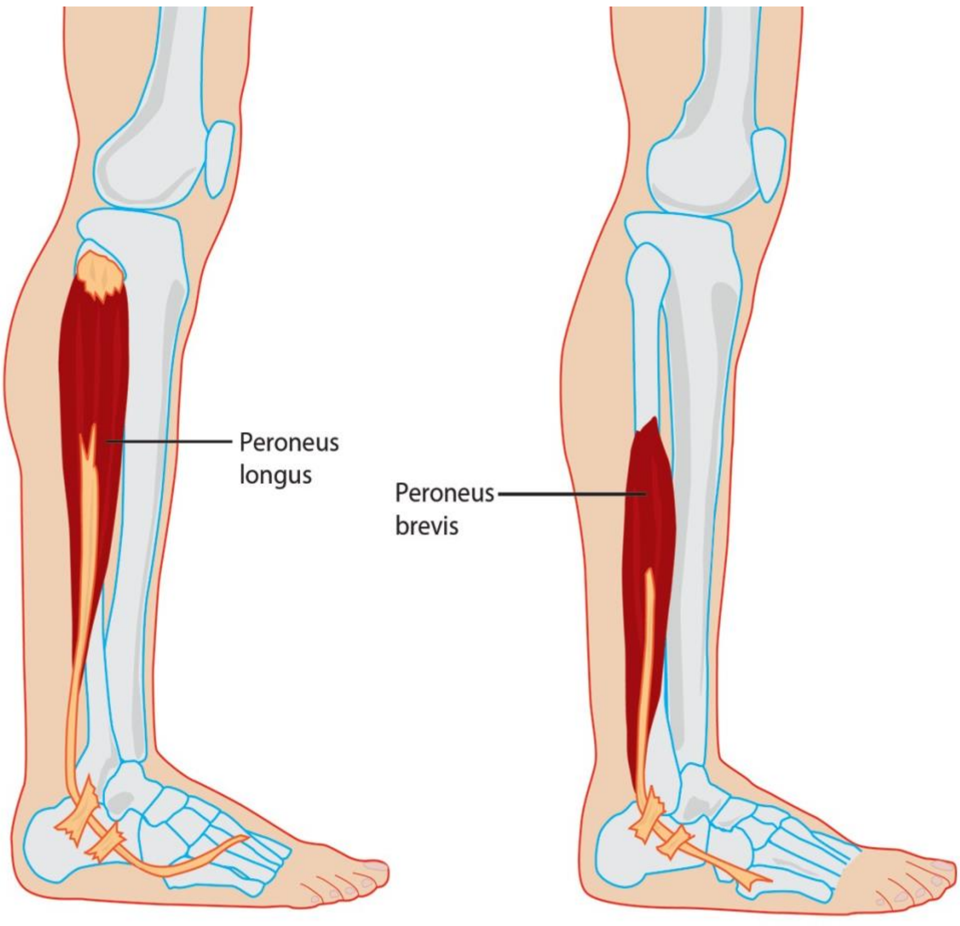


Peroneus Longus Muscle

- **Origin**: Arises from the head and upper two-thirds of the outer (lateral) surface of the fibula and from the adjacent intermuscular septa.
- **Path**: Descends along the lateral side of the leg, transforms into a tendon behind the lateral malleolus, and travels through a groove in the cuboid bone under the foot.

- **Insertion**: Attaches onto the base of the first metatarsal and the medial cuneiform, thereby aiding in stabilizing the arch of the foot.
- **Innervation**: Supplied by the superficial peroneal (fibular) nerve, which generally arises from nerve roots L5, S1, and S2.
- **Blood Supply**: Fibular (peroneal) artery branches nourish the muscle-tendon unit.
- **Function**: Main everter of the foot and helps in slight plantarflexion, while also helping support the transverse arch of the foot.

Figure 11: Lateral view of the lower leg depicting the peroneus longus muscle

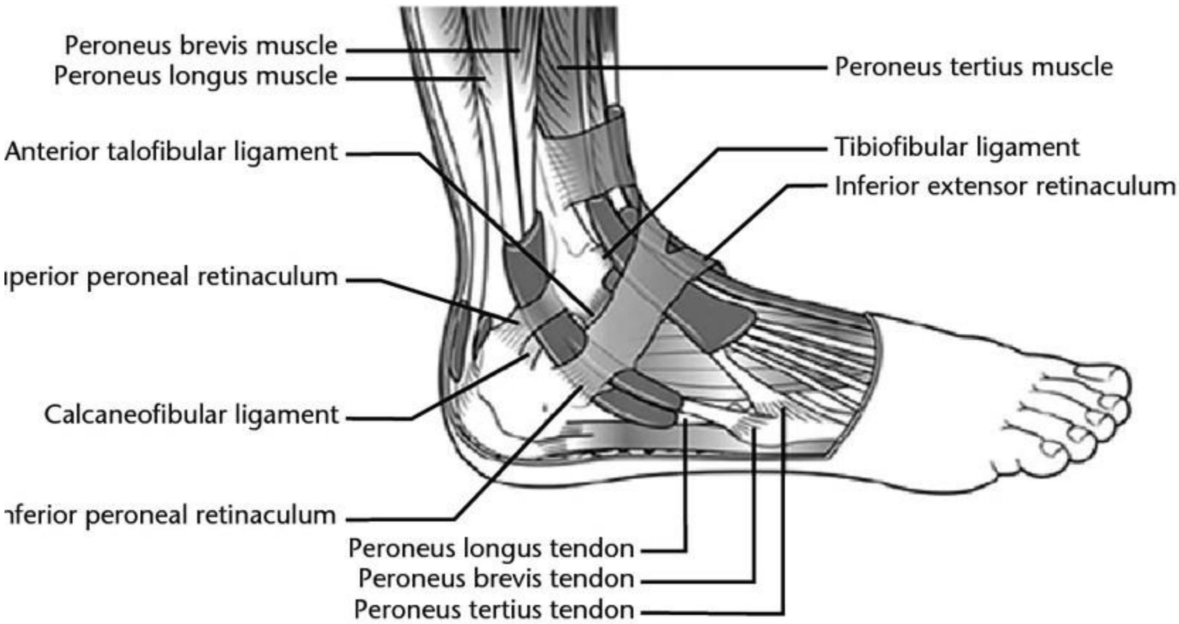


Tendon Characteristics and Mechanical Strength

The peroneus longus tendon exhibits considerable length and thickness, making it an appealing choice for reconstructive procedures such as ACL surgeries.

1. **Dimension**: Its robust width and length often match or surpass standard hamstring autografts.
2. **Tensile Strength**: Studies show it can offer biomechanical properties akin to those of the semitendinosus and gracilis tendons.
3. **Role in Foot Dynamics**: As it influences eversion, partial or total harvesting should be done cautiously to reduce the risk of compromised foot stability.

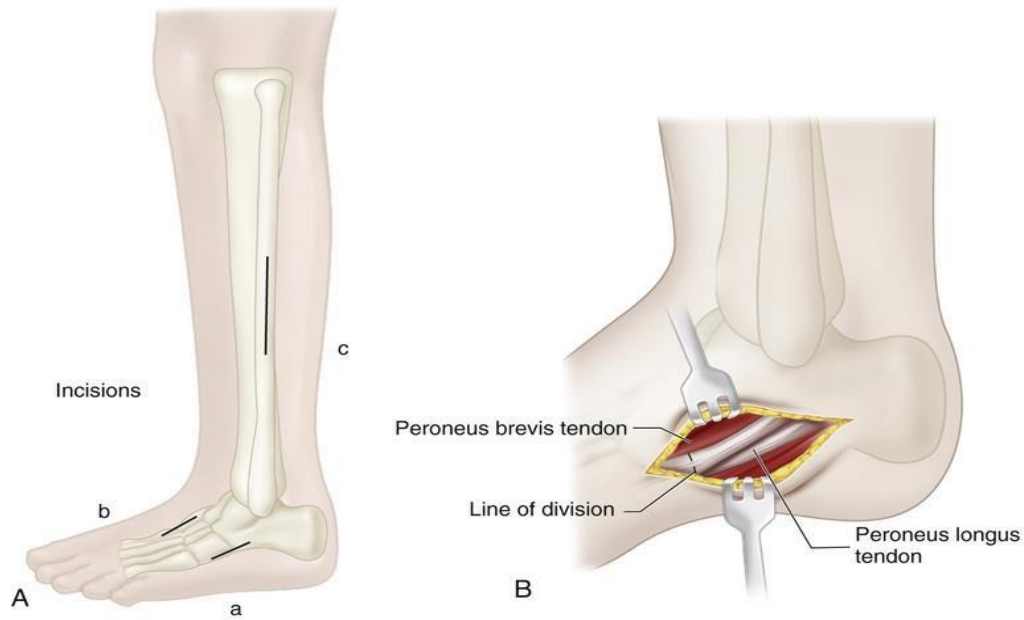
Figure 12: Demonstration of peroneus longus tendon path around the lateral malleolus and under the foot



Surgical Harvest Considerations

- **Incision Location**: A small incision is commonly made near the lateral aspect of the foot or distal to the lateral malleolus, ensuring superficial peroneal nerve branches remain intact.
- **Harvest Procedure**: The tendon can be freed and extracted using a tendon stripper, preserving adequate distal fibers to maintain some function alongside the peroneus brevis.
- **Possible Donor Site Effects**: While potential changes in foot eversion and arch support are possible, they are generally minimal, particularly when the patient undergoes structured rehabilitation.

Figure 13: Surgical approach to harvesting the peroneus longus tendon



BIOMECHANICAL RATIONALE FOR USING PERONEUS LONGUS AS A GRAFT

Essential Requirements of an ACL Graft

Ideal tendon grafts for ACL reconstruction must provide:

1. Adequate diameter (commonly 8 mm or more is desired).
2. Enough length for multi-strand graft configurations.
3. High tensile strength to handle physiological stresses.
4. Low donor site morbidity.

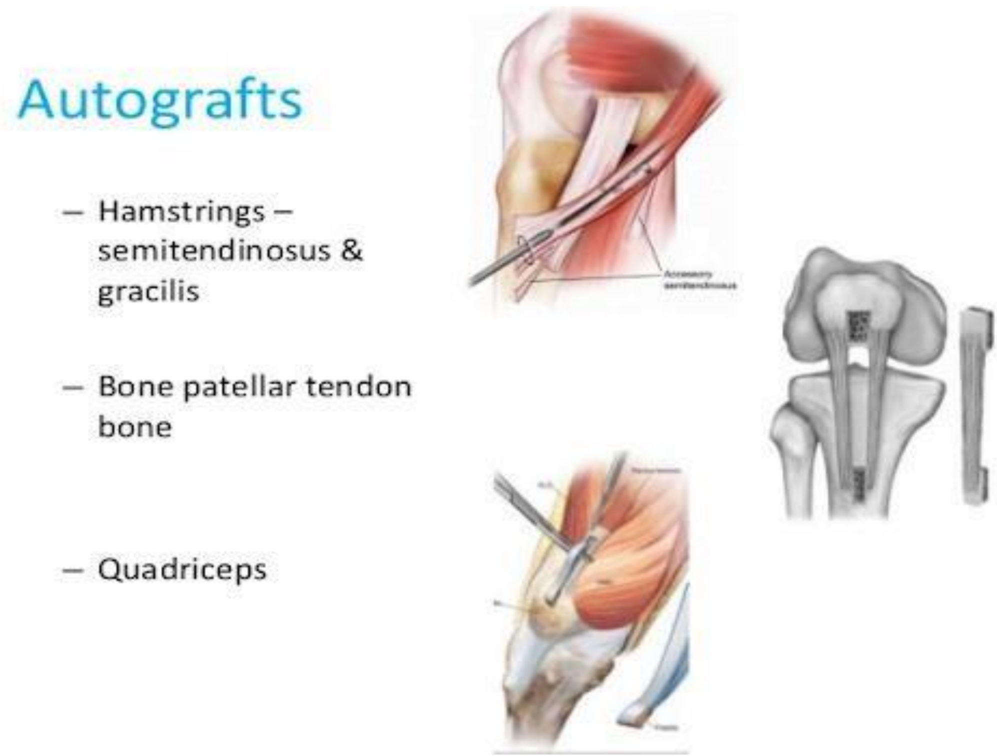
The peroneus longus meets many of these criteria, especially in cases where the surgeon aims to conserve the hamstring tendons or in revision scenarios when prior grafts have already been harvested.

Comparison with Traditional Grafts

Conventional ACL graft options, such as the bone-patellar tendon-bone (BPTB) graft and semitendinosus-gracilis autografts, have a long track record. However, the peroneus longus graft:

- **Rivals hamstring tendons** in tensile strength.
- **May reduce anterior knee pain** compared to BPTB grafts (since it avoids patellar tendon harvesting).
- **Is sufficiently long** to form four or more strands, fulfilling the length requirement for ACL reconstruction.

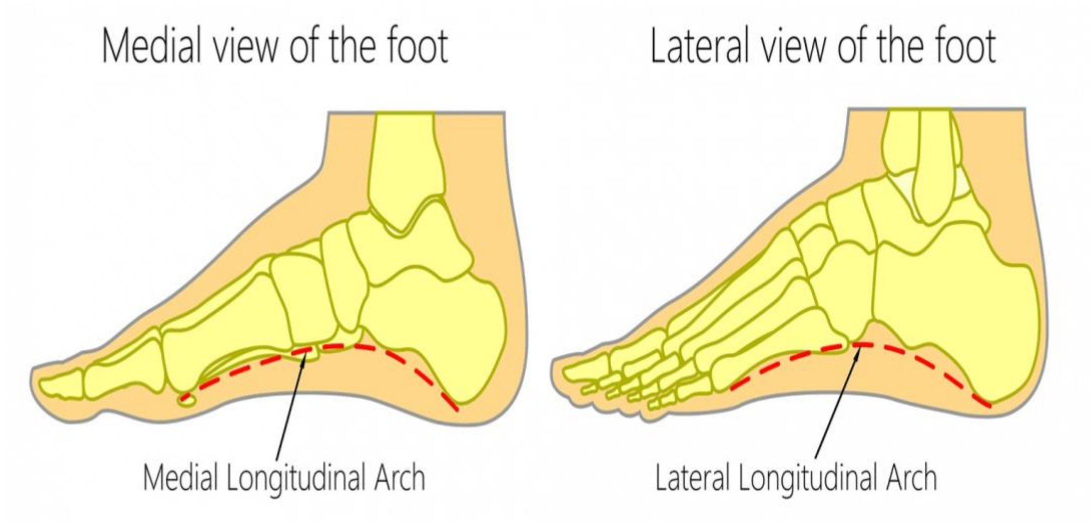
Figure 14: Comparative illustration of common ACL autografts: BPTB, hamstrings, and peroneus longus



Influences on Foot and Ankle Function

While there have been concerns about altered lateral ankle stability after removing the peroneus longus, many clinical reports indicate negligible deficits with well-planned harvesting and proper physiotherapy. Targeted ankle exercises and foot strengthening protocols are key to minimizing any loss in eversion strength.

Figure 15: Illustration of foot arches and peroneus longus role in supporting lateral and transverse arches



KEY OBSERVATIONS

1. **Knee Complexity**: Stability arises from the ligaments (cruciate and collateral), menisci, capsule, and muscle-tendon systems.

2. **ACL Role**: The ACL limits excessive forward shifting of the tibia and plays a role in rotational control.

3. **Peroneus Longus Viability**: Offers sufficient tendon length, robust diameter, and similar strength to commonly used grafts, making it a favorable alternative in specific clinical scenarios.

4. **Neurovascular Vigilance**: Special care must be taken to protect the peroneal nerve during tendon harvesting and to avoid injury to arteries around the popliteal region.

5. **Meniscal and Collateral Significance**: Although not directly harvested, their integrity is vital for optimal knee function.

6. **Holistic Rehabilitation**: Rehabilitation plans should address both knee mobility and potential changes in ankle or foot mechanics following graft harvesting.

CONCLUDING REMARKS

A thorough understanding of knee joint anatomy—covering bony structures, menisci, ligaments, and the joint capsule—forms the bedrock of effective ACL reconstruction. Equally important is an awareness of the peroneus longus tendon's detailed anatomy and physiology, given its utility as an alternative autograft. By recognizing the biomechanical implications, potential harvest techniques, and rehabilitation strategies, surgeons can optimize patient outcomes. Evidence suggests that peroneus longus grafts can reliably restore knee function while introducing minimal deficits at the donor site, particularly when the procedure and postoperative therapy are carefully managed.

