"CHANGE IN HAMSTRING PARAMETRES AFTER ACL RECONSTRUCTION USING HAMSTRING GRAFT- PROSPECTIVE STUDY"

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"CHANGE IN HAMSTRING PARAMETERS BY ISOKINETIC ANALYSIS AFTER ARTHROSCOPIC ACL RECONSTRUCTION USING HAMSTRING GRAFT-PROSPECTIVE STUDY."**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

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LIST OF ABBREVIATIONS USED

Abbreviation	Expansion
LM	Lateral Meniscus
MM	Medial Meniscus
MRI	Magnetic Resonance Imaging
OA	Osteoarthritis
ACL	Anterior Cruciate Ligament
TNF	Tumor Necrosis Factor

ABSTRACT

INTRODUCTION

After ACL reconstruction (ACLr), muscle weakness is often observed, with lower strength in the extensor muscles when BPTB is used and in flexor muscles when HT is the choice. Torque measurement through isokinetic testing is commonly employed to evaluate knee muscle performance following ACL reconstruction (ACLR). Researchers typically assess patients between five and six months post-reconstruction. During this period, a deficit in extensor torque in the injured leg may exceed 10% and persist for up to two years post-ACLR.

Various measurements of muscle performance play a crucial role in facilitating the return to sports and physical activities after ACLR. Peak torque, the most prevalent strength measure obtained from an isokinetic dynamometer, is often represented as a percentage normalized to body mass. It serves as a reliable indicator of joint function and relative muscle strength compared to peers. Additionally, the angle of peak torque, depicting the torque as a function of knee joint angle during maximal muscle activation, can be beneficial for designing training or rehabilitative programs.

MATERIALS AND METHODS

It is a observational study to be done at Jawaharlal Nehru Medical College And Research Centre, Belgavi where 35 ACL injury patients were followed between Jun 2022 and Setember 2023, where all patients with anterior cruciate ligament injury coming to the OPD and Emergency medical services department formed the study population. The study begun after Ethics committee approval.

Isokinetic dynamometry done 6 weeks and 6 month follow up.After that master chart made and statistical analysis made.

RESULTS

Significant change in ROM max at extension observed in injured knee at 6 month follow up compared to 6 weeks follow up.

Patients who underwent surgery within 6 months of injury had a better outcome than patients who underwent surgery between 6-12months.

Functional outcome of who underwent ACLR with isolated acl injury showed statistical significance when compared with ACL with meniscus injury.

CONCLUSIONS

- Rehabilitation following ACL reconstruction has shifted from a protocol-based paradigm to a progression-based programme with escalating difficulty.
- Early Weight bearing post ACLR plays a vital role in the rehabilitation of quadriceps muscle.
- Patients who underwent ACLR within short period of injury showed promising results with better functional outcome.

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INTRODUCTION

The clinical outcomes of anterior cruciate ligament (ACL) reconstruction involve restoring muscle strength, achieving knee stability, and ensuring sufficient range of motion. While the use of autologous bone patellar tendon bone grafts has declined due to associated donor site issues, such as anterior knee pain and long-term quadriceps femoris dysfunction, quadruple hamstring tendons have become a more common graft source. Postoperative knee extension strength typically decreases initially with a bone patellar tendon bone autograft but improves over time. Conversely, hamstring autograft ACL reconstruction may lead to greater loss of knee flexor strength due to tendon harvesting. However, it remains unclear whether extensor or flexor muscle strength decreases more postoperatively. This study aims to assess changes in hamstring muscle strength over the first year following ACL reconstruction with an autologous hamstring tendon. It is hypothesized that muscle strength will progressively recover but may not fully return even after one year, with a potentially more delayed recovery in knee flexor strength compared to knee extensor strength due to hamstring harvesting. (1)

With the growing emphasis on sports participation, there has been a rise in the occurrence of anterior cruciate ligament (ACL) injuries. The prevailing approach to addressing these injuries is through ACL reconstruction. Numerous studies have indicated a delay and often incomplete restoration of knee extension and flexion strength following ACL reconstruction. Isokinetic testing of the hamstrings and quadriceps muscles has been widely utilized as a reliable method for assessing patients' muscular status during rehabilitation, although there have been criticisms of these testing devices. Conversely, functional tests have emerged as alternative measures for evaluating the muscular condition of the lower limbs, with some research demonstrating their reliability in clinical practice.(2)

After ACL reconstruction (ACLr), muscle weakness is often observed, with lower strength in the extensor muscles when BPTB is used and in flexor muscles when HT is the choice. Torque measurement through isokinetic testing is commonly employed to evaluate knee muscle performance following ACL reconstruction (ACLr). Researchers typically assess patients between five and six months post-reconstruction. During this period, a deficit in extensor torque in the injured leg may exceed 10% and persist for up to two years post-ACLr.

Various measurements of muscle performance play a crucial role in facilitating the return to sports and physical activities after ACLr. Peak torque, the most prevalent strength measure obtained from an isokinetic dynamometer, is often represented as a percentage normalized to body mass. It serves as a reliable indicator of joint function and relative muscle strength compared to peers. Additionally, the angle of peak torque, depicting the torque as a function of knee joint angle during maximal muscle activation, can be beneficial for designing training or rehabilitative programs.

Another approach to interpreting isokinetic results involves dividing the range of motion into three segments: time to attain velocity (TTAV), load range (LR), and deceleration time (DT). These outcome variables offer valuable insights into various aspects, including reaction time and the ability to sustain velocity. This information can significantly contribute to clinical evaluation and the implementation of tailored rehabilitation protocols, ultimately optimizing treatment outcomes. (3)

The rupture of the ACL often results in increased laxity in the knee joint, leading to episodes of anterior and rotational instability, quadriceps atrophy, degeneration of the articular surfaces, meniscal damage, osteoarthritis, and recurrent pain. To address these symptoms and progressive knee dysfunction, two primary treatment options are available following an ACL injury: Conservative rehabilitation or Reconstructive surgery.

Patients willing to reduce their level of sporting activities may opt for conservative rehabilitation. However, those aiming to return to high-level sporting activities are usually advised to undergo ACL reconstruction (ACLr). While surgical reconstruction is the preferred method for treating a ruptured ACL, its associated costs are substantial. In the United States alone, the annual expenditure linked to ACLr surpasses $2 billion, with the financial burden becoming notably formidable when considering the long-term costs associated with subsequent osteoarthritis development.

Despite undergoing ACL injury or reconstruction, achieving full recovery of quadriceps and hamstring muscle strength (torque-generating capacity) is not always attained. Many clinicians and researchers utilize isokinetic dynamometry protocols to assess and monitor these strength deficits. However, there is considerable reservation about the use of isokinetic dynamometry in both applied literature and discussions with colleagues, given its perceived "non-functional" nature. Critics often argue that single-joint measures of muscle performance in a non-weight-bearing (usually seated) setting may not fully reflect real-world functional capacity.

This review paper advocates for the use of isokinetic dynamometry in the anterior cruciate ligament (ACL) reconstruction or deficiency population, where muscle deficits are prevalent, to accurately isolate and quantify these deficits in a safe and controlled manner. Furthermore, it emphasizes the significance of isokinetic dynamometry in individuals with ACL reconstruction or deficiency, as evidenced by its established known-group and convergent validity.

Known-group validity assesses the ability of a specific isokinetic measure to distinguish between individuals who can resume their pre-injury athletic or strenuous activities with minimal functional limitations and those who cannot following an ACL injury. On the other hand, convergent validity evaluates the degree to which a given isokinetic measure correlates with self-report measures of knee function in individuals with ACL reconstruction.

Overall, this paper underscores the importance of isokinetic dynamometry as a valuable tool for accurately assessing and monitoring muscle deficits in ACL reconstruction or deficiency patients, ultimately aiding in the optimization of treatment and rehabilitation strategies.

A basic understanding of the measurement properties of isokinetic dynamometry will guide the clinicians in providing reasoned interventions and advancing the clinical care of their clients. Usefulness of isokinetic dynamometry is contingent upon (1) its ability to quantify muscle deficits in a safe and controlled manner; (2) the extent to which 2 or more distinct groups of individuals with ACLD are distinguished by the isokinetic measurement (i.e., known-group validity); and (3) its strength of relationships with isokinetic measurements and established self-report measures of knee function in patients with ACLr (convergent validity). We hold the premise that healthcare practitioners who understand the measurement properties of isokinetic dynamometry, as applied specifically in ACLr/ACLd populations, are better prepared to provide reasoned interventions and advance the clinical care of their patients.(4)

AIMS AND OBJECTIVES

AIMS

The aim of this study is to evaluate the changes in hamstring strength after anterior cruciate ligament reconstruction (ACLr) with hamstring autograft followed by 6 weeks post operatively and 6 month post operatively.

OBJECTIVES

- The purpose of this study was to systematically compare the muscle strength of patients who have undergone ACL reconstruction using Hamstrings (HST) autograft.
- To decide whether patient can return to sports activity after 6 month of rehabilitation according to parametres measured by Isokinetic Dynamometry.

RESEARCH QUESTION

Can operated side hamstrings parametres achieved significantly compared to contralateral side after doing 6 months of rehabilitation.

REVIEW OF LITERATURE

- A study conducted by Lee et al in china in 2015 concluded that knee muscle strength recovered progressively after ACL reconstruction using autologous hamstring tendons but did not fully recover, being about 80 % that of the uninjured leg even one year after surgery.(5)
- Another study conducted by De jong sn et al during the year 2007 concluded that quadriceps strength deficit is related to ACL injury and is increased by ACL reconstruction, a quadriceps strength deficit of almost 20% persist.(6)
- A study conducted by Kobayashi a et al during year 2004 concluded that quadriceps strength was recovered more slowly than hamstring strength after ACL reconstruction with autogenous graft.(7)
- Another study conducted by Kim hs et al in a year 2013 concluded that the type of graft or fixation device did not make significant differences in clinical outcome or stability of ACL reconstruction.(8)
- Another study conducted by Pua YH et al in a year 2008 concluded that it is unreasonable to expect isokinetic measures from single muscle group to strongly correlate with physical performance.(4)
- A study conducted by Rothstein JM et al in a year 1987 concluded that the usefulness of isokinetic measurements has been hindered by a lack of adequate research and by a proliferation of unscientific terms. In the future, we hope that the role of isokinetic measurements will be clarified by research published in peer-reviewed journals. Until that time, clinicians must be careful in the use of these measurements, and they must assume responsibility for the decisions they make.(32)

- Another study conducted by Keating JL et al in year 1996 cuncluded that dynamometric measurements are affected by many factors that are an unavoidable part of test procedure. Movement-related variables, pretest procedures, test conditions, data-analysis methods, and subject factors (Table) were all found to affect force measurements.(33)

DEFINITION

The anterior cruciate ligament (ACL) is the primary restraint to anterior tibial translation. It is a collagenous structure and has two major bundles that function as a unit to provide isometric knee stabilization.

ANTERIOR CRUCIATE LIGAMENT ANATOMY

The anterior cruciate ligament (ACL) serves to control the anterior movement of the tibia and prevent extreme ranges of tibial rotation. Most experts agree that the ACL comprises two major bundles: the posterolateral bundle (PL) and the anteromedial bundle (AM).

These ACL bundles derive their names from their tibial insertion points. Both bundles originate from the posteromedial aspect of the lateral femoral condyle and insert just anterior to the intercondylar tibial eminence. The broad tibial insertion of the ACL is designed to prevent impingement on the intercondylar notch in full extension. Thus, during reconstructive surgery, it is crucial to ensure that the placement of the ACL graft insertion into the tibia adheres to this principle. The mean length of the AM bundle is approximately 33 mm, while that of the PL bundle is around 18 mm. The overall width of the ACL ranges from 7 to 17 mm in cadavers, with an average of 11 mm. Additionally, the average cross-sectional area of the ACL is approximately 36 mm2 for women and 47 mm2 for men. The ACL primarily consists of type I collagen fibers.