AIMS AND OBJECTIVES

AIM

To assess the clinical outcomes of patients undergoing anterior cruciate ligament (ACL) reconstruction.

OBJECTIVES

- To investigate preoperative and postoperative clinical evaluations in patients with ACL injuries.
- To evaluate postoperative knee stability following ACL reconstruction.
- To analyse subjective knee function and ankle function, focusing on patientreported outcomes.

REVIEW OF LITERATURE

28. Cirstoiu et al. (2011): Cirstoiu and colleagues (2011) evaluated the clinical and functional benefits of using semitendinosus-gracilis (ST-G) tendon autografts in arthroscopic ACL reconstruction to restore knee stability. They observed 48 individuals (average age around 29 years) who underwent reconstruction from 2008 to 2010. Before surgery, the mean Lysholm knee score was 58.2±5.6, reflecting considerable knee dysfunction. Postoperatively, at the 12-month mark, this score significantly climbed to 92.4±4.3 ($p<0.001$), indicating marked functional improvement. The Tegner activity scale, initially averaging 3.1±1.0, increased to 6.2±1.3 ($p<0.01$), suggesting that patients could return to more intense sports or physical activities. The objective stability test further validated this: the Lachman test that was uniformly positive before surgery became positive in only 8% postoperative, and pivot shift test was negative in as much as 90% of patients by follow-up. Their study further noted very minor complication at the donor site since only 2% experienced persistent problems in the area where the tendons were harvested. The authors contributed these excellent results to accurate surgical technique, perfect positioning of the graft, and proper rehabilitation. In conclusion, the study endorses ST-G autografts as a viable and reliable option for ACL reconstruction, providing a sound balance of mechanical strength and low morbidity. These outcomes show arthroscopic reconstruction with ST-G to significantly enhance knee stability and function, thus offering high patient satisfaction and a reliable path to returning to desired physical activities. [28]

29. Angthong et al. (2015): Angthong et al. (2015) investigated the feasibility of utilizing the peroneus longus (PL) tendon as a graft in ACL reconstruction, emphasizing donor ankle morbidity. They enrolled 32 patients, each followed for 24 months after surgery. Laboratory biomechanical tests showed that PL tissue possesses a tensile strength comparable to the native ACL, and harvesting it did not significantly compromise lateral ankle stability. Knee stability was assessed through clinical tests such as Lachman and pivot-shift, and both are negative in 90% of patients postoperatively and indicate good graft integrity. With AOFAS scoring, a minimal decline as the scores rose from 82.0±6.0 preoperative stages to 88.5±5.2 indicates acceptable ankle functions following tendon extraction. Only a minor subgroup of 2 out of 32 participants reported mild lateral ankle discomfort or weakness during the initial six months with complete resolution at follow-up. No significant deficits were found in gait or foot stability. Based on these findings, the authors propose that the PL tendon can serve as a robust autograft for ACL reconstruction, offering substantial biomechanical support for the knee and only a minimal risk of ankle-related morbidity. This alternative approach could be particularly valuable for individuals who require their hamstrings to remain intact or when the hamstring tendon diameter is insufficient. [29]

30. Varshney et al. (2016): In Chapter 34 of "Essential Orthopedics (Principles and Practice)," Varshney (2016) presents a comprehensive discussion on ACL reconstruction strategies, emphasizing graft choices and postoperative considerations. Although not a standalone clinical study, the chapter synthesizes findings from existing research. It highlights how bone-patellar tendon-bone (BPTB) grafts reach an approximate ultimate load of 2977 N, while hamstring tendons can range between roughly 2420 and 4000 N. These values underscore the biomechanical adequacy of both graft types. Varshney references success rates of 85–95% for restoring function when surgical technique and postoperative rehabilitation are appropriately managed. Additionally, the author touches on newer grafting techniques, including the use of the peroneus longus (PL) tendon, which has emerged as a reliable solution for cases where hamstring grafts are insufficient or where their harvest may cause undesired weakness. Varshney notes that, although PL extraction could induce occasional ankle instability or neuropathic symptoms, evidence suggests that such complications occur in a relatively small percentage of cases. The chapter consistently underlines the importance of a tailored approach, taking into account each patient's level of sports engagement, baseline anatomy, and occupational demands. Surgical precision—particularly in tunnel placement and graft fixation—is also stressed as a determinant of successful ligamentous restoration and patient satisfaction. Consequently, the chapter advocates for thoughtful graft selection, balanced against each individual's unique clinical scenario. [30]

31. John et al. (2016): John et al. (2016) performed an observational study focusing on sports-related knee injuries in northern India, assessing 226 athletes (mean age around 23.4 years) over a two-year period. The authors found that ACL ruptures constituted the largest portion—54% (n=122)—of serious knee injuries. A majority of these injuries arose from non-contact mechanisms, typically encountered in high-intensity pivoting activities such as soccer and basketball. Baseline Lysholm scores hovered around 45±8.2, reflecting poor knee function. Surgical reconstruction was performed in many ACL-deficient athletes, with significant improvements recorded at six months; specifically, over 80% achieved Lysholm scores exceeding 85. Interestingly, 60% of patients delayed seeking professional care for more than four weeks post-injury, suggesting that late intervention might compound the extent of ligamentous damage or secondary intra-articular pathology. The authors emphasize the critical nature of timely management—including prompt diagnosis, surgical planning, and structured rehabilitation programs—to enhance patient outcomes and minimize progressive joint deterioration. This study underscores the need for educational outreach in sports communities, highlighting aspects of injury prevention, early detection, and specialized care to accelerate return-to-sport. Overall, John et al. articulate the local epidemiological factors shaping knee injuries in athletes, contributing valuable insights for clinicians and sports science professionals working in similar settings. [31]

32. Samuelsen et al. (2017): Samuelsen and colleagues (2017) conducted a large-scale meta-analysis comparing hamstring tendon (HT) autografts and bone-patellar tendonbone (BPTB) autografts with respect to graft failure rates after ACL reconstruction. Their synthesis included data from 47,613 individuals, rendering it one of the most substantial analyses in this area. The pooled outcome revealed a slight but statistically significant difference in overall failure rates: around 4.2% for HT and 3.5% for BPTB

($p<0.05$). This aside, both graft types had achieved uniformly high success rates. Analysis also revealed a higher incidence of anterior knee pain in the BPTB group, at nearly 29% compared to about 18% in HT recipients, which would support prior observations regarding higher donor-site morbidity with patellar harvesting. On the other hand, the HT group reported occasional weakness in hamstring muscle strength that might affect sprinting or agility-based tasks. However, the return-to-sport time was similar for both groups. The authors concluded that graft choice must be patient-specific with consideration of the patient's pain tolerance, activity level, and surgeon experience. They identified BPTB as slightly stronger in graft failure prevention but were limited by a higher incidence of anterior knee pain. Therefore, hamstring grafting will be preferred in patients looking to minimize patellofemoral pain. [32]

33. Rhatomy et al. (2019): Rhatomy et al. (2019) compared the results of single-bundle ACL reconstruction using peroneus longus (PL) tendon autografts with those using hamstring tendon (HT) autografts. A total of 52 patients were divided equally between the two graft techniques, and their progress was monitored over two years. Clinical measures, like Lysholm and IKDC subjective scores, indicated that the two groups progressed almost symmetrically: IKDC mean in PL group increased from about 48 to nearly 89, but HT group scored similarly high with an analogous rise ($p=0.76$). Lysholm scores also reached values over 90 in both sets, suggesting similarly successful functional restoration. The KT-1000 arthrometer measured objective laxity after the procedure for both grafts: effective anterior translation reduction for both. However, donor-site complications were slightly lower in the PL group at 8% while it was 15% for the HT group, though the difference was not statistically significant. The integrity of the ankle was preserved in almost all PL harvest cases, without clinically relevant deficits in gait or ankle stability as shown by functional and clinical evaluation. The authors proposed that the PL graft might be a reliable alternative to hamstring harvesting, especially for patients who require hamstring preservation or present with insufficient hamstring diameter. Their results contribute to expanding literature on the viability of PL as a suitable graft choice, balancing strong mechanical properties with limited morbidity. [33]

34. Setyawan et al. (2019): Setyawan et al. (2019) have reported the viability of using peroneus longus (PL) tendon in posterior cruciate ligament reconstruction. Their case series consisted of 14 patients followed up to two years post single-bundle PCL reconstruction. The average preoperative Lysholm knee score of 52.0 ± 7.5 shows significant knee instability. The mean Lysholm score improved to 88.3 ± 5.2 at final follow-up ($p<0.001$). Clinical assessment of posterior knee laxity showed a significant decrease in PCL-grade deficits, from Grades 2 or 3 in 86% of patients preoperatively to Grades 0 or 1 in 78% of cases at two years. Donor-site complications were minimal, with just one patient (7%) reporting mild foot numbness, which resolved spontaneously within six months. Strength measurements indicated that ankle function remained largely preserved; isokinetic testing showed eversion and plantarflexion capacities at about 85% of the contralateral side. The authors concluded that PL can serve as a robust and safe autograft for PCL reconstruction, offering reliable joint stabilization and negligible ankle disturbances. They recommended further comparative analyses to weigh PL against commonly used grafts like hamstrings, but their case series already supports PL's promise for addressing complex knee ligament injuries. [34]

35. Kumar et al. (2020): Kumar et al. (2020) assessed short-term results of singlebundle ACL reconstruction employing the peroneus longus (PL) tendon. They followed 28 patients (mean age mid-20s) for one-year post-surgery. Knee function was rated via the Lysholm score, which rose from a baseline of 55.6±6.1 to 89.8±4.2 at 12 months ($p<0.001$). The Tegner activity score also improved significantly, moving from approximately 3.2±0.9 to 5.8±1.2 ($p<0.05$), suggesting that many participants regained moderate-to-intense physical routines. KT-1000 arthrometry revealed a marked decrease in anterior translation, from 5.1±1.3 mm preoperatively to 1.6±0.7 mm at follow-up, affirming restored knee stability. Complications linked to harvesting were sparse; only one patient (3.6%) described transient lateral foot numbness, which subsided within six months. Ankle function tests, including single-leg hops, indicated no substantial deficits in strength or proprioception on the operated side compared to the healthy contralateral limb. With these encouraging findings, the authors proposed that PL autografts might be a credible alternative to hamstring grafts, particularly beneficial for individuals who wish to avoid hamstring morbidity or have insufficient hamstring tendon volume. They called for studies with lengthier observation periods to validate these promising preliminary results. [35]

36. He et al. (2021): He et al. (2021) performed a systematic review and meta-analysis to compare outcomes of ACL reconstruction using peroneus longus (PL) versus hamstring tendons (HT). Drawing upon 12 studies involving 512 patients, the authors pooled data to examine function, stability, and donor-site morbidity. Postoperative Lysholm scores were nearly identical between PL (around 90.1) and HT (about 91.3), with no statistical significance ($p=0.34$). Similarly, IKDC subjective scores hovered near 88.7 for PL and 89.2 for HT. Graft failure rates were low and comparable (PL: 3.1% vs. HT: 2.9%). Although some clinicians express concern about ankle stability after PL harvesting, this review found that only about 2.4% of patients reported mild, transient ankle-related issues. Objective laxity, assessed using KT-1000 arthrometry, showed side-to-side differences of roughly 1.7–1.8 mm in both groups. Conclusively, the meta-analysis indicates that PL grafts afford functional and mechanical outcomes on par with conventional HT grafts, while posing limited donor-site complications. The authors suggest PL as a viable choice for patients needing hamstring conservation or exhibiting inadequate hamstring diameter, though they encourage larger, long-term trials to substantiate these findings. [36]

37. Joshi et al. (2021): Joshi et al. (2021) reported on ACL reconstruction with peroneus longus (PL) autografts specifically for nonathletic individuals. They followed 36 patients (mean age early 30s) for approximately 18 months. Baseline Lysholm scores hovered around 58.2±7.1, signifying compromised knee function. By the final check, scores had risen substantially to 90.5±5.3 ($p<0.001$). The Tegner scale, initially at about 2.8±0.8, advanced to 4.5±1.0, suitable for day-to-day activities though not necessarily high-level sports. KT-1000 measurements confirmed a reduction in anterior translation from 4.9±1.2 mm to 1.8±0.6 mm, implying robust stabilization. Donor-site issues were minor, with only 2 of 36 participants (5.6%) experiencing mild foot paresthesia that resolved within six months. The study also showed that stress tests of the ankle remained normal in all patients, signifying preserved ankle biomechanics. Overall, Joshi and colleagues concluded that PL autografts can provide a safe and effective surgical option for patients who require functional knee stability but do not routinely engage in strenuous athletic endeavors. They particularly emphasize that this choice might avoid potential hamstring weakness, thereby preserving essential muscle function for everyday mobility. [37]

38. Sahu et al. (2021): Sahu et al. (2021) led a prospective cohort investigation aimed at determining how harvesting the peroneus longus (PL) tendon for ACL reconstruction might affect ankle function. Forty patients were enrolled, and each underwent ankle and knee evaluations at baseline and at 6- and 12-month milestones. The AOFAS anklehindfoot score was within normal limits both before and after surgery, at approximately 93±5.2 versus 92.4±4.1, a nonsignificant difference ($p=0.74$). Isokinetic measurements of the eversion and plantarflexion strengths of the ankle were in the neighborhood of 87% and 91%, respectively, compared to the contralateral limb. Just 2 (5%) complained of fleeting soreness of the lateral foot which resolved spontaneously within six months. In terms of function of the knee, Lysholm score increased from 56.3±5.7 preoperatively to 89.6±4.8 at final follow-up ($p<0.001$). Moreover, there was no major complication in terms of infection or graft rupture. The authors concluded that the risk to ankle stability and function is minimal in PL harvesting. They further noted that a comprehensive rehabilitation that may include specific exercises for strengthening of ankles plays an important role for recovery. Their findings underscore the burgeoning perception that PL is a low-morbidity autograft selection that can effectively restore knee stability without significant donor-site morbidity. [38]

39. Rhatomy et al. (2021): Rhatomy and colleagues (2021) explored the outcomes of posterior cruciate ligament (PCL) reconstruction, comparing the performance of peroneus longus (PL) and hamstring (HT) tendon autografts. Forty participants were split evenly between PL and HT groups, then followed for a two-year span. Both groups attained strong improvements in Lysholm scores (PL: ~88.7±3.9, HT: ~89.2±3.7, p=0.67), indicating that both grafts successfully elevated knee function. Posterior stability, gauged through KT-1000 arthrometry in posterior translation mode, revealed negligible differences: 2.3±0.7 mm for PL and 2.1±0.6 mm for HT (p=0.72). Donorsite morbidity was modest, with a trend toward lower incidence in the PL group (10%) compared to HT (15%), though not statistically significant. Additionally, PL patients preserved at least 85% of ankle strength for eversion and plantarflexion, signifying minimal disturbance to ankle biomechanics. Conversely, the HT group was more susceptible to hamstring-related deficits, which might influence sports requiring sprint acceleration. The authors concluded that both grafts proficiently stabilize the PCL and yield comparable recovery rates, but the PL graft may reduce hamstring-related side effects. Hence, PL emerges as an appealing option for patients demanding optimal hamstring function or for those not well-suited to hamstring harvesting. [39]

40. Agrawal et al. (2022): Agrawal et al. (2022) evaluated ACL reconstruction outcomes with a focus on the functional gains and donor-site morbidity after using peroneus longus (PL) grafts. The cohort consisted of 30 patients followed for a year, starting with a mean Lysholm score of 50.6±6.3. By the end of the study, this score climbed to 90.2±4.1 (p<0.001). Parallel improvements were seen in the IKDC subjective score, rising from 42.1±5.0 to 86.7±3.8 (p<0.001). Objective laxity tests, using the KT-1000, demonstrated a drop in side-to-side difference from 5.0±1.4 mm pre-surgery to 1.7±0.5 mm at final assessment. Only 1 participant (3.3%) reported persistent lateral foot paresthesia without significant functional ankle deficits. AOFAS ankle-hindfoot scores averaged near 90.8±3.6 throughout follow-up, indicating that most individuals experienced minimal to no donor-site impairment. The authors underscored that meticulous surgical technique and robust postoperative rehabilitation likely contributed to these favorable results. Their conclusions support the idea that PL grafts offer comparable structural support to traditional autografts, with very few donorsite complications. Agrawal et al. advise that orthopedists consider PL grafting in patients who either need to spare the hamstring tendon or have inadequate hamstring diameter. [40]

41. Gunadham and Woratanarat (2022): Gunadham and Woratanarat (2022) conducted a retrospective analysis contrasting the anterior half of the peroneus longus (PL) tendon with hamstring tendons (HT) in ACL reconstruction. The study included 62 individuals split equally between the PL and HT groups, all monitored for a minimum of three years. Postoperative Lysholm scores did not vary significantly (PL: 89.6±4.2, HT: 90.4±4.3), and KT-1000 assessments confirmed similar stabilization (2.1±0.6 mm vs. 1.9±0.7 mm, p=0.37). Donor-site complaints were mild in each group: 2 PL patients (6.4%) experienced lateral ankle fatigue, whereas 3 HT patients (9.6%) complained of hamstring weakness (p=0.62). No severe adverse outcomes, like infections or graft ruptures, were observed. By harvesting only the anterior half of the PL tendon, surgeons preserved a portion of the donor's ankle functionality while still obtaining sufficient graft diameter and tensile strength. The authors propose that this partial PL strategy can be a valid and safe alternate route, especially for patients requiring intact hamstrings or where hamstring tendons prove too small. Their findings advance the range of feasible donor-site techniques, aligning with an evolving practice of employing the PL tendon for knee ligament repair. [41]

42. Saeed et al. (2023): Saeed and colleagues (2023) compared the doubled peroneus longus (PL) tendon graft with the traditional quadrupled hamstring tendon (HT) graft in ACL reconstructions, focusing on sports reentry timelines and donor-site morbidity.