Studies by Giuliani et al have revealed that the primary blood supply to the ligament is from the middle genicular artery, supplemented by additional supply from the inferomedial and inferolateral genicular arteries. Furthermore, various types of mechanoreceptors are present within the ACL, including Ruffini corpuscles, Pacinian corpuscles, Golgi-like organs, and free nerve endings.

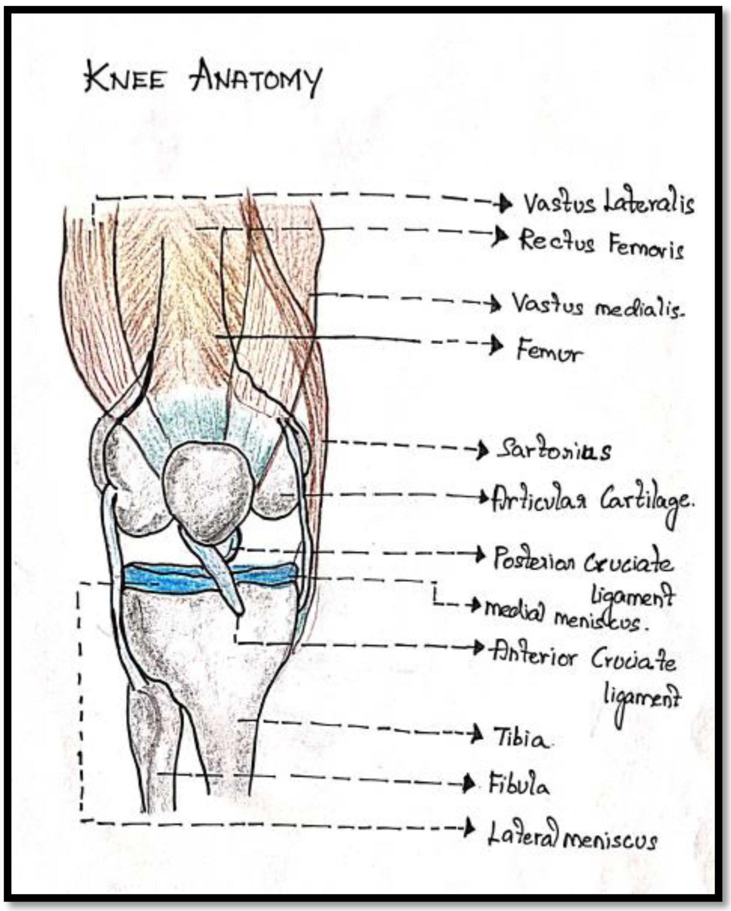


Figure 1: Anatomy

ANTERIOR CRUCIATE LIGAMENT BIOMECHANICS

Forces transmitted through anterior cruciate ligament (ACL) bundles vary depending on the position of the knee joint. In a study by Gabriel et al., an anterior tibial load and a combined rotatory load were applied to the medial side of cadaveric knees, stressing the valgus angle and an internal tibial torque. The testing aimed to replicate the in situ strain associated with the ACL. Results showed that the greatest forces transmitted through the anteromedial (AM) bundle occurred at 60 and 90 degrees of flexion, while the posterolateral (PL) bundle experienced the greatest force at full extension. At 15 degrees of flexion, there was no statistically significant difference in stress between the two bundles.

Another study using cadaveric knees found that the PL bundle handled more force overall than the AM bundle in response to anterior tibial loads. The in situ forces in the AM bundle remained relatively constant and unaffected by changes in flexion angle and anterior tibial load force. The in situ forces in the PL bundle correlated with those of the entire ACL at different flexion angles. This suggests that during ACL reconstruction surgery, closely replicating the PL bundle's position may be more important than that of the AM bundle.

Most ACL injuries occur when the knee is at full extension, making the PL bundle crucial for overall biomechanical stability. Based on these findings, it is evident that both the AM and PL bundles have unique contributions to load transfer across the knee joint. Standard ACL reconstructions tend to restore the limit of anterior tibial translation closer to that of an intact knee. However, they may not fully address more complex rotatory motions, such as internal tibial and valgus rotation.

It is thus essential for surgical techniques to address the function of both bundles. The PL bundle carries the majority of the load when the knee is at full extension or 15% flexion, particularly in response to rotatory loads, while the AM bundle carries the majority of the load with the knee flexed past 30%. Therefore, reconstructions should aim to replicate the function of both bundles to restore full knee function and stability.

MRI AND GRADING OF ACL INJURY

A 1.5-tesla scanner from Siemens was utilized for imaging. Three sequences were employed for assessing the integrity of the cruciate ligament: sagittal and coronal fat-saturated proton-density–weighted turbo spin–echo images (repetition time: 3610 msec; echo time: 40 msec; slice thickness: 3.5 mm; interslice gap: 0 mm; echo train length: 7; field of view: 140 mm × 140 mm; matrix: 256 × 256), as well as sagittal T1-weighted spin–echo images (repetition time: 475 msec; echo time: 24 msec; slice thickness: 3.5 mm; interslice gap: 0 mm; field of view: 140 mm × 140 mm; matrix: 256 × 256).

The MRI scans were evaluated by a single reader with a background in orthopedics. In cases where the findings were inconclusive, confirmation was sought from a second reviewer, who was a musculoskeletal radiologist**.**

CLASSIFICATION

- **Grade 1:** The ligament has sustained mild damage and been slightly stretched (ACL sprain) but can still keep the knee joint stable.
- **Grade 2:** The ACL is stretched and becomes loose. This type of ACL injury is often referred to as a partial tear of the ligament. It is rare.
- **Grade 3:** Commonly referred to as a complete ligament tear (complete ACL tear), the ACL is split into two pieces and the knee is unstable.

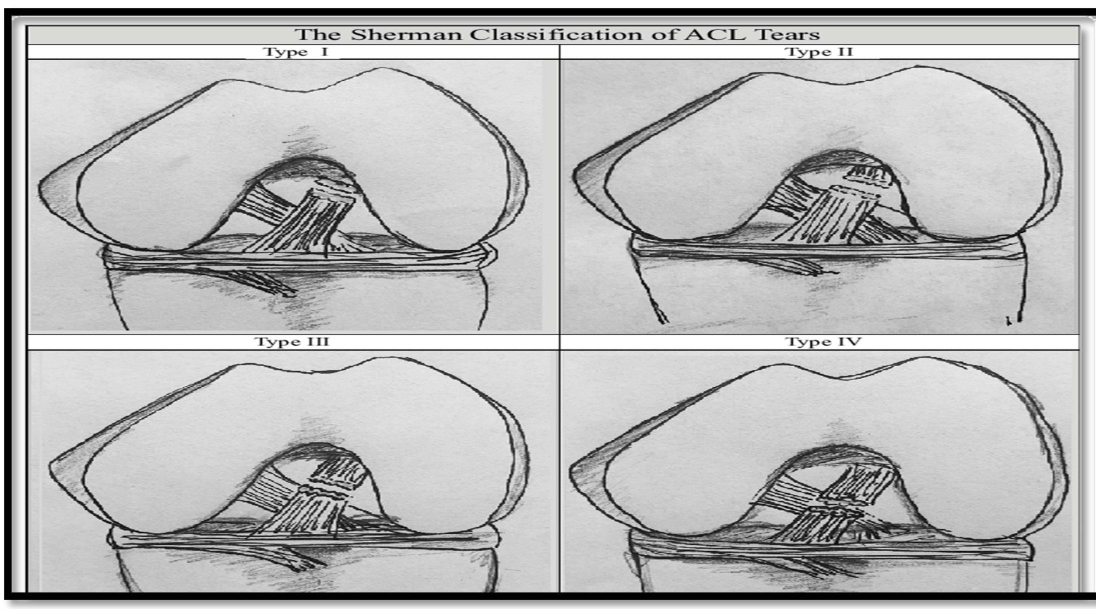


Figure 2: Classification

Illustrations of the four types of ACL tears as described by Sherman et al . Type I is an avulsional, proximal tear. Type II is a proximal fourth tear. Type III is a proximal third tear. Type IV is a midsubstance tear.

ETIOLOGY

- Suddenly slowing down and changing direction (cutting)
- Pivoting with your foot firmly planted
- Landing awkwardly from a jump
- Stopping suddenly
- Receiving a direct blow to the knee or having a collision, such as a football tackle

RISK FACTORS – MODIFIABLE NON MODIFIABLE

- Being female — possibly due to differences in anatomy, muscle strength and hormonal influences
- Participating in certain sports, such as soccer, football, basketball, gymnastics and downhill skiing
- Poor conditioning
- Using faulty movement patterns, such as moving the knees inward during a squat
- Wearing footwear that doesn't fit properly
- Using poorly maintained sports equipment, such as ski bindings that aren't adjusted properly
- Playing on artificial turf

PATHOPHYSIOLOGY

The anterior cruciate ligament (ACL) serves as the primary restraint to anterior tibial translation and facilitates the screw-home mechanism during knee extension. Additionally, it plays a secondary role in preventing varus and valgus stresses, particularly when the knee is extended. Injury to the ACL disrupts the normal kinematics of the knee, leading to episodes of subluxation and creating abnormal shear forces on the meniscus and articular cartilage. Consequently, the risk of subsequent meniscal injury is significantly increased.

The authors have observed a noteworthy rise in meniscal pathology when ACL reconstruction is delayed. This delay is associated with a higher incidence of osteoarthritis. In a series conducted by the authors, a 15% incidence of ACL tears was documented in patients undergoing total knee replacement (TKR). This incidence is at least three times greater than that found in the general population.

HISTOPATHOLOGY AND CLINICAL RELAVANCE

After rupture, the human anterior cruciate ligament (ACL) progresses through four histological phases: inflammation, epiligamentous regeneration, proliferation, and remodeling. While the response to injury shares similarities with other dense connective tissues, there are notable differences. These include the formation of an alpha-smooth muscle actin-expressing synovial cell layer on the surface of the ruptured ends, the absence of tissue bridging the rupture site, and the presence of an epiligamentous reparative phase lasting eight to twelve weeks. Additionally, characteristics such as fibroblast proliferation, alpha-smooth muscle actin expression, and revascularization also occur in the healing process of the ruptured human anterior cruciate ligament.

Unlike extra-articular ligaments, which can heal after injury, the human intra-articular ACL forms a layer of synovial tissue over the ruptured surface, potentially hindering ligament repair. Furthermore, a significant number of cells within this synovial layer and the epiligamentous tissue express the gene for alpha-smooth muscle actin, indicating their differentiation into myofibroblasts. These events may contribute to the retraction and lack of healing observed in ruptured anterior cruciate ligaments.

Epidemiology including risk factors and primary prevention

In the United States, there are approximately 250,000 ACL injuries reported annually. Research indicates that female high school athletes have a higher rate of injury per hours of exposure compared to their male counterparts, especially in sports like soccer and basketball. Similarly, football and lacrosse pose higher risks for men. Both intrinsic and extrinsic factors contribute to ACL injury risk.

Intrinsic factors include biological sex, hormonal status, genetic predisposition, neuromuscular deficits, cognitive factors, anatomical variations, and history of previous injury. Extrinsic factors involve the level and type of activity, playing surface, environmental conditions, and equipment used. Neuromuscular control patterns play a significant role in ACL injury risk, with identified patterns including increased dynamic knee valgus, decreased hip and knee flexion, increased internal rotation of the hip coupled with increased external rotation of the tibia, and increased quadriceps muscle activation.