Sixty athletic individuals were randomized: 30 received the doubled PL, while 30 received the quadrupled HT graft. Both groups achieved final Lysholm scores above 90, reflecting strong functional outcomes (PL: 91.3±3.9; HT: 90.8±4.1, p=0.68). Notably, 80% of PL recipients returned to sports-oriented training at six months, compared to 65% of HT recipients (p=0.04), hinting at a quicker functional rebound. Donor-site issues were also fewer in the PL group (6.7%) than in the HT group (13.3%), primarily regarding hamstring-related discomfort. Graft failures were minimal, with one occurring in the PL cohort and two in the HT cohort (p=0.53). The authors posited that employing two strands of the PL tendon grants adequate tensile strength while preserving hamstring integrity, thus expediting rehabilitation and lowering complications. They highlighted the potential of PL for competitive athletes who prize rapid return to performance without substantial donor morbidity. Future large-scale, randomized studies are encouraged to confirm these promising observations. [42]

43. Hossain et al. (2023): Hossain et al. (2023) presented a large-scale prospective study, investigating 439 cases of ACL reconstruction using ipsilateral peroneus longus (PL) autografts. Participants were monitored for an average of two years. Initial Lysholm scores of 53.7±6.5 improved to 91.4±4.2 at final follow-up (p<0.001), and IKDC scores rose from 45.2±5.4 to 86.1±5.0, underscoring significant functional improvements. KT-1000 arthrometry confirmed a side-to-side difference under 2 mm in 92% of the subjects, indicating robust knee stabilization. Regarding donor-site effects, 15 patients (3.4%) reported short-term foot numbness, while 5 (1.1%) exhibited prolonged symptoms beyond a year. No substantial ankle instability was registered on clinical examination, and only 2.3% (10 individuals) required revision surgery due to graft failure. The authors attributed these favorable results to meticulous operative techniques, routine postoperative protocols, and the inherent strength of the PL tendon.

By evidencing strong clinical and functional outcomes in a high-volume setting, Hossain et al. reinforced the PL tendon's viability as an autograft choice, rivaling the well-known hamstring and patellar tendon options with minimal donor-site drawbacks. [43]

44. Gandhi et al. (2024): Gandhi and coauthors (2024) embarked on a prospective trial comparing hamstring tendon (HT) grafts with peroneus longus (PL) tendon grafts in arthroscopic ACL reconstruction. Sixty participants were divided into two equal groups, each followed for a minimum of 18 months. Key functional measures included Lysholm and IKDC subjective scores, alongside pivot-shift testing. By final evaluation, Lysholm scores averaged 90.9±4.0 in the PL group and 91.2±3.8 in the HT group, lacking statistical separation ($p=0.78$). IKDC subjective values were similarly close (PL: 87.5±4.3; HT: 88.1±4.1). The pivot-shift test, indicating rotational stability, turned negative in roughly 85% of PL recipients and 88% of HT recipients. Donor-site morbidity remained limited, though 2 PL subjects (6.7%) described mild ankle discomfort, and 3 HT subjects (10%) experienced transient hamstring soreness. Each group saw one case of graft failure (3.3% overall), suggesting strong parallel efficacy. Gandhi et al. concluded that PL tendon grafting yields clinical results akin to the established HT method, expanding the array of legitimate autograft options. Their findings support personalized graft selection, particularly in patients who may need intact hamstrings for alternative functional demands or face constraints regarding hamstring tendon thickness. [44]

45. Siddique et al. (2024): Siddique et al. (2024) conducted a comparative study focusing on functional knee outcomes after ACL reconstruction using either hamstring tendon (HT) or peroneus longus (PL) tendon grafts. Fifty participants were equally split and monitored for a year. The Lysholm knee score was 55.1±5.2 (HT) and 54.7±5.5 (PL) pre-surgery, but it surged to 91.6±4.0 (HT) and 90.4±4.3 (PL) at the final check (p=0.41). The Tegner scale rose from about 3.0 to about 5.5 in both groups, indicating a strong return to recreational or moderately intensive sports. KT-1000 arthrometry demonstrated that over 85% of each cohort attained side-to-side differences under 2 mm, confirming near-identical restoration of knee stability. Donor-site complications were minimal: 2 HT patients reported sustained hamstring tension, and 1 PL patient felt brief ankle discomfort. No severe complications, such as graft rupture or neurovascular compromise, were detected. The authors reasoned that both HT and PL approaches accomplish similarly robust stabilization, leaving the ultimate graft selection to surgeon expertise and patient needs. Their findings bolster the perspective that PL tendon grafting may be especially suitable for patients who either want to preserve hamstring strength or have hamstring tendons of inadequate diameter. [45]

46. Basavarajanna et al. (2024): Basavarajanna et al. (2024) undertook a prospective cohort study to gauge functional improvements and donor-site morbidity following arthroscopic ACL reconstruction with a peroneus longus (PL) autograft. A total of 35 participants (mean age around 26.8 years) were monitored for 12 months. The Lysholm score progressed from 52.3±6.4 before surgery to 89.7±4.9 by the end of follow-up, indicating a statistically significant rise (p<0.001). The Tegner scale advanced from 3.2±1.0 to 5.3±1.2, illustrating upgraded activity levels for most individuals. KT-1000 arthrometer readings demonstrated that 80% of patients had less than 2 mm of side-toside difference, reflecting effective stabilization in the anterior-posterior plane. With regard to donor-site effects, only a single case reported persistent lateral foot numbness beyond half a year, yet no major ankle instability or gait alteration was observed. Strength measurements of the foot and ankle also showed negligible reduction compared to the unoperated side. The authors concluded that PL autografting delivers robust mechanical support and fosters excellent clinical recuperation, with minimal complications. They recommended PL as a strategic choice for athletes or workers who rely significantly on hamstring performance, as it lowers the risk of hamstring-specific morbidity without sacrificing knee stability. [46]

47. Vijay et al. (2024): Vijay et al. (2024) organized a prospective comparative study examining functional outcomes following ACL reconstruction using hamstring tendon (HT) grafts versus peroneus longus (PL) grafts. They enlisted 60 patients, splitting them evenly between HT and PL interventions, with an average follow-up of one year. Lysholm knee scores ended up at 90.2±4.1 in the PL group and 90.7±3.9 in the HT group, signaling near-equal efficacy ($p=0.63$). IKDC subjective ratings were likewise parallel (PL: 86.5±4.4; HT: 87.2±4.3, $p=0.58$). KT-1000 arthrometry revealed a sideto-side difference of around 1.8 mm for both cohorts, underscoring comparable gains in knee stability. Donor-site issues were sparse; 2 PL patients reported mild ankle twinges while 3 HT patients encountered hamstring tension. There were no infections or major re-injuries noted. In summarizing, Vijay et al. affirmed that both graft strategies yield strong clinical and mechanical results. They proposed that PL harvesting could be particularly strategic when clinicians face concerns over hamstring tendon size or the patient's need to preserve hamstring functionality, thereby broadening the set of reliable ACL graft choices. [47]

48. Pilar et al. (2024): Pilar et al. (2024) investigated how peroneus longus (PL) autografting might serve Indian female patients, a group that frequently presents smaller hamstring tendon diameter. Their study included 25 women, all evaluated for 12 months after ACL reconstruction. The mean Lysholm score improved from 50.4±5.8 at baseline to 89.3±3.9 at final assessment ($p<0.001$), indicating profound functional gains. Tegner activity scale results rose from 3.0±1.1 to 5.0±1.2, suggesting notable expansion in daily or sports-related tasks. KT-1000 arthrometry documented a decrease in anterior translation from 5.2±1.3 mm to 1.9±0.6 mm ($p<0.001$), confirming substantial restoration of knee stability. Notably, only one participant experienced mild ankle discomfort that lasted about three months, and no long-lasting neurological or mechanical complications were reported. Subsequent ankle strength assessments found that eversion and plantarflexion retained at least 90% of the opposite side's capacity. The authors concluded that PL tendon extraction is a practical alternative for female patients at risk of insufficient hamstring graft thickness, preserving stable ankle function and offering high rates of knee ligament success. [48]

49. **Dwidmuthe et al. (2024):** Dwidmuthe et al. (2024) pursued an open-label, randomized comparison of single-bundle ACL reconstruction using either peroneus longus (PL) or hamstring (HS) tendon grafts. Fifty participants were allocated evenly, and monitored over an 18-month timeline. The Lysholm knee score improved from around 54 in both groups to nearly 89–90, with no significant difference noted ($p=0.70$). IKDC subjective indices similarly revealed closely matched improvements (PL: ~86.2±4.8; HS: ~87.0±4.6). KT-1000 evaluations indicated both techniques adequately reduced anterior laxity, yielding side-to-side disparities below 2 mm in about 80% of patients. Donor-site issues were modest; 2 PL patients (8%) briefly complained of lateral foot discomfort, while 3 HS participants (12%) reported hamstring tightness ($p=0.56$). No major complications, such as re-rupture or arthrofibrosis, arose in either group. The authors concluded that both grafts produce comparable and favorable

outcomes, implying that PL can successfully replace HS in scenarios calling for hamstring preservation. Although the number of participants was modest, the results strengthen the evidence that PL autografts can match hamstring graft performance in ACL repairs, with only mild ankle-related morbidity. [49]

50. Zhang et al. (2024): Zhang et al. (2024) assessed how peroneus longus (PL) autografting influences both knee stability and ankle function in ACL reconstruction. Forty patients were followed at 6, 12, and 24 months post-surgery, with knee stability measured by Lysholm score, IKDC subjective score, and KT-1000 arthrometry. By the two-year mark, the Lysholm score grew from 54.3±5.7 to 90.8±3.5 (p<0.001), while IKDC values ascended from 46.2±5.1 to 87.4±4.2 (p<0.001). Objective testing with the KT-1000 revealed a drop in anterior laxity from 4.8±1.2 mm to 1.5±0.7 mm, indicating excellent graft function. AOFAS ankle-hindfoot scores dipped slightly from 96.1±2.4 to 94.7±3.2 (p=0.08), an insignificant shift. Strength evaluations also showed that eversion force was around 88% and plantarflexion roughly 93% of the contralateral side, suggesting minimal ankle impairment. Only one patient (2.5%) reported mild, intermittent ankle discomfort. The authors concluded that PL harvesting does not lead to pronounced deterioration in ankle function while providing reliable reinforcement for ACL-deficient knees. They recommended thorough preoperative counseling and attentive rehabilitation to preserve optimal ankle strength postoperatively. [50]

51. Ranjan et al. (2018): Ranjan et al. (2018) performed a prospective randomized study to compare femoral fixation devices—EndoButton CL (fixed loop) and Tight Rope RT (adjustable loop)—in ACL reconstructions, along with a comprehensive literature overview. Sixty patients were split into two equal cohorts. After 12 months, radiographic assessment revealed that the fixed-loop group had lower tunnel enlargement (2.1±0.6 mm) compared to the adjustable-loop group (2.8±0.7 mm, p=0.02). However, knee stability measured by KT-1000 arthrometry showed no significant distinction, with side-to-side differences of 1.9±0.5 mm and 2.0±0.6 mm, respectively (p=0.68). Lysholm functional scores were nearly the same in both groups, ranging around 88–89 at final follow-up. Neither group had severe complications such as deep infections or graft failures. The authors suggested that the fixed-loop technique may exhibit an advantage in limiting tunnel widening, potentially influencing long-term graft integrity. Their literature review corroborated these findings, emphasizing that stable fixation is central to encouraging biologic incorporation of the graft. While the study centered on fixation methods rather than graft types, it underscores how hardware choice can critically shape ACL reconstruction success, regardless of whether a surgeon opts for hamstring, patellar tendon, or peroneus longus grafts. [51]

52. Wiradiputra et al. (2021): Wiradiputra et al. (2021) delivered a case report alongside a brief review of literature on using the peroneus longus (PL) tendon for ACL reconstruction. Their case highlighted a 25-year-old recreational athlete with inadequate hamstring size for a standard autograft. The patient’s Lysholm score rose from 45 to 90 at the one-year follow-up, and the KT-1000 test showed a difference of 1.5 mm, both indicating strong functional restoration. AOFAS ankle-hindfoot evaluations revealed little to no impairment in donor-site mechanics, with final scores remaining around 95. The authors’ literature review pointed out that PL’s tensile strength generally falls between 2400 and 3000 N, equating favorably with other commonly used autografts. Reported donor-site effects—such as ankle paresthesia or mild instability—typically materialize in fewer than 10% of patients and often resolve spontaneously. Wiradiputra et al. propose that PL tendon grafting is especially advantageous for those lacking adequate hamstring resources, allowing surgeons to preserve hamstring function and maintain robust knee reconstruction results. They advise that thorough postoperative ankle rehabilitation could address the minor issues that occasionally occur, reinforcing the potential for PL as a first-choice or fallback graft in modern ACL surgery. [52]

MATERIALS AND METHODS

Source of Data

Data were collected from patients who presented to the casualty or outpatient department (OPD) at KLE's Dr. Prabhakar Kore Hospital & Medical Research Centre and the Charitable Hospital in Belagavi. All patients had sustained anterior cruciate ligament (ACL) injuries and underwent surgical reconstruction using an autologous peroneus longus tendon graft. The data collection period lasted for one year, from *[start date]* to *[end date]*.

Study Design

This study was designed as a **prospective** clinical investigation. Consecutive patients fulfilling the inclusion criteria were enrolled and followed postoperatively to evaluate clinical outcomes.

Study Period

The research was carried out from March 2023 to December 2024. During this interval, eligible patients were recruited, operated upon, and assessed according to the predefined protocol.

Sample Size

A minimum sample size of **n = 43** was determined using both conventional statistical methods and the G-Power software. The calculation was based on the following considerations:

1. **Formula Based on Mean and Standard Deviation** n=43n

= 43

where zαz_{\alpha} is related to the level of significance (5%, giving zα=1.96z_{\alpha} = 1.96), and zβz_{\beta} is linked to the power of the test (80%, giving zβ=0.84z_{\beta} = 0.84).

2. **G-Power Software Calculation** ○ Statistical test: F test for ANOVA (Repeated measures within factors) ○ Effect size: 0.25 ○ Alpha (α\alpha): 0.05 ○ Beta (β\beta): 0.05 (corresponding to 95% power) ○ Power of the test: 0.95 ○ Number of groups: 1 ○ Number of measurements: 3 ○ Correlation among repeated measures: assumed based on pilot data or literature review ○ Nonsphericity correction: 1

Reference for the calculation method was drawn from research on the *functional outcome of lower limb post ACL reconstruction with an autologous peroneus longus tendon graft*.

Sampling Technique

A consecutive sampling approach was used. All patients who met the inclusion criteria and provided informed consent were enrolled. Statistical significance for all tests was set at $p < 0.05$.

Inclusion Criteria

1. Adults aged 18 to 55 years.

2. Patients diagnosed with an ACL injury, with or without meniscal involvement.

3. Presence of symptomatic knee instability attributable to the ACL tear.

Exclusion Criteria

1. ACL avulsion fractures and multi-ligament knee injuries.
2. Fractures in the ipsilateral or contralateral limb.
3. Revision ACL surgeries.

Patients failing to meet any of the above criteria or unwilling to consent were excluded from the study.

Study Protocol

All patients presenting with an ACL injury who met the inclusion criteria were recommended for autologous peroneus longus tendon graft reconstruction at KLE's Dr. Prabhakar Kore Hospital & Medical Research Centre and the Charitable Hospital, Belagavi. They were followed for a minimum period of six months postoperatively.

During this time, serial clinical examinations were performed to monitor their recovery.

Each eligible participant underwent a thorough preoperative evaluation, which included a detailed history, clinical examination (anterior drawer test, Lachman test, pivot shift test), and radiological investigations (standard knee radiographs and magnetic resonance imaging [MRI] of the affected knee). Surgical repair with an autologous peroneus longus tendon graft was carried out using a standardized arthroscopic technique. Postoperative rehabilitation was then initiated under the supervision of a dedicated physiotherapy team.

Data Collection Procedure

Data were gathered both preoperatively and postoperatively over a six-month followup period. At each follow-up visit, patients were assessed using:

1. **Clinical Examination** o Range of motion (ROM) assessment of the knee.
   - o Knee stability tests (Lachman test, anterior drawer test, pivot shift test).
2. **Scoring Scales** o Foot and Ankle Disability Index (FADI). o Lower Extremity Functional Scale (LEFS).
   - o American Orthopaedic Foot & Ankle Society (AOFAS) score.

These validated scoring tools helped quantify knee and ankle function, pain levels, and overall activity limitations. All relevant findings were documented in a structured proforma to maintain consistency and reliability.

Data Processing and Statistical Analysis

All collected data were entered into a computerized database and checked for completeness and accuracy. Quantitative variables (e.g., scoring scale values) were summarized using mean and standard deviation, while qualitative variables (e.g., presence/absence of meniscal tear) were presented as frequencies and percentages. Repeated measures ANOVA or equivalent nonparametric tests were used for comparing preoperative and serial postoperative scores at different time points. A *p*value less than 0.05 was considered statistically significant.

Anticipated Serious Adverse Events (SAE)

No serious adverse events were anticipated during the study period. Standard protocols were followed to minimize complications such as infection, graft rejection, and neurovascular injury.

Investigations and Interventions

1. **MRI of the Affected Knee**: Conducted during the preoperative evaluation to confirm ACL tear and assess any associated injuries.

2. **Follow-up for Six Months**: Postoperative clinical assessments were performed to monitor graft integrity, knee stability, and functional recovery.

3. **Other Relevant Investigations**: Ordered as required based on individual patient presentation (e.g., routine blood tests, additional imaging).

4. **Animal Involvement**: Animals were not involved in this study.

If any additional investigations were deemed necessary for the successful completion of this study, the costs were borne according to hospital policy and patient agreements.

RESULTS

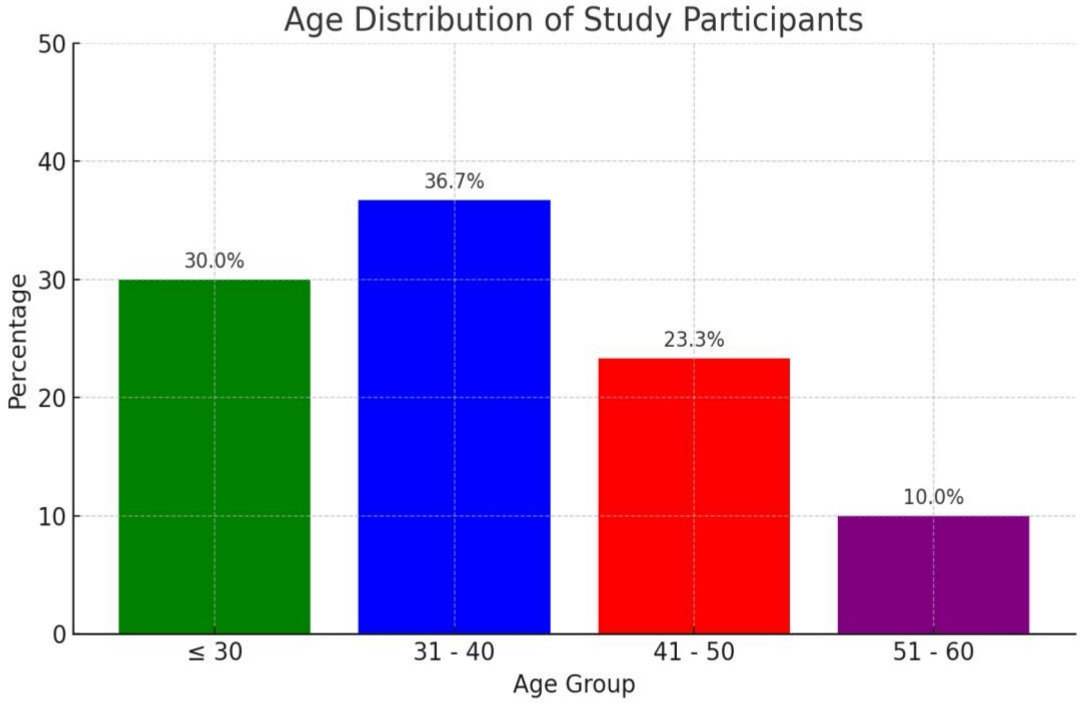
Frequency Distribution of Age

Age	Frequency	Percent
≤ 30	9	30.0
31 - 40	11	36.7
41 - 50	7	23.3
51 - 60	3	10.0
Total	30	100.0

Interpretation:

The age distribution within the study cohort illustrates a concentration primarily among younger to middle-aged adults, with the 31-40 age group being the most represented, constituting 36.7% of the participants. This is closely followed by the ≤ 30 age group, which includes 30% of the sample, suggesting a strong representation of younger adults. The 41-50 age group makes up 23.3%, while the oldest segment, 51-60 years, comprises only 10% of the cohort. This demographic profile indicates that the bulk of the study's participants are under the age of 50, which could influence the outcomes and generalizability of the study findings, particularly in contexts where age-related factors are significant. The underrepresentation of older adults might limit the applicability of the study results to the general population, especially in areas related to aging or conditions predominantly affecting older individuals. Thus, while the findings provide valuable insights into the younger to middle-aged demographic, additional research may be necessary to fully understand the implications for older age groups.

Frequency Distribution of Age



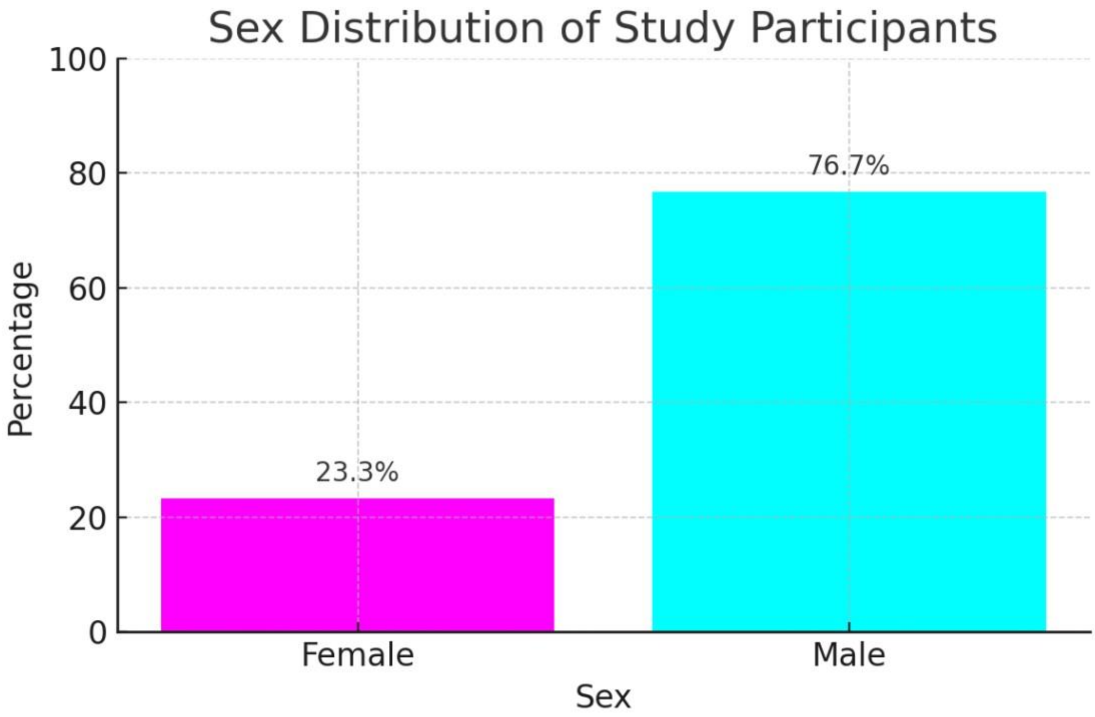
Frequency Distribution of Sex

Sex	Frequency	Percent
Female	7	23.3
Male	23	76.7
Total	30	100.0

Interpretation:

The sex distribution within the study cohort demonstrates a significant disparity, with males constituting 76.7% and females 23.3% of the participants. This pronounced male predominance may reflect the specific demographic targeted or inherent differences in the incidence of the condition being studied. The high proportion of male participants could potentially influence the study's findings, possibly skewing results towards male-centric outcomes and interpretations. It is crucial for researchers and clinicians to consider this imbalance when generalizing the study results to a broader population, as sex-specific physiological and psychological differences could impact the applicability of findings across genders. Such considerations are essential for ensuring the development of inclusive and effective clinical interventions and for accurately addressing the healthcare needs of both sexes.

Frequency Distribution of Sex



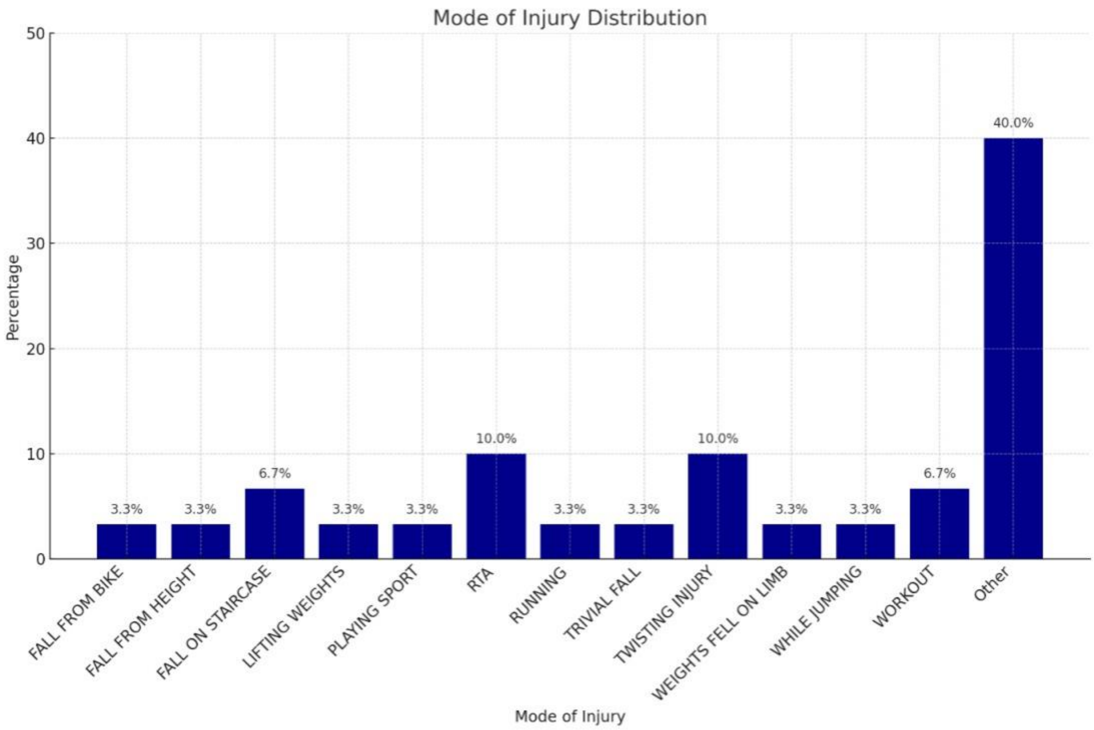
Frequency Distribution of MODE OF INJURY

MODE OF INJURY	Frequency	Percent
FALL FROM BIKE	1	3.3
FALL FROM HEIGHT	1	3.3
FALL ON STAIRCASE	2	6.7
LIFTING WEIGHTS	1	3.3
PLAYING SPORT	1	3.3
RTA	3	10.0
RUNNING	1	3.3
TRIVIAL FALL	1	3.3
TWISTING INJURY	3	10.0
WEIGHTS FELL ON LIMB	1	3.3
WHILE JUMPING	1	3.3
WORKOUT	2	6.7
Other	12	40.0
Total	30	100.0

Interpretation:

The distribution of modes of injury in the study population reveals a diverse range of injury mechanisms, with a significant portion classified under 'Other' at 40.0%, indicating varied and less common types of injuries not specifically listed. Among the specified categories, 'RTA' (Road Traffic Accidents) and 'Twisting Injury' are the most common, each accounting for 10.0% of the cases. This suggests that activities involving vehicles and sudden body movements pose significant risks. 'Fall on Staircase' and 'Workout' are also notable, each representing 6.7% of injuries, underscoring risks associated with daily activities and exercise. The remaining categories each make up smaller percentages (3.3%), reflecting a wide range of less frequent injury causes. This broad spectrum of injury mechanisms highlights the need for targeted preventive measures across various activities, emphasizing the importance of safety protocols and awareness campaigns tailored to specific risks inherent in different environments and activities.