Importantly, both neuromuscular control patterns and biomechanical movement patterns are modifiable risk factors that can be targeted through specific prevention programs. This highlights the potential for interventions aimed at modifying these factors to reduce the incidence of ACL injuries.(9,10)

Specific secondary or associated conditions and complications

Meniscal injury commonly accompanies ACL injury and is a recognized risk factor for future osteoarthritis development. Quadriceps weakness, attributed to muscle inhibition or impaired neural activation, is frequently observed in both the injured and uninjured legs following ACL injury and is considered a contributing factor to osteoarthritis development. Restricted motion, particularly in knee extension, has also been linked to osteoarthritis.

Persistent proprioceptive deficits following ACL injury may heighten the risk of knee instability and subsequent chondral injury. However, there is limited evidence suggesting that proprioceptive deficits, as assessed by commonly used tests, adversely affect function in individuals with ACL deficiency or those who have undergone ACL reconstruction.(13)

Essentials of Assessment

History

An accurate history plays a pivotal role in diagnosing ACL injury. Patients typically report experiencing a sensation of a "pop" or "give-way" in the knee. Noncontact mechanisms, such as aggressive cuts, pivots, deceleration movements, awkward landings from jumps, or knee hyperextension, are commonly associated with ACL injury. Another mechanism involves valgus collapse, resulting from a medially directed contact hit to the knee.

In recreational skiing, the majority of ACL injuries occur due to the "phantom foot" mechanism, characterized by internal rotation of the tibia with the knee flexed beyond 90 degrees. The rigid ski boot amplifies anterior directed force during falls involving sitting back or attempting to recover from a fall with aggressive quadriceps contraction.

Patients typically experience rapid knee swelling, along with pain, swelling, and a sensation of instability that impedes their ability to return to sports or activities. (14)

Physical Examination

Diagnosing ACL injury often involves the Lachman's test and the Pivot shift test of Mcintosh. The Lachman's test evaluates the ACL's ability to control anterior tibial translation with the knee flexed at 20-30 degrees while stabilizing the femur. This test demonstrates high sensitivity (87%) and specificity (97%) for detecting ACL tears. Increased tibial excursion without a clear end point indicates ACL disruption. Proper hamstring relaxation is crucial for accurate Lachman's test performance, as hamstring contraction can hinder sensitivity by opposing anterior tibial translation.

The Pivot shift test is a dynamic assessment involving rotation and valgus pressure on the knee, resulting in tibial plateau subluxation and reduction. It has a reported sensitivity of 0.49 and specificity of 0.98. The anterior drawer test, although commonly used, is less sensitive in detecting acute ACL injury compared to the Lachman's and Pivot shift tests.

Functional Assessment

After an acute ACL injury, individuals often require assistance with ambulation using crutches until weight-bearing pain subsides and gait mechanics return to normal. However, upon discontinuation of crutches, abnormal gait patterns may persist. These patterns can include hip retraction and reduced hip and knee flexion in the affected leg, which can impact limb advancement.

Following injury or surgical reconstruction, a functional evaluation may reveal difficulties with single-leg control, valgus collapse during activities such as single-leg squats or stepping down from a bench, and abnormal landing techniques from jumps, characterized by knee extension and valgus collapse. Importantly, these biomechanical abnormalities may be present in both the injured and non-injured limbs.

IMAGING FEATURES

Radiography:

The presence of calcium in the body results in the absorption of radiation during the procedure, causing bone structures to appear white on imaging. In clinical assessment of the knee, weight-bearing conditions are favored as they allow for natural loading of the knee during functional movements, aiding in a more accurate evaluation of its function and condition.

Magnetic Resonance Imaging (MRI):

The principles of magnetic waves are integral to the functionality of MRI technology. Patients are positioned within the MRI tube while lying down, facilitating the generation of highly detailed cross-sectional and longitudinal images.

Consequently, MRI is widely regarded as an invaluable tool in research studies due to its ability to produce precise and promising imaging results.

Computed Tomography (CT):

In this process, computer technology is employed to generate internal body images obtained from a rotating X-ray machine. This procedure is commonly utilized for evaluating the anterior cruciate ligament, involving imaging of both weight-bearing and non-weight-bearing joints.[41] Additionally, contrast dye may be utilized to improve the accuracy and clarity of visualization in specific areas of interest.

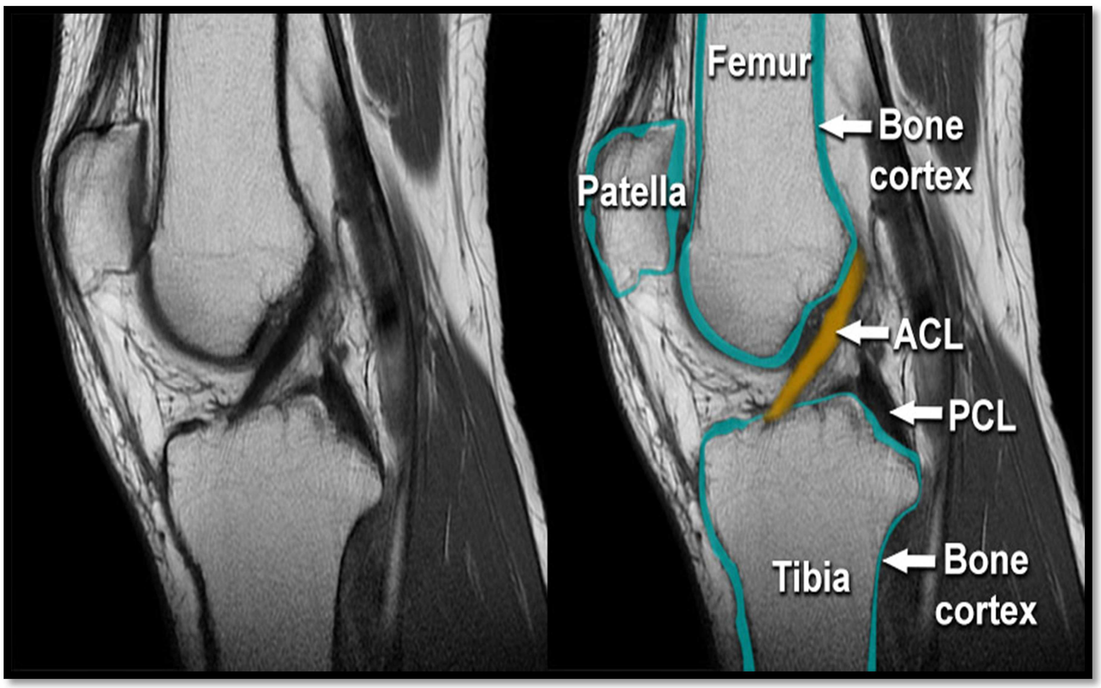


Figure 3: Normal MRI showing ACL

Figure 4: MRI showing TORN ACL

DEFINITION

An ACL injury is a tear or sprain of the anterior cruciate ligament (ACL).

MANAGEMENT OF ACL INJURY- CONSERVATIVE

Grade 1 ACL injuries typically do not involve complete tearing of the ligament fibers and can often be managed nonsurgically. Treatment options may include immobilization or bracing to stabilize the knee, physical therapy to strengthen the surrounding muscles and improve range of motion, and a gradual return to regular activities and sports. These conservative measures aim to support the healing process and restore normal function without the need for surgical intervention.

SURGICAL

Surgical treatment is recommended for individuals with a grade 3 or complete ACL tear. Surgical options may vary based on the type of ACL injury, whether the patient has open or closed growth plates, and the type.

ACL RECONSTRUCTION TECHNIQUE

Reconstruction of the ACL follows a number of basic steps, although they may vary slightly from case to case:

- The orthopedic surgeon makes small incisions around the knee joint, creating portals of entry for the arthroscope and surgical instruments.
- The arthroscope is inserted into the knee and delivers saline solution to expand the space around the joint. This makes room for surgical tools, including the arthroscopic camera, which sends video to a monitor so that the surgeon can see inside the knee joint.
- The surgeon then evaluates structures that surround the torn ACL, including the left and right meniscus and the articular cartilage. If either of these soft tissues have any lesions, the surgeon repairs them.
- Next the graft will be harvested (unless a donor allograft is used). A section of tendon from another part of the patient's body is cut to create a graft, which is then attached at each end to plugs of bone taken from the patella and tibia. These plugs help to anchor the graft that will become the new ACL.
- The surgeon inserts the new ACL into the femur and tibia using a flexible guide wire.

- Screws are used to secure the plugs of bone. Over time, these plugs will grow into the surrounding bone.
- The surgical instruments are removed to complete the procedure.

ACL repair is an older technique that involved sewing the torn ACL tissue back together with sutures, rather than rebuilding it with a graft.

METHODS AND METHODOLOGY

It is a observational study to be done at Jawaharlal Nehru Medical College And Research Centre, Belgavi between Jun 2022 and Setember 2023, where all patients with anterior cruciate ligament injury coming to the OPD and Emergency medical services department will form the study population. The study will begin after Ethics committee approval.

Study Design: Hospital based PROSPECTIVE= Study.

Sample Size: Calculation is based on previous study done by Martin Englund et al in 2008, where the prevalence of meniscal damage in patients with radiographic osteoarthritis of the knee was 82%.

$$n = \left(Z \propto 2\right) \times P(100 - p) \div d^2$$

n = 35 ACL Injury cases

STATISTICAL ANALYSIS

The data was subjected to statistical analysis using a Stata 10 software We applied ANOVA or a chi square test. A P>0.05 was considered to give a statistical significance.

METHODOLOGY

- After getting the anesthetic fitness, the patient will be posted for arthroscopic ACL reconstruction surgery, by using hamstring tendon.
- After operation patients were put on rehabilitation programme.
- Patients were followed 6 weeks and 6 month post operative period and Isokinetic analysis done.

Rehabilitation Management and Treatments

Over the past decade, ACL rehabilitation has undergone significant evolution, moving away from techniques like postoperative casting, delayed weight bearing, and limited range of motion (ROM) towards early rehabilitation programs emphasizing immediate ROM training and weight-bearing exercises. This shift has been propelled by intensive research into the biomechanics of both injured and operated knees.

ACL rehabilitation is crucial for both non-surgically and surgically managed patients. Non-operative treatment may be suitable for sedentary patients, considering factors such as age, level of physical activity, and subjective instability symptoms in daily life activities. In such cases, a physiotherapeutic program focusing on restoring full ROM, enhancing proprioception, and training normal gait patterns could be the optimal rehabilitation protocol.

However, if symptomatic knee instability persists despite physiotherapy or activity modification, ACL reconstruction is recommended. This approach aims to prevent further interventions due to potential meniscal and cartilage damage.

It's important to note that ACL injuries rarely occur in isolation, often accompanied by additional injuries such as Medial Collateral Ligament (MCL) tears or meniscal damage. Associated injuries like microfractures or bone contusions, with or without chondral injuries, further complicate the rehabilitation process. In such cases, individualized ACL rehabilitation programs tailored to specific comorbidities are essential.

The primary objectives of general rehabilitation for an ACL-injured knee are as follows:

1. Achieve full range of motion (ROM) in the knee.
2. Restore muscle strength and proprioception.
3. Attain optimal functional stability of the knee.
4. Restore the knee to its pre-injury functional level.
5. Reduce the risk of re-injury.

Available or current treatment guidelines

The objective of treating an ACL injury is twofold: to mitigate the risk of recurring knee instability and to safeguard the joint from additional trauma. This can be achieved through either nonsurgical intervention, which involves modifying activities, undertaking lower extremity strength and stability training, and employing appropriate bracing, or surgical reconstruction or repair of the ligament[24,25]. It is crucial to avoid engaging in high-risk activities to prevent recurrent instability episodes and further harm to other knee structures like the menisci and articular cartilage[26].

At different disease stages

The initial treatment for an ACL injury aims to address inflammation, pain, and swelling while also enhancing strength, neuromuscular control, and gait quality. The decision regarding whether to opt for surgery alongside rehabilitation or pursue rehabilitation with bracing depends on various factors. Young and competitive athletes desiring to return to activities involving aggressive movements like jumping, cutting, or deceleration, as well as patients with meniscal tears amenable to repair, often choose surgical reconstruction. Conversely, individuals not engaged in high-risk movement patterns can typically manage knee stability with rehabilitation alone.

ACL rehabilitation protocols typically encompass three phases: acute, recovery, and functional, followed by a structured return-to-play (RTP) phase. Progression through these phases should be guided by individual progress rather than a strict timeline based on injury or surgery. For those treated without surgery, rehabilitation commences with modalities aimed at alleviating pain and swelling, followed by exercises to regain full range of motion. Return to activity is contingent upon meeting specific criteria, including absence of symptoms at rest or with activity, normal strength, range of motion, and satisfactory performance on functional tests.

Pre-operative rehabilitation is advised before surgical intervention, focusing on reducing knee swelling, attaining full motion (especially knee extension), and restoring normal strength. Post-operative rehabilitation programs prioritize early weight bearing, pain and swelling management, improvement of range of motion, and activation of quadriceps muscles during the acute phase. RTP decisions are based on physical examination findings, physical readiness (assessed via isokinetic testing and hop tests), as well as psychological readiness.(27)

Rehabilitation Protocol

STAGE1; 0-2weeks

- Patella mobilization
- Motion with long knee brace 0-90 degrees
- Quadriceps sets/straight leg raising in all planes
- Passive extension

- Prone hangs
- Pillow under heel
- Partial weight bearing 50-75% with crutches.
- Sleep in brace locked in full extension.

STAGE 2:2-4 weeks

- Motion control brace-full range motion
- Passive, active and active assisted ROM knee flexion
- Progress ROM to 120 degrees by 4th week
- Progress SLR
- Wall sits at 45 degree angle with tibia vertical, progress time
- Knee extension 90 to 60 degrees with manual resistance by therapist.

STAGE 3:4-10 weeks

- Progress to full ROM by 6 weeks
- Begin lunges
- Continue strengthening of lower extremity muscle groups especially throughfull range of hamstring/quadriceps.

STAGE 4:12-16 weeks

- Continue flexibility exercises
- Quadriceps strength progression

STAGE 5:16-18 weeks

- Begin jogging program if quadriceps strength 65%.

STAGE 6:5-6months

- Sports specific drills
- Agility training

STAGE 7:6 months

- Return to normal life routine

Budget Plan

A. DIRECT COST:

a. Personal

b. Equipment

c. Investigations -ISOKINETIC ANALYSIS

- RS 84000

B. INDIRECT COST:

a. Printing and copying supplies

b. Data collection and transport

c. Meeting and other expenses

C. MISCELLANEOUS:- Rs 10,000

TOTAL = Rs 94000

INCLUSION CRITERIA

1. Patient undergoing arthroscopic ACL reconstruction using hamstring graft
2. Age above 18 years
3. An interval of 6 weeks from trauma to surgery

EXCLUSION CRITERIA

1. Congenital deformity
2. Patient is having neurological disorder of lower limb
3. Patient having Multi-Ligamentous Injury of knee

ISOKINETIC ANALYSIS

Figure 5: Isokinetic Dynamometer

To assess the isokinetic variables, a Biodex Isokinetic Dynamometer (System 3, Software version 3.2) was employed. Before testing, participants underwent a warm-up on an ergonomic bicycle for five minutes, consisting of submaximal effort with a comfortable load and cadence to prevent fatigue. Subsequently, the dorsiflexor and plantar flexor muscles underwent three sets of 30-second stretches.

Prior to commencing the tests, the isokinetic dynamometer was calibrated and positioned optimally. Participants were seated, with the tested limb placed in a support at the distal thigh, and the foot sole supported by a rigid plate. The ankle joint's biological axis of motion was aligned with the dynamometer's mechanical axis, while the knee was maintained at 30° of flexion. The rigid plate permitted a 20° range of plantar flexion from the ankle's neutral position. Participants were secured in this position using thoracic and pelvic belts, Velcro straps on the thigh's distal portion, and Velcro straps on the metatarsal area dorsally on the foot. Additionally, participants were instructed to grasp the chair's lateral support for enhanced stability.

Following positioning, participants performed three submaximal repetitions to familiarize themselves with the equipment. Data recording included a set of five repetitions at a velocity of 60°/s and another set of 30 repetitions at 180°/s, in both concentric/eccentric and eccentric/concentric modes for plantar flexion and dorsiflexion. Ten seconds of rest were provided between sets. These tests were bilateral and standardized, with the right lower limb evaluated first. Verbal encouragement was consistently provided during the tests to ensure participants exerted maximum strength during contractions.

For the 60°/s speed, peak torque was analyzed, representing the maximum torque attained during the series of five repetitions, expressed in Newton-meters (N•m). For the 180°/s speed, total work was analyzed, defined as the cumulative muscle work performed in the 30 repetitions, expressed in joules (J).

RESULTS

Table 1: Gender vise distribution

GENDER	NUMBER	%
FEMALE	20	57.14
MALE	15	42.86
TOTAL	35	100.00

Graph 1: Gender distribution of the sample

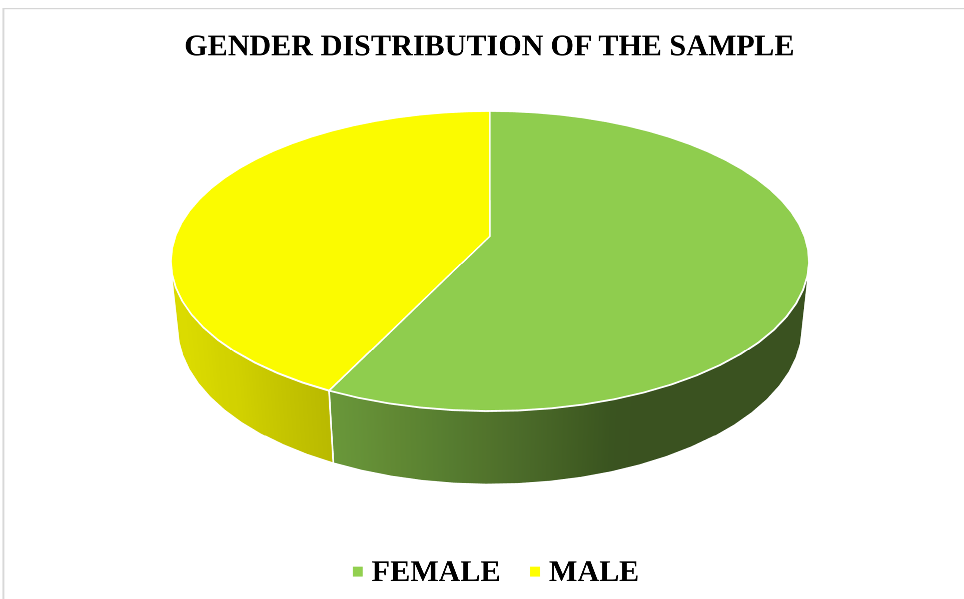


Table 2: Showing age wise distribution of ACL cases

AGE	NUMBER	%
15 – 24	13	37.14
25 – 34	11	31.43
35 – 44	2	5.71
45 – 54	7	20.00
55 – 64	2	5.71
TOTAL	35	100.00

Graph 2: Age distribution of the sample

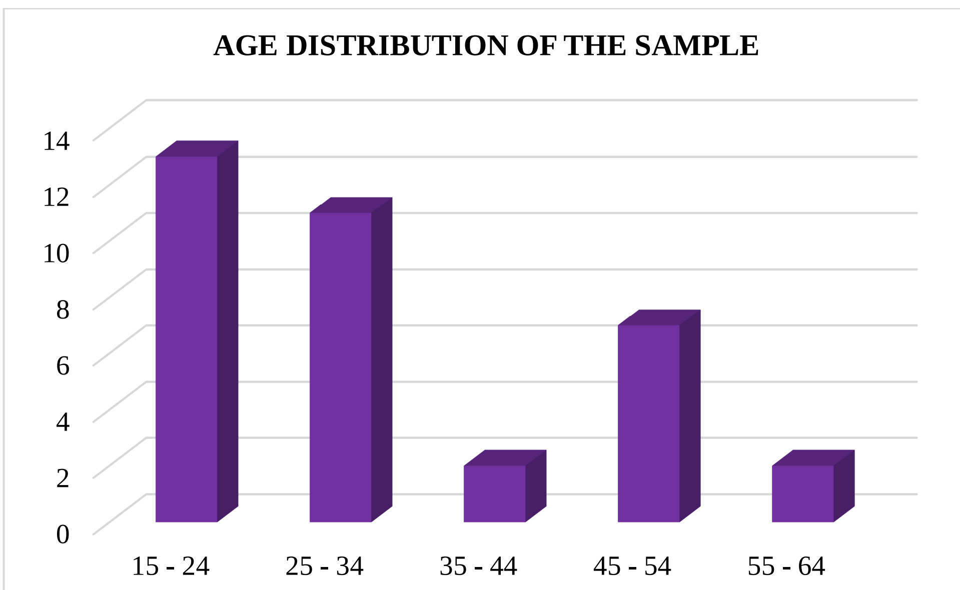


Table 3: Mean age

	MEAN	S.D.	MIN	MAX
AGE	32.89	12.97	18	67

Table 4: Right knee involvement is more than left in this study.

COMPLAINT	NUMBER	%
LEFT KNEE PAIN	17	48.57
RIGHT KNEE PAIN	18	51.43
TOTAL	35	100.00

Table 5: RTA is the major cause for ACL tear than Self fall in this study

HISTORY	RTA	SELF FALL	TOTAL
LEFT KNEE PAIN	10	7	17
RIGHT KNEE PAIN	9	9	18
TOTAL	19	16	35

Table 6: ACL grade 3 is more in this study

ACL TEAR GRADE	2	3	TOTAL
LEFT KNEE PAIN	10	7	17
RIGHT KNEE PAIN	6	12	18
TOTAL	16	19	35

IN THE FOLLOWING TABLES p VALUES ARE CALCULATED USING STUDENT'S PAIRED t TEST

ABBREVIATIONS: NS -NOT SIGNIFICANT

S - SIGNIFICANT VS - VERY SIGNIFICANT

HS - HIGHLY SIGNIFICANT

Table 7: Showing normal and injured site parameters at 6 weeks of follow up.

	Injured Side				Normal Side					
	MEAN	S.D.	Min	Max	Mean	S.D.	Min	Max	P Value	Inference
ROM MAX EXT	30.94	28.80	1	114	30.40	29.08	0	115	0.8194	NS
ROM MAX FLX	78.80	37.28	0	123	77.14	36.62	0	123	0.2021	NS
AVG. PEAK TORQUE EXT	46.31	42.80	12	220	43.86	46.98	4	220	0.4550	NS
AVG. PEAK TORQUE FLX	27.40	35.96	5	183	28.17	33.94	4	179	0.6699	NS
MAX POWER EXT	72.17	85.26	8	395	67.06	72.30	1	303	0.2358	NS
MAX POWER FLX	30.63	45.05	1	239	34.40	43.26	0	179	0.3674	NS

Table 8: Showing injured and normal side parametres at 6 month follow up.