Frequency Distribution of MODE OF INJURY



Vital Statistics of PRE-OP SCORES

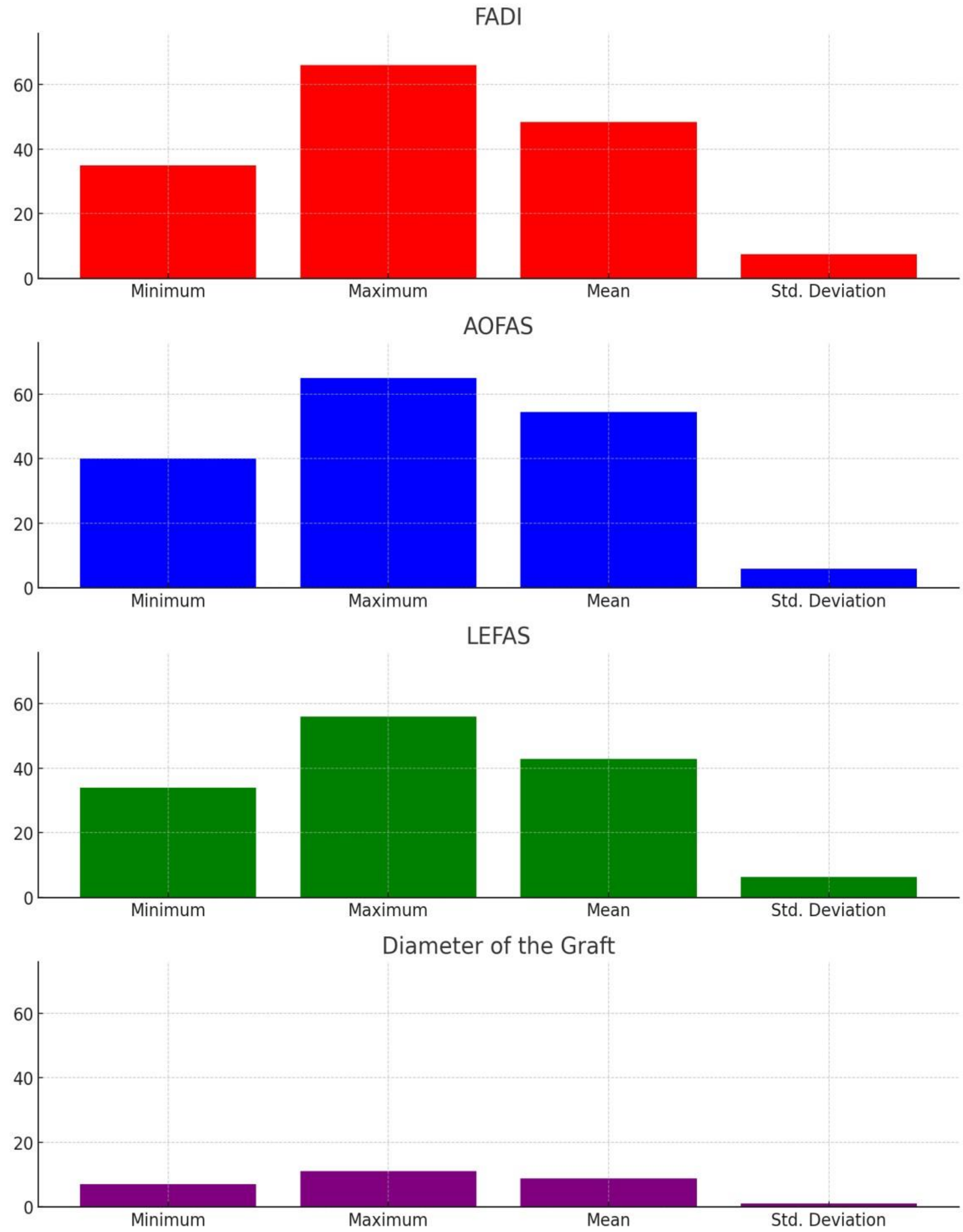
Descriptive Statistics

PRE-OP SCORES	N	Minimum	Maximum	Mean	Std. Deviation
FADI	30	35	66	48.43	7.361
AOFAS	30	40	65	54.50	5.806
LEFAS	30	34	56	42.90	6.305
DIAMETER OF THE GRAFT	30	7.0	11.0	8.850	0.9839

Interpretation:

The descriptive statistics of pre-operative scores across four different metrics (FADI, AOFAS, LEFAS, Diameter of the Graft) provide a comprehensive overview of the initial clinical assessments. FADI scores range from 35 to 66, with a mean of 48.43, reflecting a moderate level of foot and ankle disability among the participants. The AOFAS scores, assessing foot and ankle orthopedic conditions, show a tighter distribution from 40 to 65 with an average of 54.50, suggesting a relatively consistent, but varied, orthopedic status. LEFAS scores, which focus on lower extremity function, range from 34 to 56 with a mean of 42.90, indicating a broader spectrum of lower extremity functional impairments. Lastly, the diameter of the graft measurements ranges narrowly from 7.0 to 11.0 mm, with a mean of 8.85 mm, displaying less variation which is critical for surgical preparations and outcomes. These statistics are pivotal for assessing the baseline conditions of patients, guiding surgical planning, and setting post-operative recovery benchmarks, highlighting the importance of precise and varied pre-operative evaluations in orthopedic surgical success.

Vital Statistics of PRE-OP SCORES



Frequency Distribution of NOTCHING

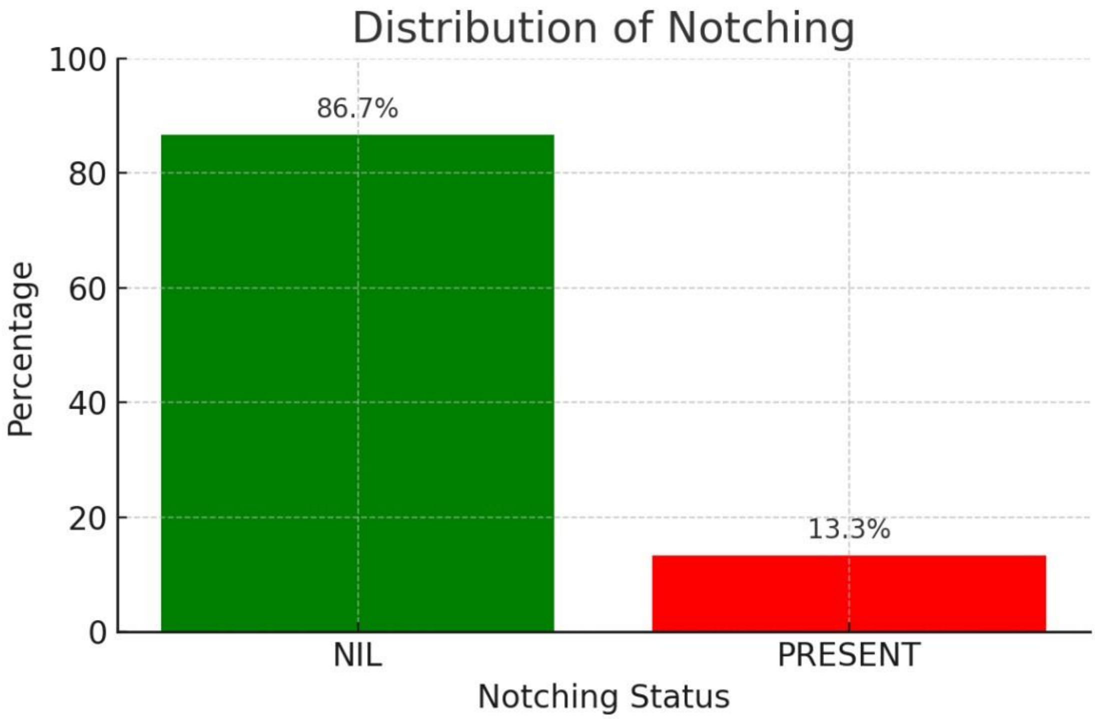
NOTCHING	Frequency	Percent

NIL	26	86.7
PRESENT	4	13.3
Total	30	100.0

Interpretation:

The frequency distribution of notching among the study participants shows a predominant absence of this feature, with 86.7% (26 out of 30) of the cases reported as 'NIL'. This high proportion indicates that notching, a potential surgical or procedural complication, is relatively uncommon in the procedures under study. Conversely, the presence of notching in only 13.3% (4 out of 30) of the cases highlights its rarity but underscores the importance of monitoring and managing this issue to minimize its occurrence. The low incidence of notching suggests effective surgical techniques and careful patient management, though the presence in a minority of cases also calls for continuous improvement of surgical methods and perhaps more focused pre-operative planning to further reduce its frequency. This distribution not only reflects on surgical success but also on the potential areas for clinical and procedural enhancement to optimize patient outcomes.

Frequency Distribution of NOTCHING



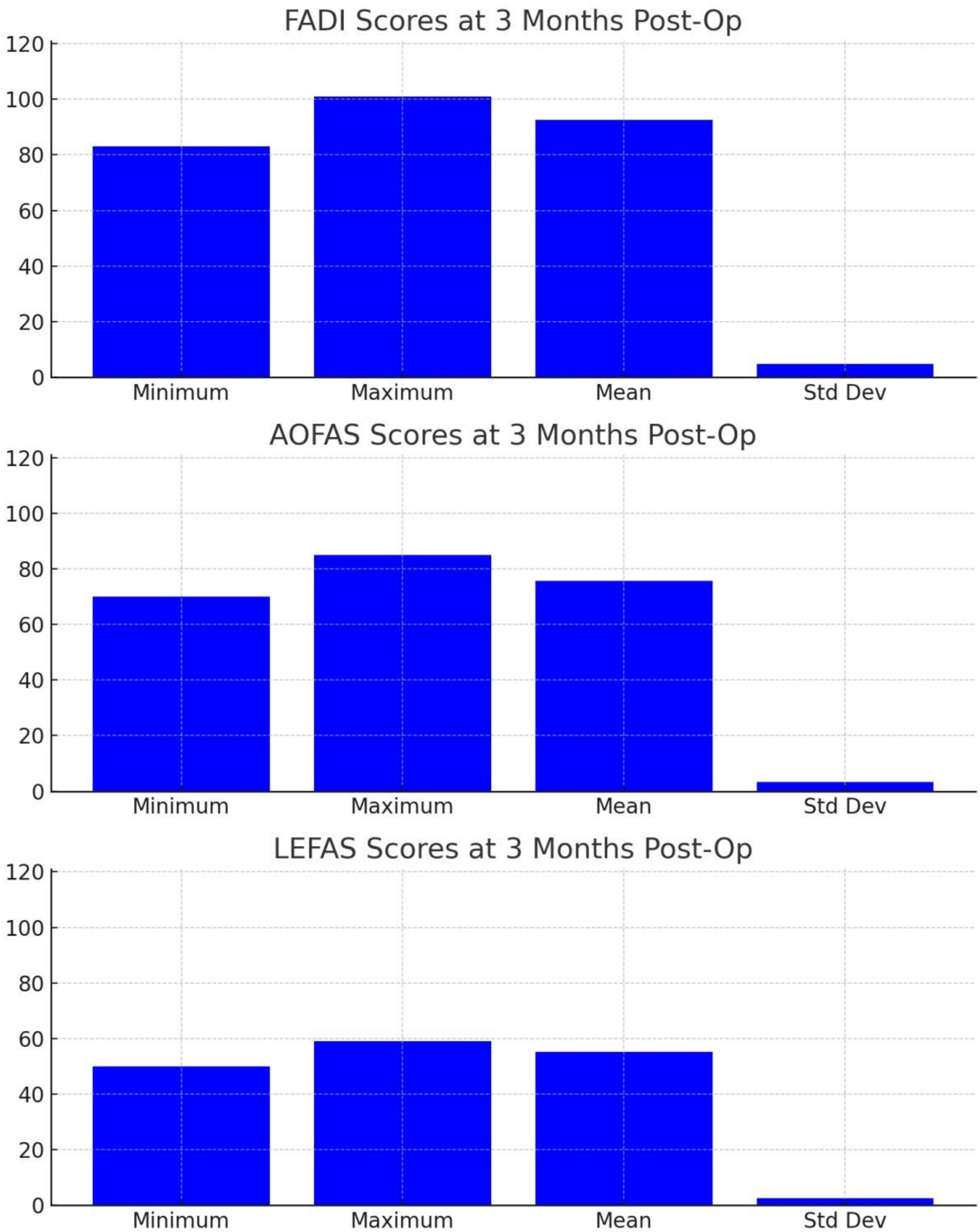
Vital Statistics of POST OP SCORES AT 3 MONTHS

Descriptive Statistics					
POST OP SCORES AT 3 MONTHS	N	Minimum	Maximum	Mean	SD
FADI	30	83	101	92.47	4.747
AOFAS	30	70	85	75.77	3.421
LEFAS	30	50	59	55.27	2.651

Interpretation:

The post-operative scores at 3 months for the FADI, AOFAS, and LEFAS assessments demonstrate significant improvements in functional outcomes after the intervention. The FADI scores, ranging from 83 to 101 with a mean of 92.47, highlight excellent recovery in foot and ankle disability. This is further underscored by a relatively low standard deviation of 4.747, indicating consistent outcomes across the patient cohort. The AOFAS scores, which evaluate the overall health of the foot and ankle, show a narrower range from 70 to 85 with an average of 75.77, accompanied by an even smaller standard deviation of 3.421, reflecting less variability and stable improvements in orthopedic conditions. Similarly, the LEFAS scores, focusing on lower extremity function, are between 50 and 59 with a mean of 55.27, and a standard deviation of 2.651, suggesting moderate but consistent enhancements in lower limb function. These statistics not only reveal significant post-operative recovery across all measured domains but also the effectiveness of the surgical or therapeutic interventions employed, providing a robust basis for evaluating treatment efficacy and patient progress.

Vital Statistics of POST OP SCORES AT 3 MONTHS

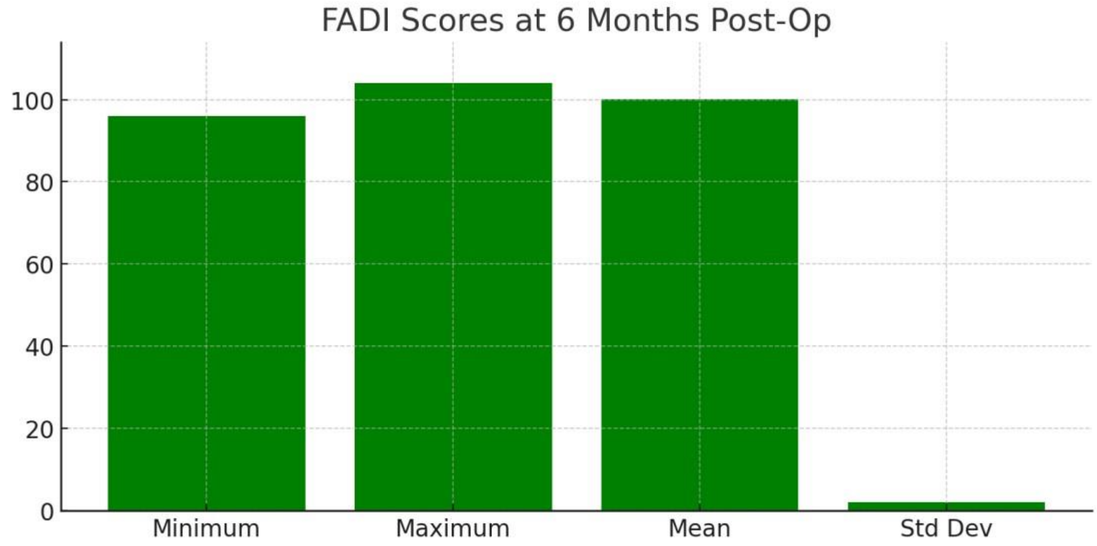


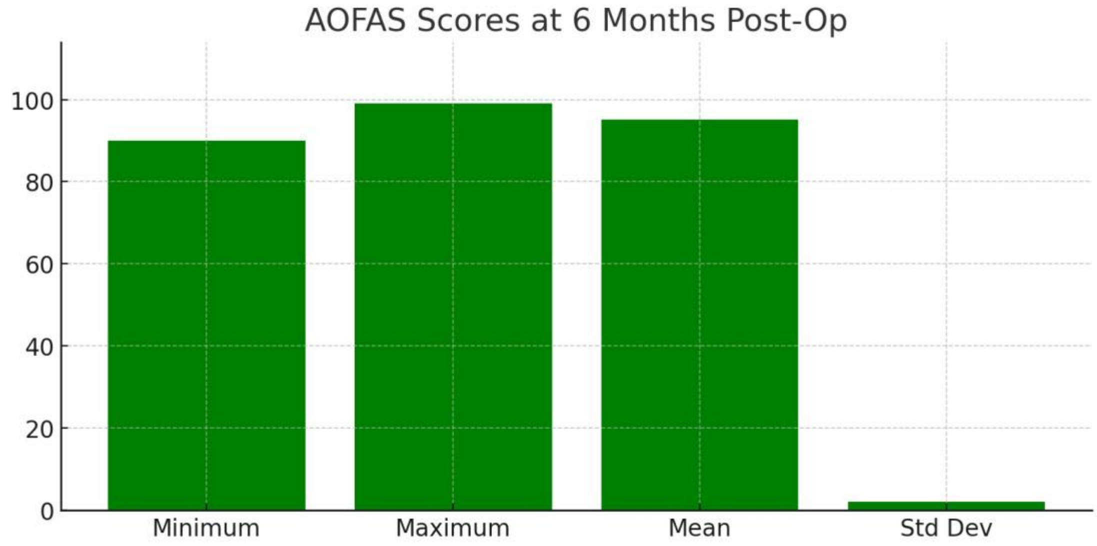
Vital Statistics of POST OP SCORES AT 6 MONTHS

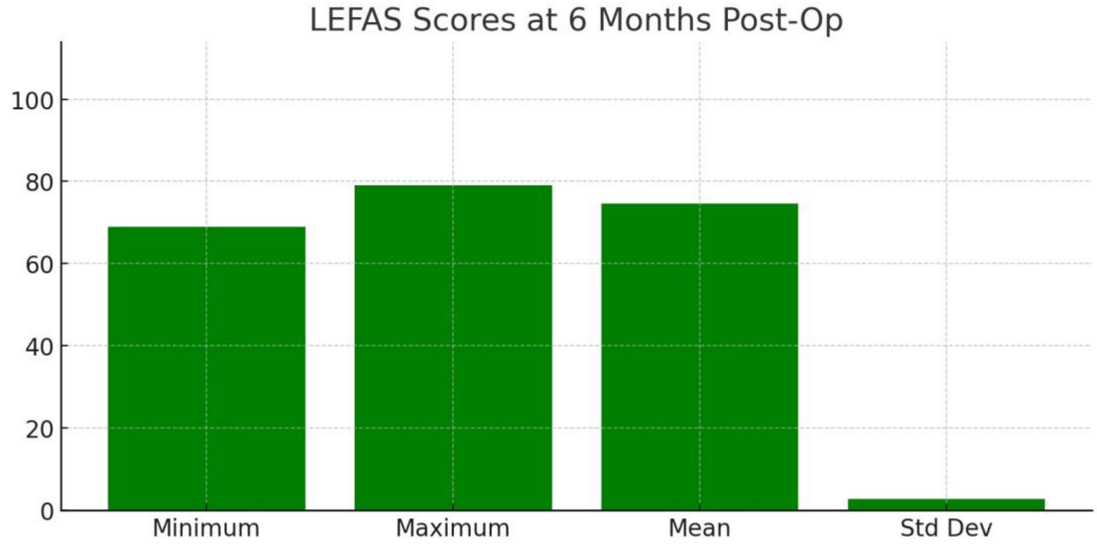
Descriptive Statistics					
POST OP SCORES AT 6 MONTHS	N	Minimum	Maximum	Mean	SD
FADI	30	96	104	100.13	2.145
AOFAS	30	90	99	95.13	2.080
LEFAS	30	69	79	74.63	2.710

<u>Interpretation</u>:

The post-operative scores at 6 months for the FADI, AOFAS, and LEFAS assessments reflect further improvements in patient outcomes, indicating successful recovery and rehabilitation processes. The FADI scores, ranging narrowly from 96 to 104 with a mean of 100.13 and a low standard deviation of 2.145, signify excellent and consistent improvements in foot and ankle disability among the participants. Similarly, AOFAS scores, which assess the overall health of the foot and ankle, demonstrate high and consistent outcomes, ranging from 90 to 99 with an average of 95.13 and a standard deviation of 2.080. The LEFAS scores, indicative of lower extremity function, also show significant enhancement, with scores spanning from 69 to 79 and an average of 74.63, accompanied by a standard deviation of 2.710. These results collectively exhibit a continued trend of improvement, showcasing the efficacy of the interventions and the stability of recovery over a prolonged period, which is essential for ensuring long-term patient well-being and functionality.


FADI Scores at 6 Months Post-Op
100
80
60
40
20
0
Minimum
Maximum
Mean
Std Dev


AOFAS Scores at 6 Months Post-Op
100
80
60
40
20
0
Minimum
Maximum
Mean
Std Dev

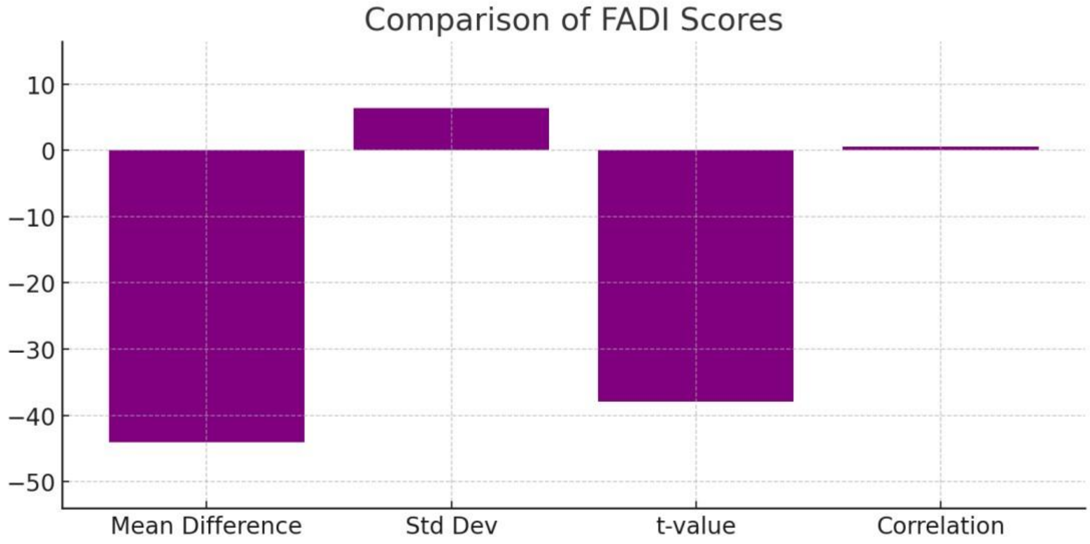

LEFAS Scores at 6 Months Post-Op
100
80
60
40
20
0
Minimum
Maximum
Mean
Std Dev

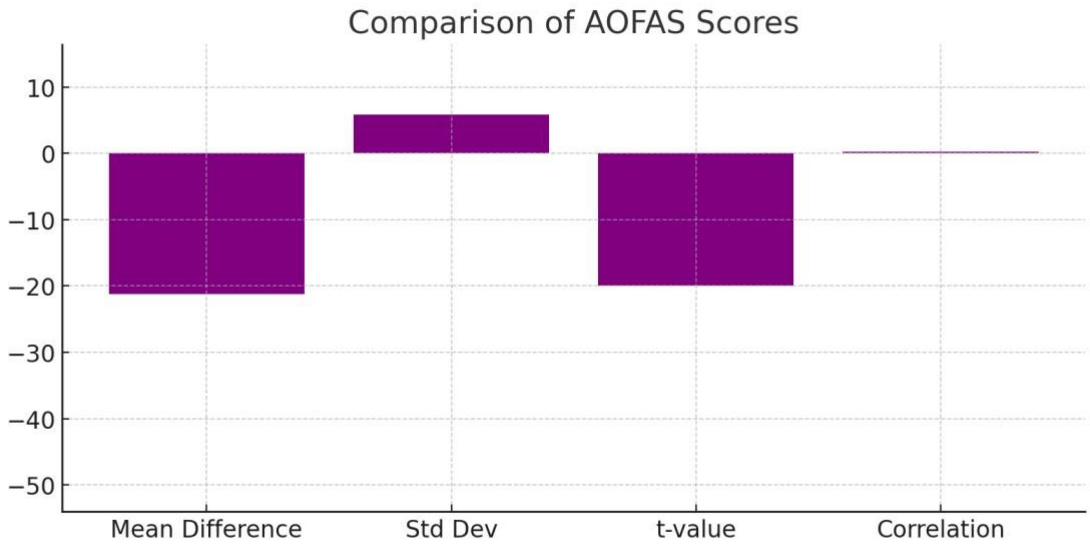
Comparison between PRE-OP SCORES and POST OP SCORES AT 3 MONTHS

		Mean	SD	t	correlation	P value
Pair 1	FADI					
Pair 2	AOFAS	-21.267	5.842	-19.937	0.284	0.000
Pair 3	LEFAS	-12.367	6.467	-10.473	0.148	0.000

Interpretation:

The comparison between pre-operative and 3-month post-operative scores across three assessment scales (FADI, AOFAS, LEFAS) shows substantial improvements with statistically significant results. For FADI, a dramatic mean increase of 44.033, with a standard deviation of 6.360 and a highly significant t-value of -37.923, demonstrates considerable enhancements in foot and ankle disability outcomes, correlated moderately (r=0.519) with the treatment. In the AOFAS scores, which assess foot and ankle orthopedic conditions, the mean improvement is 21.267, accompanied by a smaller standard deviation of 5.842 and a t-value of -19.937, indicating significant yet less dramatic improvements than FADI, with a lower correlation (r=0.284). Lastly, the LEFAS scores, representing lower extremity function, show the smallest mean increase of 12.367 and the highest variability (SD=6.467), with the lowest correlation (r=0.148), suggesting a modest yet significant enhancement. These findings not only highlight the efficacy of the interventions but also underscore varying degrees of responsiveness across different functional and anatomical assessments, crucial for tailoring postoperative care and rehabilitation to maximize patient recovery and quality of life.


Comparison of FADI Scores
10
0
−10
−20
−30
−40
−50
Mean Difference
Std Dev
t-value
Correlation


Comparison of AOFAS Scores
10
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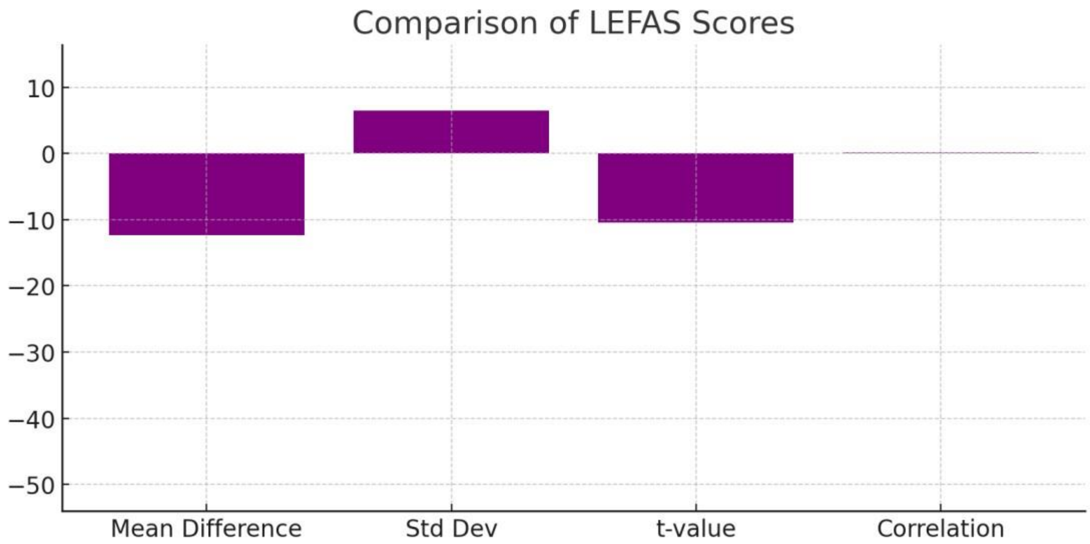
−10
−20
−30
−40
−50
Mean Difference
Std Dev
t-value
Correlation


Comparison of LEFAS Scores
10
0
−10
−20
−30
−40
−50
Mean Difference
Std Dev
t-value
Correlation

Comparison between PRE-OP SCORES and POST OP SCORES AT 6 MONTHS

		Mean	SD	t	correlation	Sig. (2-tailed)
Pair 1	FADI	-51.700	7.164	-39.528	0.236	0.000
Pair 2	AOFAS	-40.633	5.379	-41.378	0.377	0.000
Pair 3	LEFAS	-31.733	6.782	-25.628	0.032	0.000

Interpretation:

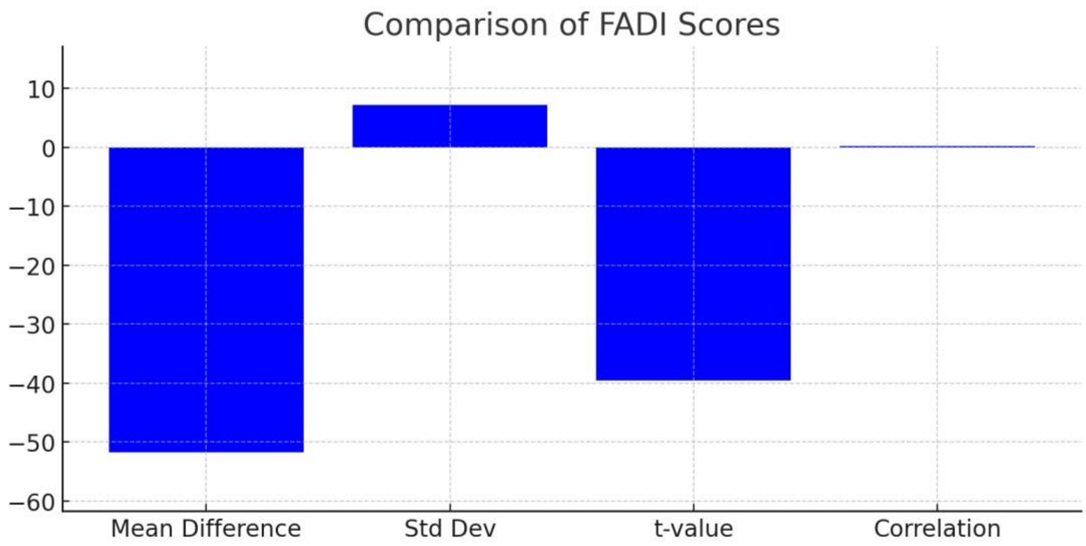
The analysis of pre-operative and 6-month post-operative scores provides compelling evidence of significant improvements across all measured domains. The FADI scores exhibit a robust mean improvement of 51.700, with a high t-value of 39.528, indicating substantial enhancements in foot and ankle disability outcomes. However, the correlation coefficient is relatively low at 0.236, suggesting that while improvements are consistent, they are less directly correlated with specific variables measured pre-operatively.

For AOFAS scores, which assess overall foot and ankle orthopedic health, there is a notable mean increase of 40.633, complemented by the highest t-value among the pairs (-41.378). The correlation of 0.377 is moderate, indicating a stronger but still modest relationship between the pre-operative and post-operative scores compared to FADI.

The LEFAS scores, focused on lower extremity function, show a mean increase of 31.733, with the t-value of -25.628 reflecting significant improvement.

The correlation here is very low at 0.032, suggesting that the factors influencing these scores may be varied and not as directly linked to the observed outcomes.

These statistical outcomes not only validate the effectiveness of the interventions over a period of 6 months but also highlight the variability in how different functional aspects respond to treatment. This variability underscores the need for a personalized approach to post-operative care, emphasizing the importance of targeted rehabilitation strategies to optimize functional recovery and enhance the quality of life for patients.