	Injured Side				Normal Side					
	MEAN	**S.D.**	**MIN**	**Max**	**Mean**	**S.D.**	**Min**	**Max**	**P Value**	**Inference**
ROM MAX EXT	39.71	30.83	1	110	40.20	26.39	1	88	0.8541	NS
ROM MAX FLX	77.94	44.02	0	140	78.49	32.91	12	134	0.8881	NS
AVG. PEAK TORQUE EXT	61.97	56.13	5	186	51.94	34.00	5	159	0.2473	NS
AVG. PEAK TORQUE FLX	41.40	34.05	4	140	34.74	25.24	7	102	0.1648	NS
MAX POWER EXT	72.46	61.34	5	284	76.11	55.05	1	283	0.5080	NS
MAX POWER FLX	39.09	35.57	3	155	38.23	26.51	3	104	0.8492	NS

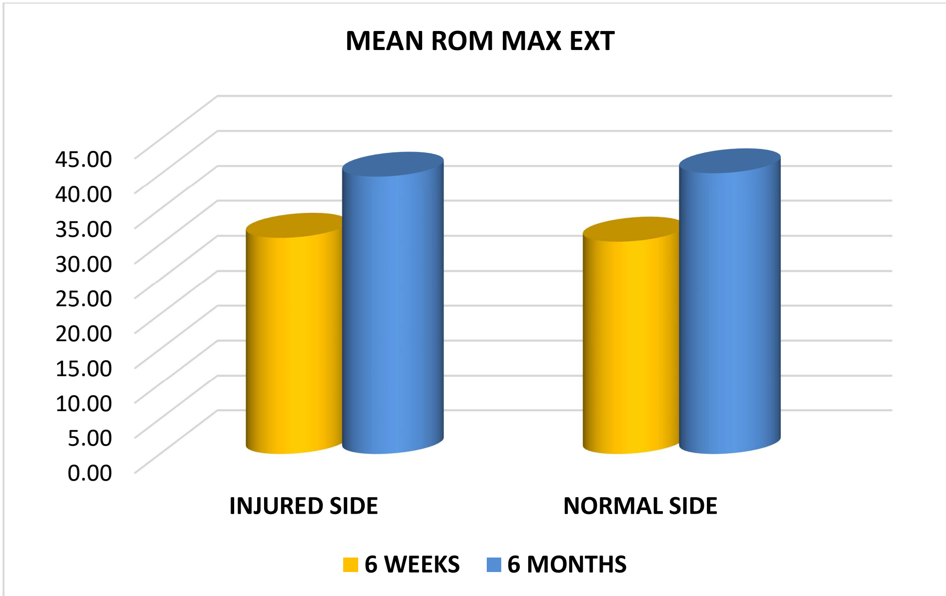
Table 9: Showing 6 week and 6 month interval parametres and their p values of injured side.

	6 Weeks				6 Months					
	MEAN	**S.D.**	**Min**	**Max**	**Mean**	**S.D.**	**Min**	**Max**	**P Value**	**Inference**
ROM MAX EXT	30.94	28.80	1	114	39.71	30.83	1	110	0.0103	S
ROM MAX FLX	78.80	37.28	0	123	77.94	44.02	0	140	0.8302	NS
AVG. PEAK TORQUE EXT	46.31	42.80	12	220	61.97	56.13	5	186	0.1021	NS
AVG. PEAK TORQUE FLX	27.40	35.96	5	183	41.40	34.05	4	140	0.0466	NS
MAX POWER EXT	72.17	85.26	8	395	72.46	61.34	5	284	0.9790	NS
MAX POWER FLX	30.63	45.05	1	239	39.09	35.57	3	155	0.2842	NS

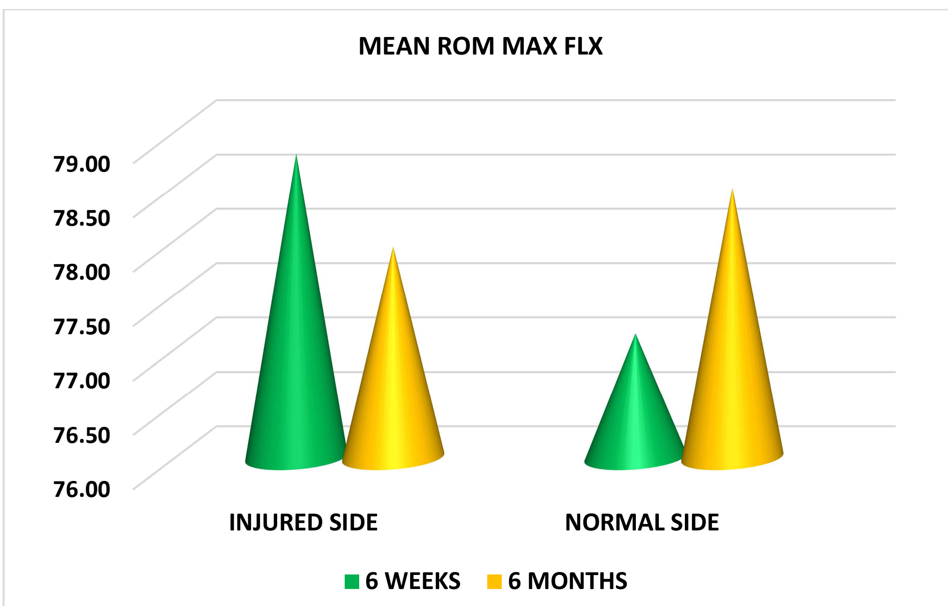
Table 10: Showing 6 week and 6 month interval parametres and their p values of normal side.

	6 Weeks				6 Months					
	MEAN	**S.D.**	**Min**	**Max**	**Mean**	**S.D.**	**Min**	**Max**	**P Value**	**Inference**
ROM MAX EXT	30.40	29.08	0	115	40.20	26.39	1	88	0.0398	S
ROM MAX FLX	77.14	36.62	0	123	78.49	32.91	12	134	0.7126	NS
AVG. PEAK TORQUE EXT	43.86	46.98	4	220	51.94	34.00	5	159	0.0470	NS
AVG. PEAK TORQUE FLX	28.17	33.94	4	179	34.74	25.24	7	102	0.1387	NS
MAX POWER EXT	67.06	72.30	1	303	76.11	55.05	1	283	0.2196	NS
MAX POWER FLX	34.40	43.26	0	179	38.23	26.51	3	104	0.4030	NS

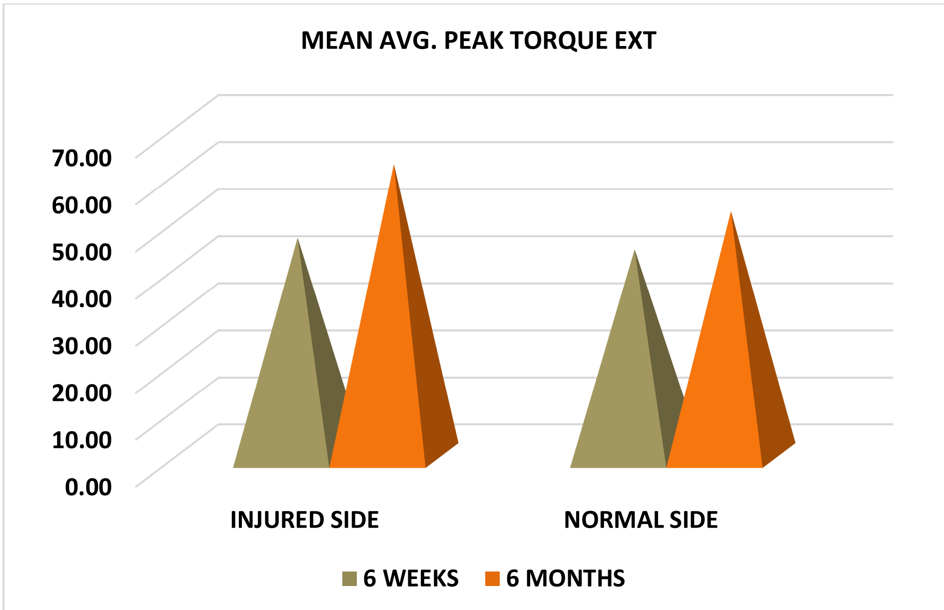
Graph 3: Showing change in MEAN ROM MAX EXT of injured and normal side at 6weeks and 6 months interval.



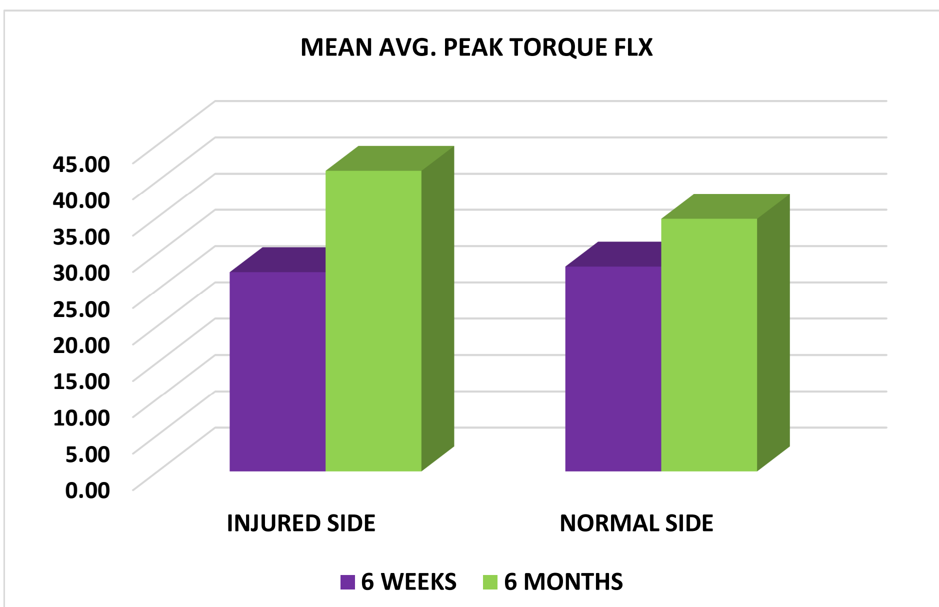
Graph 4: Showing change in MEAN ROM MAX FLX of injured and normal side at 6weeks and 6 months interval.



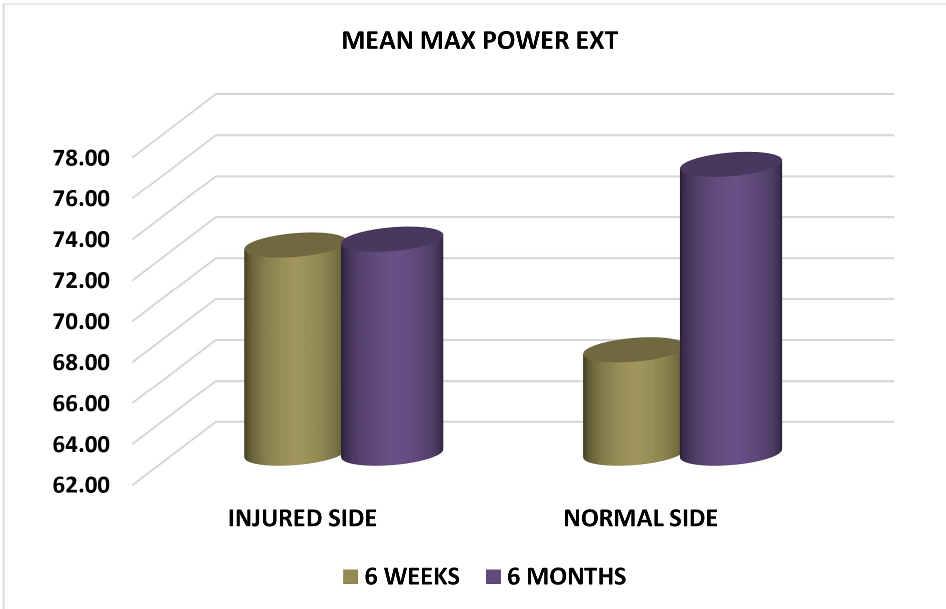
Graph 5: Showing change in MEAN AVG. PEAK TORQUE EXT of injured and normal side at 6weeks and 6 months interval.