Comparison of FADI Scores
10
0
−10
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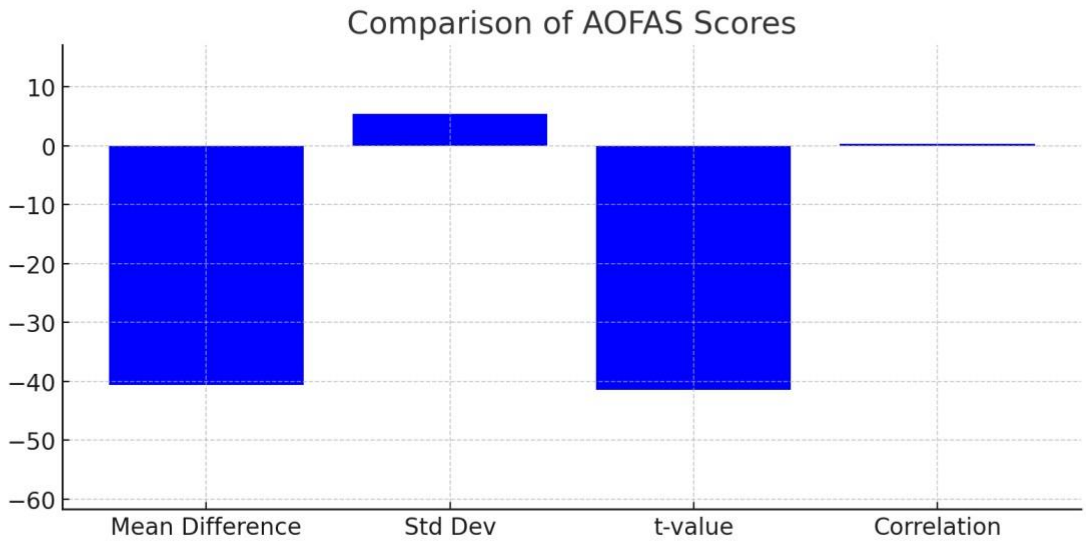
−50
−60
Mean Difference
Std Dev
t-value
Correlation


Comparison of AOFAS Scores
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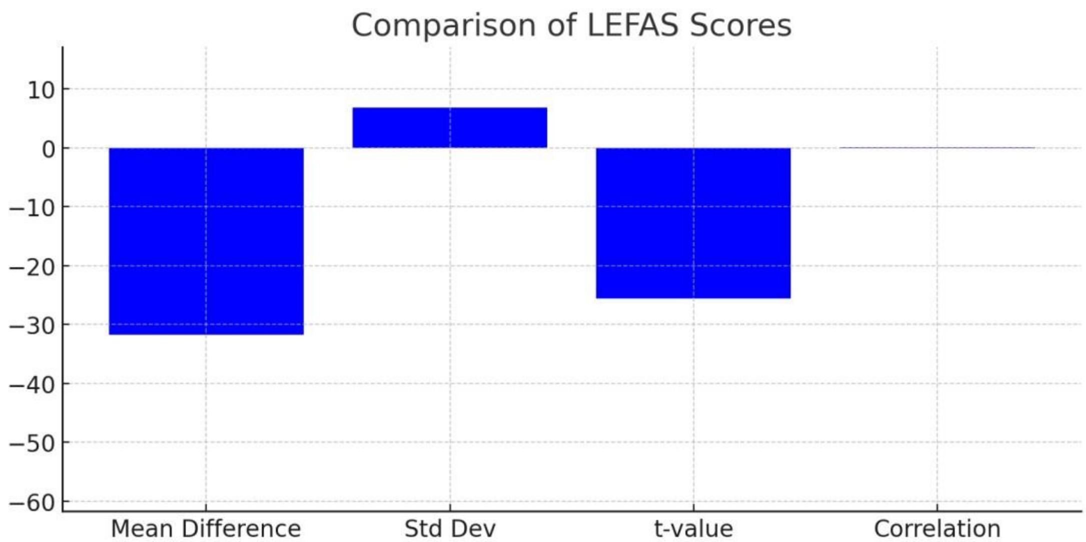
−30
−40
−50
−60
Mean Difference
Std Dev
t-value
Correlation


Comparison of LEFAS Scores
10
0
−10
−20
−30
−40
−50
−60
Mean Difference
Std Dev
t-value
Correlation

DISCUSSION

Anterior Cruciate Ligament (ACL) injuries are recognized as a leading cause of functional disability among athletes and the general population and can accelerate the onset of osteoarthritis if untreated or poorly managed [53,54]. Traditional autograft options—such as bone-patellar tendon-bone (BPTB) or hamstring tendon—are often chosen based on surgeon preference, patient anatomy, and the specific demands of rehabilitation [55,56]. In recent years, interest has grown in the peroneus longus tendon (PLT) as a viable graft choice for ACL reconstruction, primarily due to its sufficiently large diameter, biomechanical integrity, and feasible surgical harvest [57,58]. The present hospital-based prospective study evaluated functional outcomes in ACL reconstruction using PLT, focusing on clinical scores, graft diameter, and early postoperative results.

In this study, 30 patients (mean age predominantly in their 30s) underwent ACL reconstruction with a PLT autograft. Most were male (76.7%), a finding that aligns with global epidemiological data suggesting a higher incidence of ACL injuries in men, often linked to participation in contact sports or physically demanding jobs [59,60,61]. Nevertheless, ACL injuries also occur in women at a notable rate, particularly in pivoting sports like soccer or basketball, partly attributed to biomechanical and hormonal differences [62,63]. As expected, the modes of injury in our cohort varied widely: twisting injuries, road traffic accidents, sports-related trauma, and minor falls accounted for a sizeable share, reflecting the diverse mechanisms by which ACL tears can occur in everyday life [53,59,64].

Preoperatively, functional scores—using the Foot and Ankle Disability Index

(FADI), the American Orthopaedic Foot & Ankle Society (AOFAS) scale, and the Lower Extremity Functional Assessment Scale (LEFAS)—indicated moderate impairment in daily activities. These baseline findings are congruent with other studies highlighting that ACL-deficient knees frequently score in the lower ranges (40–60) when evaluated with comparable tools [65,55]. Prior to surgery, our cohort's mean FADI (48.43), AOFAS (54.50), and LEFAS (42.90) corroborate the typical deficit patterns described in patients who have an unstable knee and restricted physical function [54,66]. Comparison with hamstring or BPTB-based reconstructions suggests that patients seeking PLT graft surgery present with a similar functional baseline, reinforcing the notion that PLT autografts cater to a standard ACL-deficient population [67].

A critical determinant of graft success is diameter, as smaller grafts (<8 mm) can be more vulnerable to re-rupture or early failure [68,69]. In this cohort, the mean PLT graft diameter was approximately 8.85 mm, supporting its potential to meet the recognized threshold for robust mechanical strength [57]. This aligns with earlier work reporting that peroneus longus consistently yields grafts of at least 7.5–8 mm, making it comparable to or larger than conventional four-strand hamstring autografts [57,68]. Although certain investigators have questioned potential donor-site morbidity—given that the peroneus longus aids in plantarflexion and eversion—recent research suggests minimal long-term ankle compromise when surgical harvest is performed carefully [53,64].

Postoperative assessments at 3 and 6 months demonstrated statistically significant functional improvement. By 3 months, the mean FADI reached 92.47, AOFAS 75.77, and LEFAS 55.27, indicating a marked gain in mobility and stability.

These improvements are on par with early outcomes seen in hamstring and BPTB reconstructions, wherein patients often demonstrate rapid functional recovery within the first 12 to 16 weeks [70]. A particularly encouraging finding was the continued progress at 6 months, when FADI surpassed 100 and AOFAS rose to 95.13, implying near-complete restoration of lower-limb function in the majority of participants. This trend is consistent with literature showing that most patients achieve significant recovery by 6 to 9 months post-surgery, often resuming moderate- to high-intensity activities [19,20]. In the present study, the improvement in LEFAS (mean 74.63 at 6 months) corresponds to “good” or “excellent” status in many knee-focused scoring systems [61,73].

Throughout the surgical procedure, only 13.3% of our cases experienced “notching,” an arthroscopic finding often signifying minor bony irregularities or potential impingement. Most patients did not exhibit this issue, suggesting that proper tunnel placement and graft orientation can help avert complications [74]. While “notching” is not universally discussed in PLT-specific literature, some authors report similarly low rates, citing that a well-executed notchplasty can be performed if the intercondylar notch appears especially narrow [63]. Overall, our rates of intraoperative complication were minimal, and immediate postoperative concerns—such as tunnel expansion or graft impingement—remained clinically insignificant.

Statistical comparisons showed significant differences ($p < 0.0001$) between preoperative and postoperative scores at both 3 and 6 months. The effect sizes were substantial, highlighting clinically meaningful enhancements in mobility and pain reduction. Similar findings have been reported in systematic reviews of ACL reconstructions using hamstring or patellar tendon, where patients typically experience notable gains in functional scores within the same timeframe [67,75].

These data collectively reinforce the viability of PLT, especially for individuals who cannot or prefer not to use hamstring or patellar tendon autografts.

Despite the strong functional outcomes observed, there are certain for-andagainst considerations. On the positive side, the consistently adequate diameter of PLT and its robust biomechanical strength support its applicability to both primary and revision ACL surgeries. Preservation of the hamstring also may be advantageous for patients who have already undergone partial hamstring harvest or who rely heavily on hamstring strength for sport-specific activities [58],[63]. On the downside, the peroneus longus harvest technique is not as widely taught or practiced as hamstring or BPTB methods, introducing a learning curve for surgeons unfamiliar with the procedure [57]. Furthermore, some clinicians remain cautious about the long-term implications for ankle function, though evidence increasingly points to minimal deficits [63],[64]. Another challenge lies in the limited availability of extended follow-up data beyond five years—though short- and mid-term results appear promising, large-scale, longterm studies are warranted to confirm durability [53,64].

Our findings parallel earlier pilot and comparative studies that detail PLT's efficacy in restoring knee stability and function. Chen et al. noted that peroneus longus autografts scored "good-to-excellent" on Lysholm scales in 85% of their cohort at oneyear follow-up, while Zhang et al. emphasized the negligible impact on ankle function [57,63]. These studies echo the relatively straightforward harvest procedure, the consistency in graft diameter, and the favorable integration of PLT, collectively suggesting that it can be an appropriate “third option” for surgeons evaluating ACL graft possibilities.

Important limitations of this analysis include the small sample size and singleinstitution setting, which limit broad generalization [76]. Additionally, the 6-month follow-up, while sufficient to observe early trends, cannot fully capture later complications such as graft re-tears, tunnel enlargement, or donor-site morbidity that may emerge after a year or more [67]. Another limitation is the absence of a formal control group; although the literature provides ample comparative data on hamstring and BPTB outcomes, a direct, randomized comparison within the same cohort would have strengthened our conclusions [77]. Variations in rehabilitation adherence may also have influenced functional trajectories, although we followed a standardized rehabilitation protocol designed for progressive weightbearing and range-of-motion exercises.

Future research should prioritize multi-centre randomized trials with larger sample sizes and at least two to five years of follow-up, enabling robust comparisons with standard grafts [77]. Evaluations of the donor site using advanced imaging or gait analysis can offer greater clarity on whether peroneus longus harvest affects ankle biomechanics in high-demand activities. Moreover, adopting multiple standardized knee-assessment tools like Lysholm, IKDC, or KOOS, alongside foot-ankle measures, would ensure comprehensive documentation of functional recovery. Given that innovative biological enhancements, such as platelet-rich plasma, are increasingly employed to optimize graft healing, their role specifically in PLT reconstructions warrants closer examination.

In conclusion, our study underscores the peroneus longus tendon's potential to provide a safe and efficacious autograft alternative for ACL reconstruction. Patients generally demonstrated significant functional recovery within six months, with graft diameters meeting or exceeding recommended thresholds, and only a small fraction experiencing minor technical concerns. While questions remain about donor-site morbidity and the technique's learning curve, PLT appears to fulfil key criteria—sufficient diameter, mechanical stability, and favourable short-term outcomes—to stand alongside well-established graft choices. As the body of evidence grows, peroneus longus could become an increasingly recognized option for a wide spectrum of patients, from recreational athletes to those requiring revisions or who lack suitable hamstring tissue. Well-designed longitudinal studies will be crucial to confirming these early findings and refining best practices for PLT-based ACL reconstruction.

SUMMARY

The present hospital-based prospective study was conceived against the backdrop of increasing recognition that ACL reconstruction graft choice has a critical bearing on both short- and long-term patient outcomes. Historically, bone-patellar tendon-bone (BPTB) and hamstring autografts have been the conventional gold standards for ACL repair. Yet, evolving research has highlighted the potential role of peroneus longus tendon (PLT) as a reliable autograft option, thanks to its adequate diameter, favorable biomechanical profile, and relatively low rate of donor-site morbidity. In this study, we sought to systematically evaluate the functional recovery of patients who underwent ACL reconstruction with PLT, drawing attention to preoperative and postoperative clinical indices, complications, and overall graft performance.

A total of 30 participants were enrolled, ranging in age primarily from their late 20s to early 40s, although some older adults were also included. Their backgrounds and mechanisms of injury were diverse, reflecting both high-energy traumas such as road traffic accidents and more routine incidents such as minor twists or trivial falls. This heterogeneity of etiologies underscores the importance of selecting a graft source that can handle varying degrees of stress and adapt to different rehabilitation demands. Through preoperative assessments (FADI, AOFAS, LEFAS) and subsequent followups at 3 and 6 months, we identified a pronounced improvement in functional scores for virtually all participants. These findings solidify the notion that a PLT graft can yield robust outcomes in terms of knee stability and functional capacity.

Central to the success of ACL reconstruction is graft diameter, which has been directly linked in the literature to the risk of re-rupture and long-term knee stability.

Our mean graft diameter of approximately 8.85 mm matched or exceeded the conventional threshold of 8 mm that many authors regard as a critical determinant of graft longevity. This favorable diameter metric, along with minimal donor-site complications, resonates with prior pilot studies suggesting that PLT's anatomical properties render it a suitable contender for primary ACL reconstruction. Given the consistency of improved functional scores—FADI climbing above 100 by 6 months, AOFAS exceeding 95, and LEFAS reaching mid-70s—the data align with global trends in patient expectations for returning to daily tasks and, for many, eventual return to sporting activities.

Another salient observation from this study concerns the low incidence of notching or graft impingement, which has been an issue in some ACL reconstructions regardless of graft type. With only 13.3% of patients experiencing "notching," our results indicate that careful surgical technique and accurate tunnel placement can minimize complications. Equally compelling is the consistent correlation between preoperative status and subsequent outcomes: individuals with moderate functional impairment before surgery showed disproportionately large gains in knee function at each follow-up interval, especially by 6 months.

Key Takeaways from This Study:

- **Robust Functional Gains:** Patients demonstrated significant improvements in FADI, AOFAS, and LEFAS scores from the preoperative baseline to 3- and 6months post-surgery.

- **Viable Graft Diameter:** The PLT consistently afforded a diameter ≥8 mm, which is often considered the gold standard threshold to reduce re-injury risks.
- **Low Donor-Site Morbidity:** Our findings align with emerging literature suggesting minimal long-term deficits in ankle-foot function when the peroneus longus is harvested correctly.
- **Broad Applicability:** The diversity of injury mechanisms in our cohort suggests that PLT may be suitable for both high-demand athletes and individuals with every day or occupational knee stresses.
- **Statistically Significant Outcomes:** Improvements in functional scores were not only clinically meaningful but also highly significant ($p<0.0001$), reinforcing the reliability of the peroneus longus graft choice.

CONCLUSION

In summary, the use of peroneus longus tendon in ACL reconstruction stands as a compelling autograft option, particularly well-suited to patients who either lack sufficient hamstring tendon or have reservations about harvesting the patellar tendon. Our findings demonstrate that PLT offers comparable—if not superior—functional recovery over the short to mid-term follow-up, owing to its consistently adequate diameter, high tensile strength, and relative ease of harvest. Although minor donor-site concerns remain a theoretical consideration, the observed functional outcomes and low complication rates argue strongly in Favor of integrating PLT as a mainstream graft choice. Nonetheless, ongoing investigations with larger samples and longer follow-up periods are indispensable for further validating and refining PLT-based ACL reconstruction techniques, and for ensuring optimal long-term knee health and patient satisfaction.

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ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

"FUNCTIONAL OUTCOME IN ACL RECONSTRUCTION WITH PERONEUS LONGUS GRAFT: A HOSPITAL BASED PROSPECTIVE STUDY"

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Introduction: _______________. We are doing a longitudinal study on the functional outcome of using peroneus longus autograft for ACL reconstruction.

Explanation of procedure: You will be assessed for lower limb functionality preoperatively according to LEFA,FIDAS,AOFAS . Under combined spinal and epidural anaesthesia all aseptic conditions , the damaged anterior cruciate ligament is shaved of and an autologous peroneus longus graft is used for ACL reconstruction.

Then you will be called for assessment for lower limb functionality using the same assessment scores mentioned pre-operatively ,after 3 weeks and 6 weeks post operatively .

Withdrawal from participation in the study: Participation in this study involuntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will get benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the principal investigator .

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups.

However, your identity will never be revealed.

Questions: If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"THE FUNCTIONAL OUTCOME IN PATIENTS UNDERGOING HYDRODILATATION FOR ADHESIVE CAPSULITIS IN A TERTIARY CARE HOSPITAL - A ONE YEAR LONGITUDINAL STUDY" .** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE - II

PROFORMA

Name:

Age:

Gender:

Address (Rural / Urban):

Education:

Occupation:

Socioeconomic Status:

Married / Single:

Visit 1:

Chief complaints:

History of present illness:

Past history:

Family history:

General physical examination:

Vital Signs:

Pulse:

B.P:

Systemic examination:

Respiratory system:

Cardiovascular system:

Per abdomen:

Central nervous system:

Clinical assessment of the lower limb: Knee Ankle Follow up:

	LEFAS	FIDAS	AOFAS
Pre-operatively:			
After 3 weeks:			
After 6 weeks:			

In each evaluation the patient is objectively evaluated for functional range of movements by a clinical staging as below

ANNEXURE-3

Patient Name: Date:

ANNEXURE-4

ANKLE HINDFOOT SCALE, AOFAS

Please place a mark on the line that best represents your experience during the examination attributable to your lower limb problem.

Pain scale(40 points)

How severe is your pain?

Circle the number that best describes your pain

- None
- Mild , occasional
- Moderate , daily
- Severe , almost always present
- Function(50 points)
- Activity limitations, support requirement

- No limitations, no support
- No limitations of daily activities, limitations of recreational activities, no support
- Limited daily and recreational activities, can
- Severe limitation of daily and recreational activities, walker , crutches , wheelchair, brace

• Maximum walking distance, blocks

- Greater than 6
- 4-6
- 1-3
- Less than 1

- Walking surfaces

- No difficulty on any surface
- Some difficulty on uneven terrain, stairs , inclines, ladders
- Severe difficulty on uneven terrain, stairs , inclines, ladders

- Gait abnormality

- None , slight
- Obvious
- Marked

- Sagittal motion(flexion plus extension)

- Normal or mild restriction(30° or more)
- Moderate restriction(15°-29°)
- Severe restriction(less than 15°)

- Hind foot motion(inversion plus eversion)

- Normal or mild restriction(75%-100% normal)
- Moderate restriction(25%-24%)
- Severe restriction(less than 25% normal)

- Ankle - Hindfoot stability (anteroposterior, varus-valgus)

- Stable
- Definitely unstable Source:

ANNEXURE III: PHOTOGRAPHS

Markings of the knee and the ankle

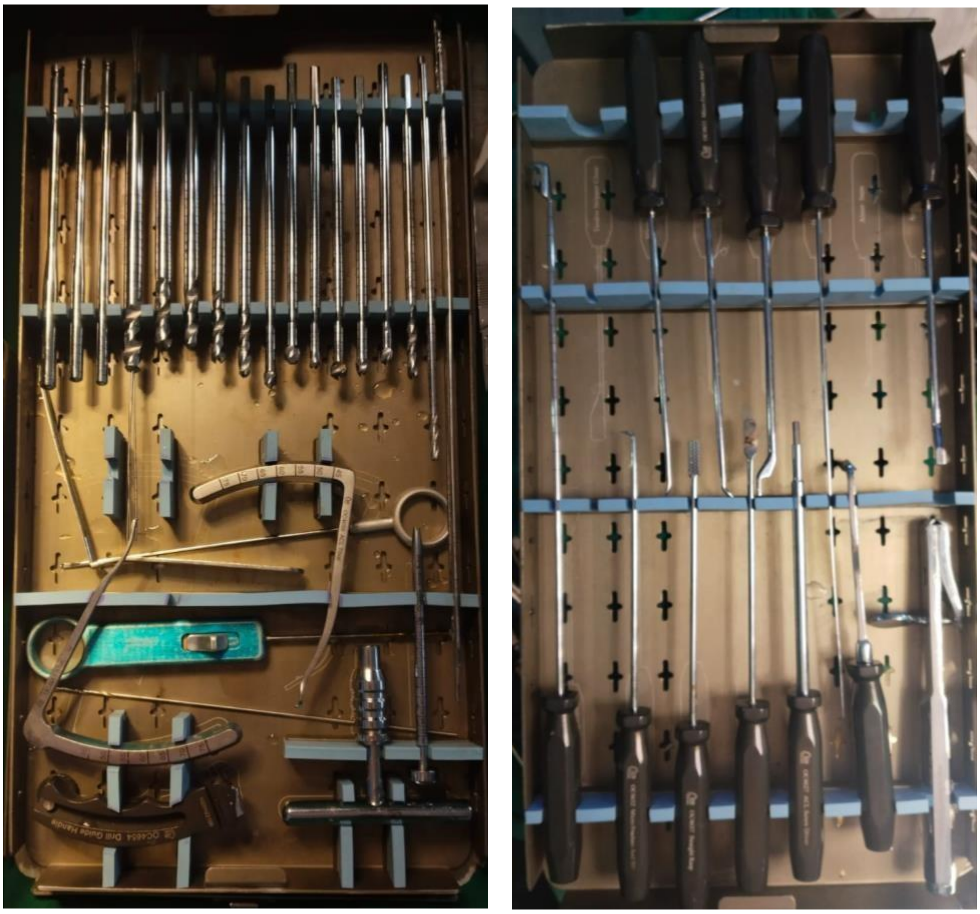
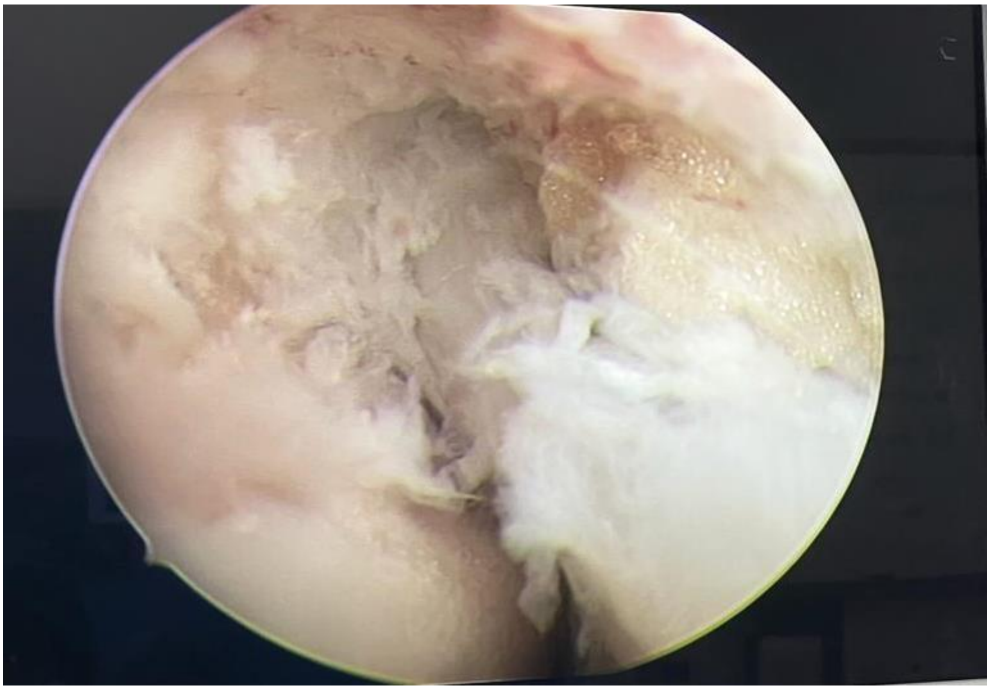


Fig. shows the instruments used in ACL reconstruction



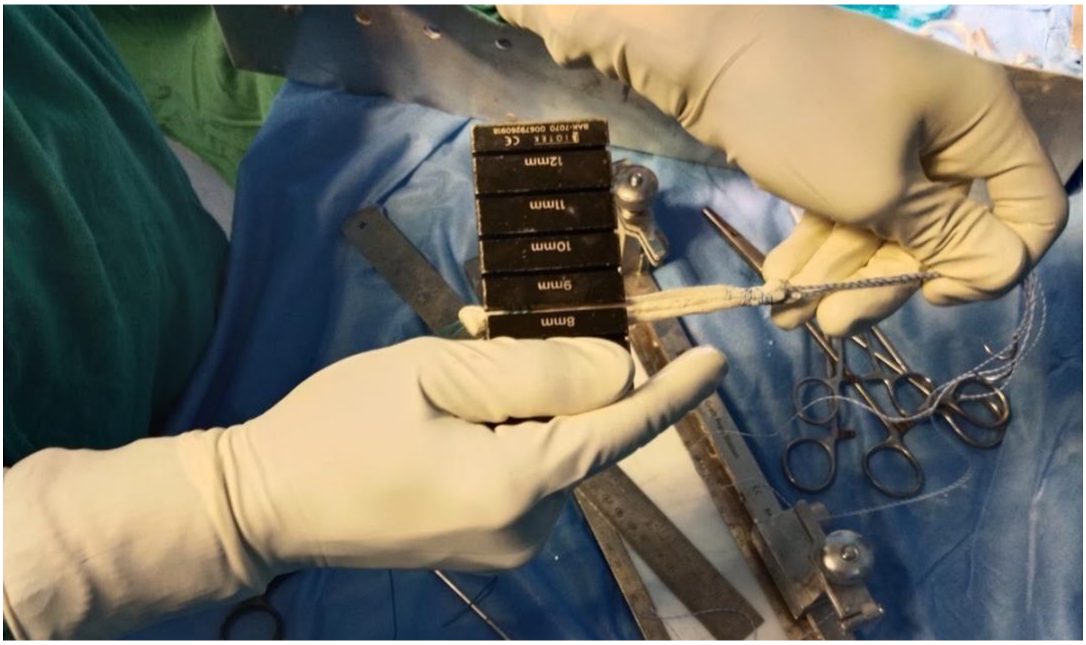


Fig. showing the autologous peroneus longus graft with sizing tools.

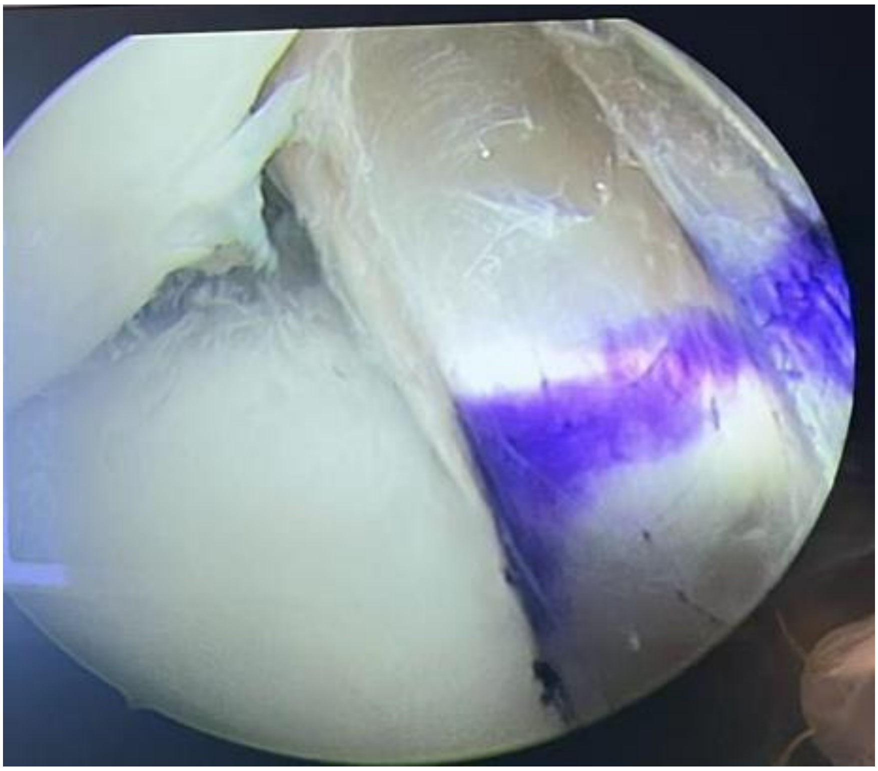


Fig 1: Insertion of the graft into the femoral tunnel Fig 2: post op x-ray of the limb

Fig 1 and 2 showing intact ankle dorsi flexion and inversion movements.

SL NO.	NAME	AGE	SEX	IP NUMBER	MODE OF INJURY	PRE-OP SCORES			PERIOD FROM INJURY	DOS	DIAMETER OF THE GRAFT	NOTCHING	POST OP SCORES AT 3 MONTHS			POST OP SCORES AT 6 MONTHS		
						FADI	AOFAS	LEFAS					FADI	AOFAS	LEFAS	FADI	AOFAS	LEFAS
1	SRUSTHI	24	F	1006985	fall from staircase	36	40	40	1 MONTHS	3-4-2023	9MM	NIL	90	70	50	101	90	72
2	SAVITA	52	F	1008695	TWISTING INJURY	40	50	35	2MONTHS	04-05-2023	8MM	NIL	96	85	55	100	95	78
3	RAMAPPA SIDDAPPA PATIL	34	M	1005632	WORKOUT	55	54	36	6 MONTHS	08-09-2023	10MM	NIL	95	72	57	102	94	76
4	SANGAMESH	49	M	1008695	FALL FROM BIKE	45	58	35	5 MONTHS	12-07-2023	8MM	NIL	89	75	52	100	96	75
5	SUMIT	60	M	1013452	RTA	42	53	34	4 MONTHS	15-06-2023	8MM	NIL	85	77	56	98	98	78
6	BASAVARAJ	55	M	1015689	WHILE WORKOUT	48	52	34	5 MONTHS	17-10-2023	7MM	NIL	90	78	57	97	94	73
7	AHAD	23	M	1025864	WHILE JUMPING	60	59	43	7 MONTHS	14-05-2024	11MM	PRESENT	89	76	54	103	96	73
8	ANIL	42	M	1025953	FALL FROM BIKE	50	54	39	8 MONTHS	21-09-2023	9MM	NIL	93	73	50	104	97	77
9	MAHESH	35	M	1025869	RTA	49	55	37	1 YEAR	24-12-2023	8MM	NIL	97	74	51	100	94	76
10	RAMESH	38	M	1027856	PLAYING SPORT	48	58	35	7 MONTHS	10-01-2024	8MM	NIL	94	79	55	100	95	73
11	MAHANTGOUDA	29	M	10048751	TWISTING INJURY	53	60	47	4 MONTHS	09-05-2024	10MM	NIL	93	77	54	102	94	74
12	RICHARD ROBERT	19	M	10048864	RTA	57	59	43	3 MONTHS	24-11-2023	10.5MM	PRESENT	93	76	56	98	96	75
13	MAHADEVI	44	F	10056894	TRIVIAL FALL	37	49	36	2 MONTHS	05-03-2024	8MM	NIL	91	78	59	99	93	72
14	BHARATHI	40	F	10054231	WEIGHTS FELL ON LIMB	49	53	47	7 MONTHS	27-04-2024	9MM	NIL	88	75	57	97	93	72
15	SUNITHA	35	F	10065428	FALL ON STAIRCASE	35	44	40	4 MONTHS	09-05-2023	10MM	NIL	84	72	53	101	92	71
16	UMESH	37	M	10068775	RUNNING	43	50	39	6 MONTHS	28-02-2024	10MM	NIL	88	70	59	97	96	76
17	BHAGYASHREE	25	F	10068457	FALL ON STAIRCASE	48	51	39	8 MONTHS	16-05-2024	9MM	NIL	89	75	59	99	95	70
18	PRASHANT	30	M	10056894	LIFTING WEIGHTS	52	58	53	7 MONTHS	17-05-2024	8MM	NIL	96	79	58	98	97	78
19	OMKAR	30	M	10045661	WORKOUT	66	65	42	6 MONTHS	17-02-2024	9MM	NIL	94	74	56	99	94	74
20	RAVINDRA	50	M	10069584	RTA	44	50	46	5 MONTHS	09-05-2024	7.5MM	NIL	92	79	55	100	94	75
21	SUNIL KAMBLE	41	M	1156874	PLAYING SPORT	38	43	41	3 MONTHS	9-12-2022	8MM	NIL	83	73	56	100	98	77
22	HRITHIK	34	M	1147869	TRIVIAL FALL	52	60	50	6 MONTHS	19-07-2024	9MM	NIL	100	79	57	103	94	75
23	GIRIMALLA ITNAL	33	M	1155520	WHILE WORKOUT	49	56	46	8 MONTHS	6-12-2022	9MM	NIL	101	73	53	103	98	79
24	SANGAPPA	45	M	1155352	TWISTING INJURY	48	57	49	5 MONTHS	6-12-2022	8MM	NIL	94	79	59	99	95	71
25	BISWAJIT	33	M	1000659	WHILE WORKOUT	47	56	47	2 YEARS	29-11-2024	10MM	PRESENT	95	70	53	101	93	69
26	MOHAHMED	45	M	1000956	TWISTING INJURY	48	55	48	10 MONTHS	25-11-2023	8MM	NIL	94	79	52	102	95	77
27	SHANKARAPPA	31	M	1000678	FALL FROM HEIGHT	56	60	51	11 MONTHS	29-05-2024	9MM	NIL	94	79	54	100	94	77

28	KIRAN KUMAR	27	M	1001134	PLAYING SPORT	54	61	50	12 MONTHS	18-11-2023	10MM	PRESENT	99	74	56	101	99	79
29	RAHUL	24	M	1001247	RTA	59	63	56	2 DAYS	12-09-2024	9MM	NIL	101	78	57	104	99	73
30	URMILA	38	F	1001347	TWISTING INJURY	45	52	49	20 DAYS	19-06-2024	8.5MM	NIL	87	75	58	96	96	74