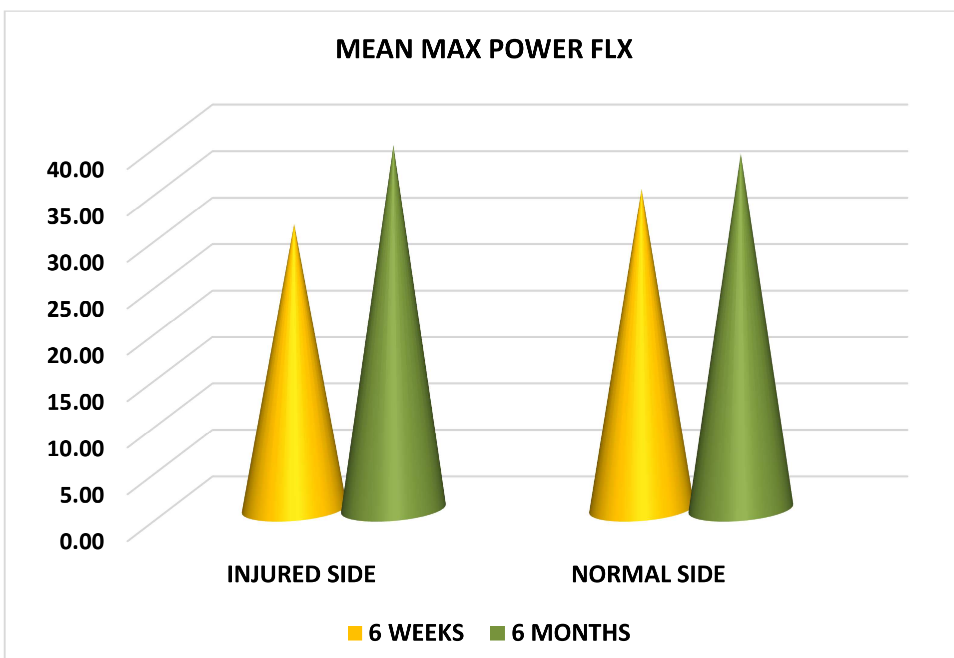
Graph 6: Showing change in MEAN AVG. PEAK TORQUE FLX of injured and normal side at 6wee ks and 6 months interval.



Graph 7: Showing change in MEAN MAX POWER EXT of injured and normal side at 6weeks and 6 months interval.



Graph 8: Showing change in MEAN MAX POWER FLX of injured and normal side at 6weeks and 6 months interval.



DISCUSSION

The knee is one of the most commonly injured joints due to its anatomical structure, exposure to external forces, and functional requirements. The anterior cruciate ligament (ACL) injury is a common sport-related injury affecting elite and recreational athletes, with up to 250,000 ACL ruptures occurring annually [34]. The anterior cruciate ligament reconstruction (ACLr) is considered the primary treatment option for ACL injuries. Despite the fact that ACLr corrects the structural deficiency, patients who have undergone ACLr often exhibit quadriceps atrophy and muscle loss. Arthritis, surgery, and traumatic injury of the knee joint are associated with the long-lasting inability to fully activate the quadriceps muscle, a process known as arthrogenic muscle inhibition (AMI).

Thomas et al [35] evaluated patients before and six-months post ACLr compared to controls and showed a deficit in PT/BM of 33% for extension and 10% for flexion. In a review of ACLr graft choice (hamstring vs. bone patellar tendon) after two years, an average muscle deficit of 10% in the flexors and extensors was observed in both grafts. However, for the flexor muscles, residual deficits were significantly higher in the hamstring group.[36]

It is important to consider that weakness post-surgery may be associated with detraining, incomplete rehabilitation, a combination of crossover inhibition of motor activation, or inadequate reconditioning post ACLr.[37]

Similarly, the results of Anderson et al.[38] showed that the ACLr group had some PT deficits, even after six months post-surgery.

According to Hiemstra et al.,[37] deficits in extensor torque have been shown to be as much as 25% one-year post ACLr.

The ACLr group had difficulty accelerating at all three velocities, indicated by greater TTAV values when compared to control group. These differences may be related to the injury, since control of movement during acceleration could be affected, and the ability to attain the specific isokinetic velocity at a given range of motion may also be impaired.[39]

Moreover, the TAV_{3D}, which provides a qualitative evaluation, demonstrated that the control group was able to maintain higher torques at higher velocities. In flexor and extensor muscles, the range of motion and the distribution of the torque during the range can change in post ACLr patients.[37] Hence, a lower extensor torque was demonstrated when compared to controls.

The limitations of this study include the low number of subjects and the lack of evaluation of eccentric muscle actions. However, isokinetic phase measurement could be a valuable way to evaluate patients post ACLr.[40,41]

Future studies that perform post ACLr testing should include isokinetic muscle performance for both concentric and eccentric actions. Isokinetic results should continue to be compared to performance-based outcome measures for better understanding of the post-reconstruction patient.[40,42]

LIMITATIONS

- Small group of patients followed up for only 6 months.
- No any scoring system like IKDC involved.

SUMMARY

- Mean age of ACL tear pts were 32.89 with SD of 12.97
- Female participants were 57.14% while males were 42.86%.
- Majority 37.14% were in age group of 15 to 24 years.
- In majority of cases 51.43% right side was affected
- Majority 19 pts had grade 3, 16 pts had grade 2 ACL tear.
- Majority 19 pts had RTA while 16 pts had self fall as etiology.

CONCLUSION

Hamstrings, in turn, act as a dynamic agonist to the ACL and thus hamstring activity and contractions are needed to compensate any functional deficit in an ACL-injured knee

The muscle strength during knee flexion is a composite of the coordinated movement of various muscles, including the biceps muscle of the thigh, the semimembranosus muscle, the semitendinosus muscle, and the gracilis muscle, and accordingly, it is difficult to analyze the properties of the individual flexor muscles

Optimal function following ACL reconstruction is dependent on many factors of which muscle strength is one of the most important. Any loss of strength may result in decreased dynamic stability of the knee and place a greater reliance on the passive restraints of the knee

The usefulness of isokinetic dynamometry, as applied in the ACLr/d population, is attested by its established known-group and convergent validity.

Lee OS et al concluded in 2020,December that after 2 years, whereas the leg undergoing ACLr with hamstring autograft maintained a similar level of strength compared to that of the uninvolved leg.[43]

So, further follow up required for the further analysis.

- Rehabilitation following ACL reconstruction has shifted from a protocol-based paradigm to a progression-based programme with escalating difficulty.
- Early Weight bearing post ACLr plays a vital role in the rehabilitation of quadriceps muscle.
- Patients who underwent ACLr within short period of injury showed promising results with better functional outcome.

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ANNEXURE I: INFORMED CONSENT

TITLE OF THE STUDY: "CHANGE IN HAMSTRING PARAMETRES AFTER ACL RECONSTRUCTION USING HAMSTRING GRAFT-PROSPECTIVE STUDY"

PRINCIPAL INVESTIGATOR: REGISTRATION NO. BL0121005

GUIDE:

This Informed Consent Form is for men and women who attend Dr PRABHAKAR KORE HOSPITAL AND RESEARCH CENTRE and who we are inviting to participate in an Prospective Study aimed to evaluate change in hamstring parametres post ACL reconstruction.

The title of the study is **"CHANGE IN HAMSTRING PARAMETRES AFTER ACL RECONSTRUCTION USING HAMSTRING GRAFT- PROSPECTIVE STUDY"**

Name of Principal Investigator:

This Informed Consent Form has two parts:

- Information Sheet (to share information about the research with you)
- Certificate of Consent (for signatures if you agree to take part)

You will be given a copy of the full Informed Consent Form.

PART I: Information Sheet

INTRODUCTION:

I am BL0121005, PG Resident, JAWAHARLAL NEHRU MEDICAL COLLEGE, Belagavi. We are doing an Prospective Study to determine the change of Hamstring Parametres post ACL reconstruction. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me, the study doctor or the staff.

PURPOSE OF THE RESEARCH:

ACL injury is a common orthopaedic problem that eventually causes significant morbidity to patients. ACL tears are frequently found during magnetic resonance imaging of knee post twisting and sports injury.

The advantages: Early intervention delays the acceleration of the disease course and yields better prognosis.

The purpose of this study is to determine the "CHANGE IN HAMSTRING PARAMETRES POST ACL RECONSTRUCTION USING HAMSTRING GRAFT" in Orthopaedic department of KLE'S Dr. Prabhakar Kore Hospital and Medical Research Centre and Charitable Hospital, Belagavi from 1st January 2023 to 31st December 2023.`

PARTICIPANT SELECTION:

Patient above age 18 years who undewent arthroscopic ACL reconstruction using hamstring graft

VOLUNTARY PARTICIPATION/ WITHDRAWL:

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part, I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The investigator may stop my participation in this study. I will inform about any important new findings that may change my willingness to continue to take part. If I choose not to take part in the study, I will receive the standard treatment for patients with my condition.

PROCEDURE:

A one-year hospital based Prospective Study. Patients in Outpatient Department after history and clinical examination diagnosed clinically and confirmed radiologically with ACL tears who are willing to participate in the study will undergo ISOKINETIC ANALYSIS at 6weeks and 6 months post surgery.

DURATION:

This is a one-year hospital based Prospective study.

RISKS:

There are no risks associated with this study.

BENEFITS:

Your participation is likely to help us find the answer to the research question. Early intervention delays the acceleration of the disease course and yields better prognosis.

COMPENSATION

As the subject voluntarily consents to be a part of the study, no compensation will be given.

CONFIDENTIALITY:

All information collected about the subject during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify the patient in this research record. Information from this study may be presented but the subjects' identity will be confidential in any publication.

SHARING THE RESULTS:

The knowledge that we get from doing this research will be shared with you through journal publications. Confidential information will not be shared.

RIGHT TO REFUSE OR WITHDRAW:

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected.

WHO TO CONTACT:

If you have any questions, you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following: BL0121005, PG resident JNMC, Belagavi.

This proposal has been reviewed and approved by ETHICS COMMITTEE JNMC, Belagavi, which is a committee whose task it is to make sure that research participants are protected from harm. If you wish to find about more about the IRB, contact [REGISTRATION NO. BL0121005, NRI PG BOYS HOSTEL.].

PART II: CERTIFICATE OF CONSENT

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant__________________

Signature of Participant ___________________

Date ___________________________ Day/month/year

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____________________

Thumb print of participant

Signature of witness ______________________

Date ________________________ Day/month/year

STATEMENT BY THE RESEARCHER/PERSON TAKING CONSENT:

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

Patients in Outpatient Department after history and clinical examination diagnosed clinically and confirmed radiologically with ACL tears who are willing to participate in the study will undergo ISOKINETIC ANALYSIS at 6weeks and 6 months post surgery.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Print Name of Researcher/person taking the consent________________________

Signature of Researcher /person taking the consent__________________________

Date ___________________________ Day/month/year

VOLUNTARY PARTICIPATION / WITHDRAWAL

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part, I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The investigator may stop my participation in this study. I will tell of any important new findings that may change my willingness to continue to take part.

If any enquiries in the future or in case of study related injury or illness, you may contact following person:

PRINCIPAL INVESTIGATOR:

BL0121005

PG. RESIDENT,

DEPARTMENT OF ORTHOPAEDICS,

KAHER, JAWAHARLAL NEHRU MEDICAL COLLEGE,

NEHRU NAGAR,

BELAGAVI – 590010

GUIDE:

PROFESSOR,

DEPT. OF ORTHOPAEDICS,

KAHER J. N. MEDICAL COLLEGE,

BELAGAVI – 590010

ANNEXURE II: CASE PROFORMA

"CHANGE IN HAMSTRING PARAMETRES AFTER ACL RECONSTRUCTION USING HAMSTRING GRAFT- PROSPECTIVE STUDY"

PATIENT NO: OP/IP NO:

NAME:

AGE: SEX:

ADDRESS:

OCCUPATION:

DOA:

CHIEF COMPLAINTS:

PRESENTING COMPLAINTS:

Pain in the knee

Swelling

Stair climbing difficulty

HISTORY OF PRESENT ILLNESS:

History of pain during squatting or while sitting cross legged?

Any history of acute knee pain

Any history of night pain

Any history of trauma to knee

HISTORY OF PAST ILLNESS:

Any history of sports related knee injury

a) History of Diabetes Mellitus, Hypertension, Asthma, Rheumatoid Arthritis, Tuberculosis and other chronic illness

Yes

No

Previous history of any medication received:

PERSONAL HISTORY:

Diet: Veg/ Nonveg/Mixed

Appetite: Increased or Decreased

Habits: Smoking/ Alcohol /Tobacco chewer / others

Bowel & Bladder Habits: Normal or Abnormal

FAMILY HISTORY:

GENERAL PHYSICAL EXAMINATION:

Built: Well /Moderate/Poor

Weight:

Temperature: Pulse:

Blood Pressure: Respiratory Rate:

Pallor

Cyanosis

Icterus

Clubbing

Pedal oedema

Lymphadenopathy

SYSTEMIC EXAMINATION:

Cardiovascular System Examination:

Respiratory System Examination:

Per Abdomen Examination:

Central Nervous System Examination:

LOCAL EXAMINATION:

Knee Involved- RIGHT LEFT

INSPECTION:

Swelling

Deformity

Scars/Sinuses

PALPATION:

Tenderness

Crepitus

Range of Movements:

Knee joint Flexion

Extension

Patellar Tap

MacMurray's Test

Anterior Drawer

Posterior Drawer

Lachmann

Apley's Grinding Test

RELEVANT INVESTIGATIONS:

X RAY OF KNEE AP WEIGHT BEARING, LATERAL VIEW

MAGNETIC RESONANCE IMAGING

DIAGNOSIS:

ANNEXURE III-CASE ILLUSTARTION WITH PHOTOGRAPHS

Age : 36

Sex : MALE

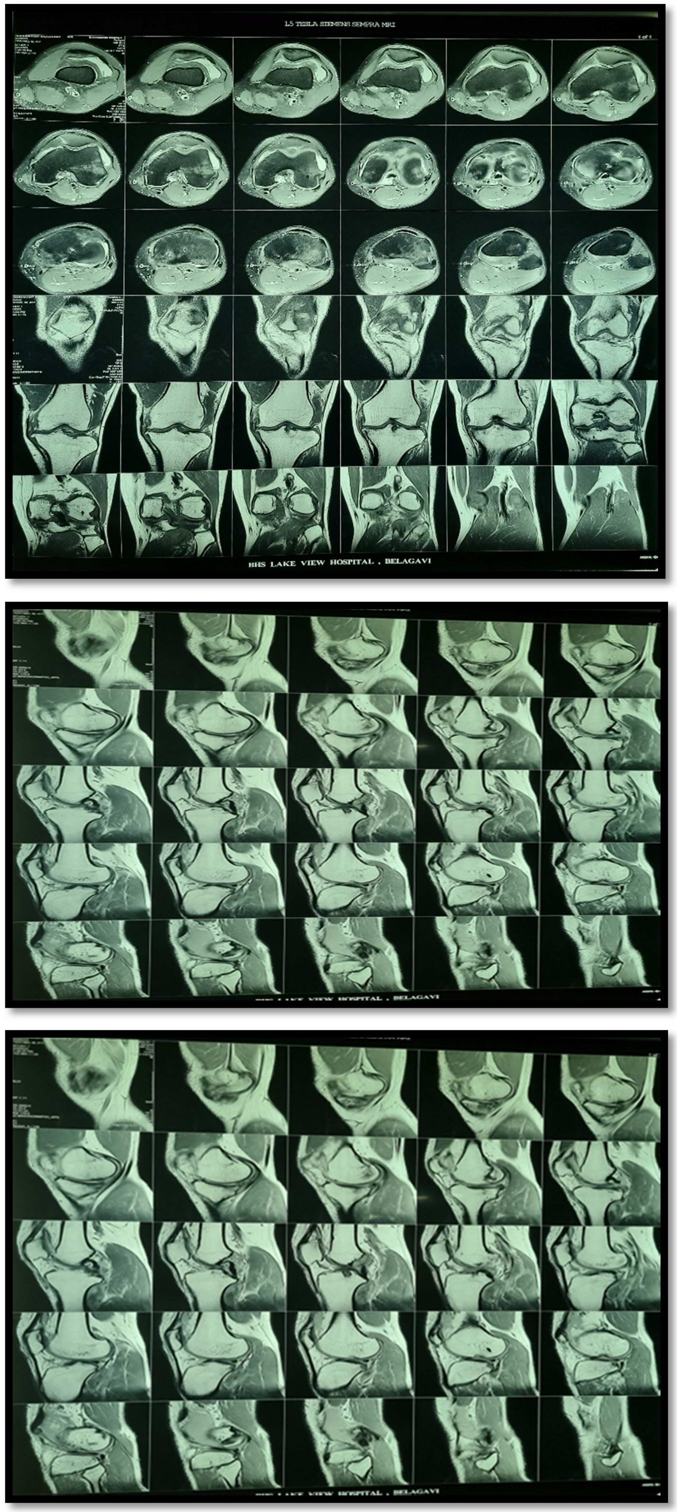
Diagnosis : ACL tear right side

Mode of injury : RTA skid and fall

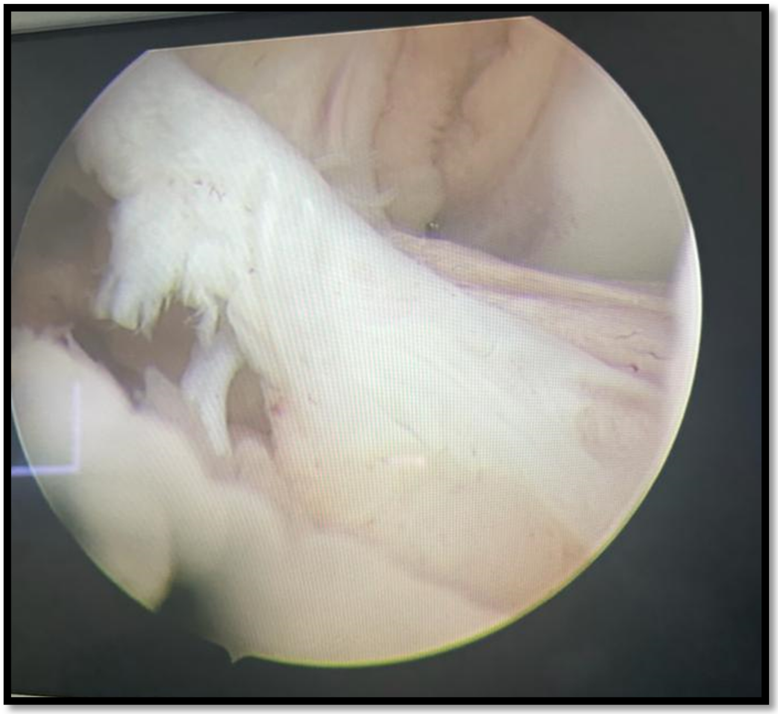
Side of injury : Right

Date of surgery : 23/7/21

Duration of injury : 2 months

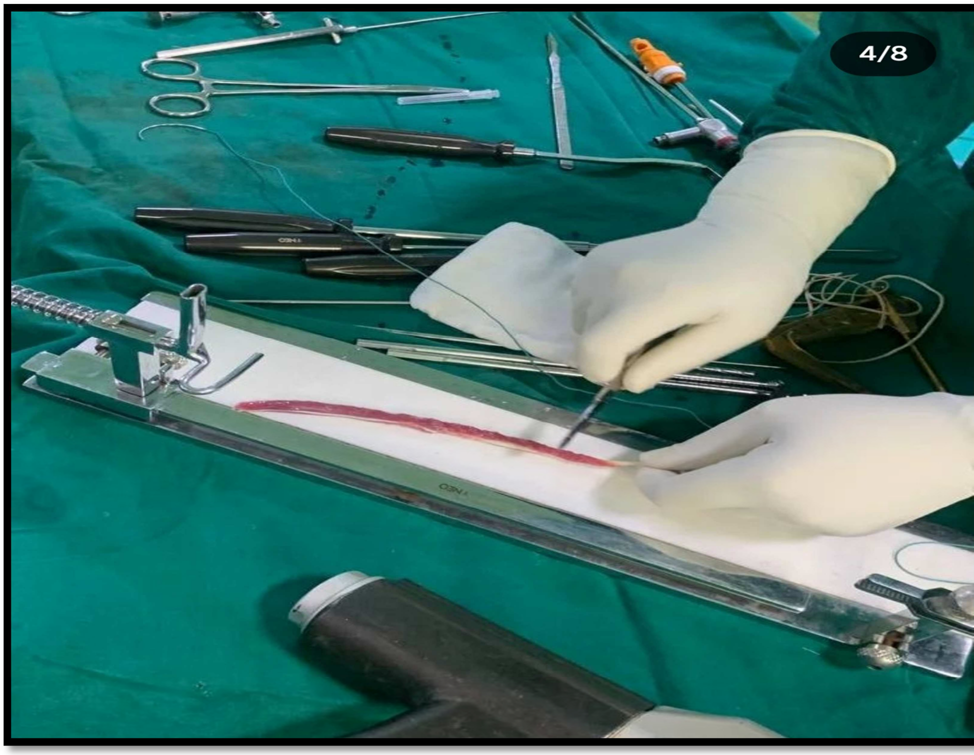


Photographs 1: MRI Suggestive of right ACL tear

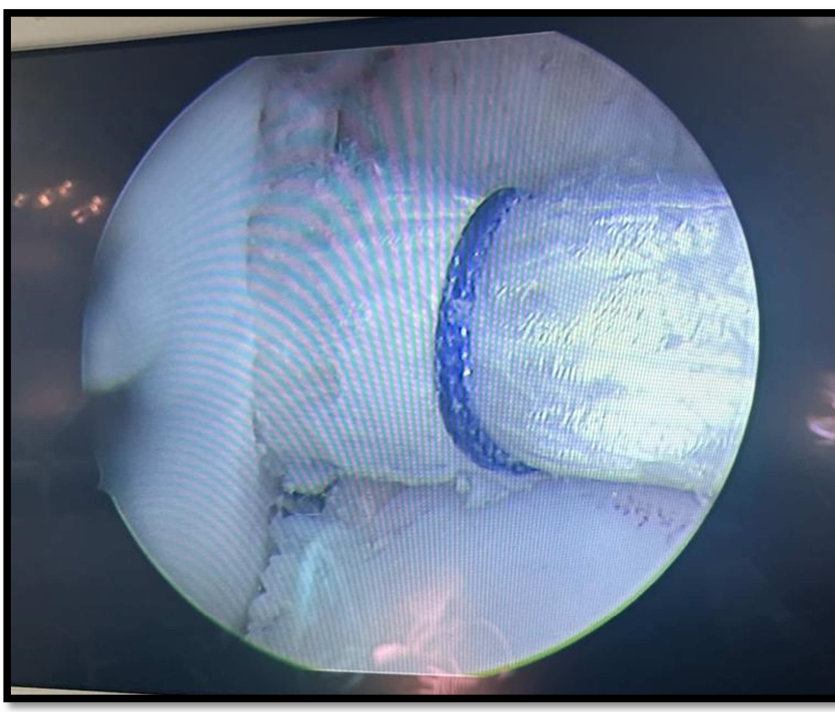


Photographs 2: Arthroscopic view of right ACL tear

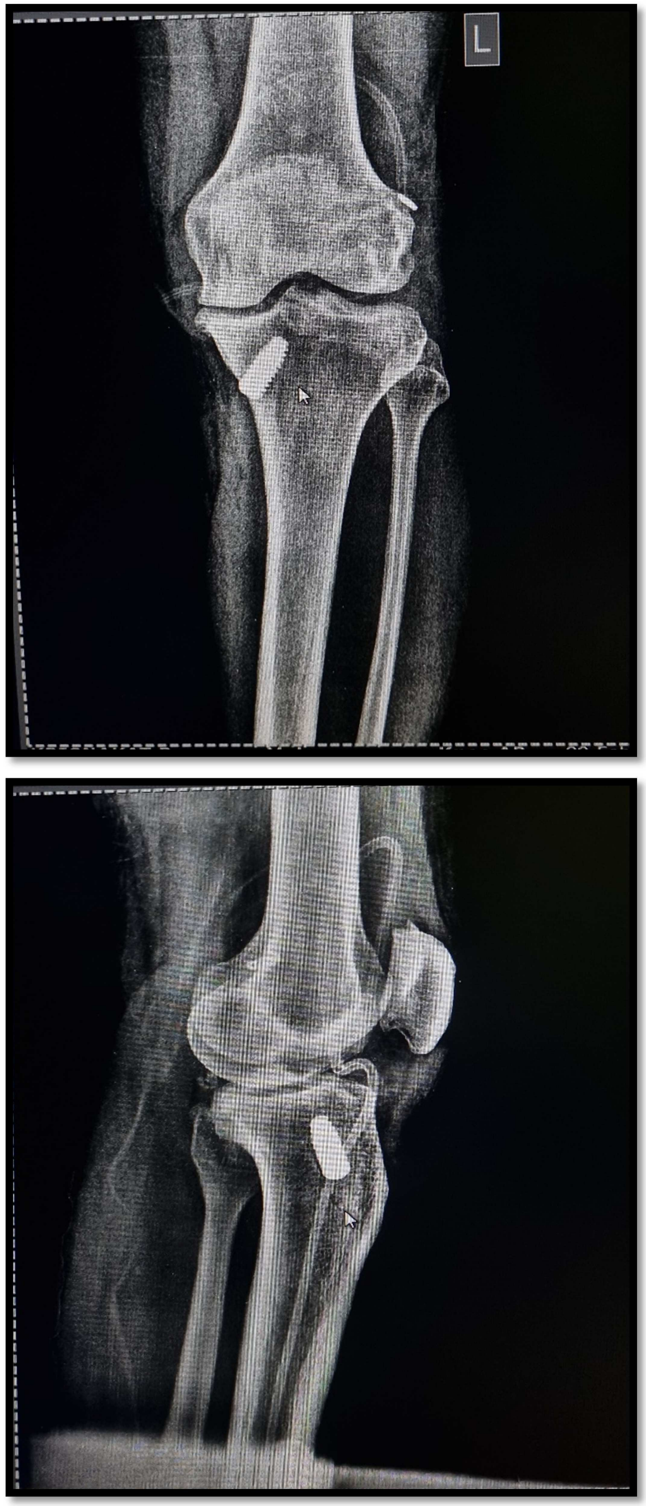
Photographs 3: Hamstring Graft Harvesting



Photographs 4: Graft Preparation

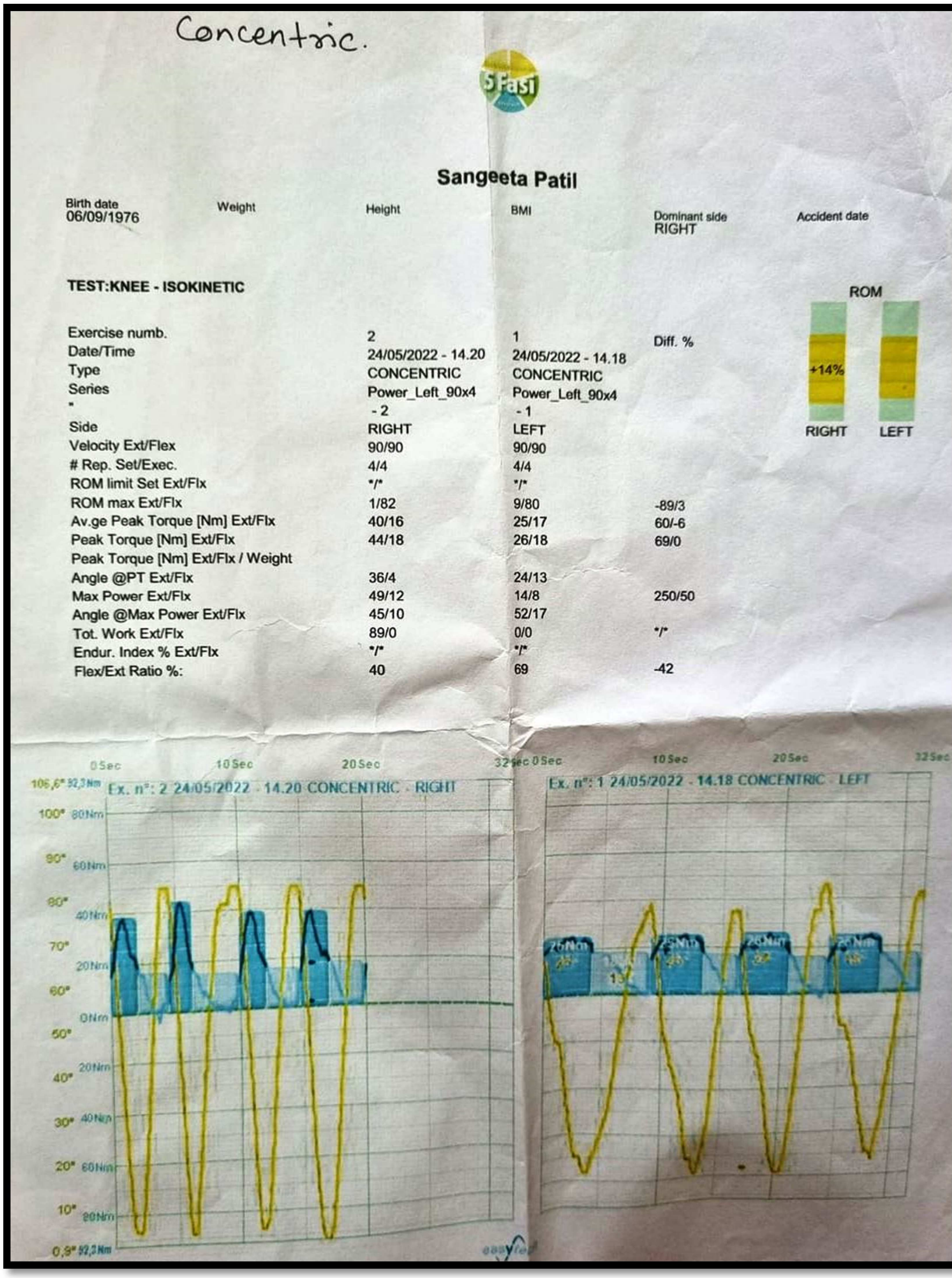


Photographs 5: Graft Passsage



Photographs 6: Post Op Xray showing endo button at the Femoral Side and bio-absorbable screw

Photographs 7: Isokinetic Analysis



Concentric.

Sangeeta Patil

Birth date	Weight	Height	BMI	Dominant side	Accident date
06/09/1976				RIGHT	

TEST:KNEE - ISOKINETIC

Exercise numb.	2	1	Diff. %
Date/Time	24/05/2022 - 14.20	24/05/2022 - 14.18	
Type	CONCENTRIC	CONCENTRIC	
Series	Power_Left_90x4	Power_Left_90x4	
"	- 2	- 1	
Side	RIGHT	LEFT	
Velocity Ext/Flex	90/90	90/90	
# Rep. Set/Exec.	4/4	4/4	
ROM limit Set Ext/Flx	*/*	*/*	
ROM max Ext/Flx	1/82	9/80	-89/3
Av.ge Peak Torque [Nm] Ext/Flx	40/16	25/17	60/-6
Peak Torque [Nm] Ext/Flx	44/18	26/18	69/0
Peak Torque [Nm] Ext/Flx / Weight			
Angle @PT Ext/Flx	36/4	24/13	
Max Power Ext/Flx	49/12	14/8	250/50
Angle @Max Power Ext/Flx	45/10	52/17	
Tot. Work Ext/Flx	89/0	0/0	*/*
Endur. Index % Ext/Flx	*/*	*/*	
Flex/Ext Ratio %:	40	69	-42

ROM

+14%

RIGHT LEFT

Ex. n°: 2 24/05/2022 - 14.20 CONCENTRIC - RIGHT

Ex. n°: 1 24/05/2022 - 14.18 CONCENTRIC - LEFT

Photographs 8: Isokinetic Report

ANNEXURE V- MASTERCHART

ANNEXURE -VI - MASTER CHART

								6 Week Follow Up												6 Month Follow Up											
								INJURED						NORMAL						INJURED						NORMAL					
Sr No	Pt Name	IP No.	Age	Sex	Complaint	History	ACL Tear Grade	ROM Max Ext	ROM Max Flx	Avg. Peak Torque Ext	Avg. Peak Torque Flx	Max Power Ext	Max Power Flx	ROM Max Ext	ROM Max Flx	Avg. Peak Torque Ext	Avg. Peak Torque Flx	Max Power Ext	Max Power Flx	ROM Max Ext	ROM Max Flx	Avg. Peak Torque Ext	Avg. Peak Torque Flx	Max Power Ext	Max Power Flx	ROM Max Ext	ROM Max Flx	Avg. Peak Torque Ext	Avg. Peak Torque Flx	Max Power Ext	Max Power Flx
1	Sangeeta Patil		48	F	Left knee pain	self fall	2	9	80	25	17	14	8	1	82	40	16	49	12	63	3	55	55	35	30	61	56	64	59	67	36
2	Smita Murgud		18	M	Left knee pain	RTA	3	65	12	12	5	11	4	4	4	4	4	1	2	93	0	186	26	203	103	79	12	79	67	89	40
3	Akshay Bhovi		24	F	Left knee pain	self fall	2	58	3	13	12	8	2	66	12	29	15	35	4	60	7	155	71	115	140	58	39	42	62	73	47
4	Ramesh Bajantri		53	M	Left knee pain	self fall	2	80	0	79	70	146	43	66	0	82	69	131	44	85	4	103	96	126	80	55	12	77	72	105	52
5	Dakshayani Bhaimani		23	F	Left knee pain	self fall	3	17	90	18	10	19	2	37	78	11	10	5	0	21	99	13	10	13	9	17	99	14	9	13	8
6	Pushkar Burye		60	F	Left knee pain	RTA	2	20	98	61	34	112	56	21	85	75	37	142	69	23	95	85	140	85	12	30	45	84	44	133	73
7	Viola Colaco		25	F	Left knee pain	RTA	2	21	90	67	18	92	18	25	90	61	18	88	20	36	91	20	13	101	21	20	91	57	21	155	36
8	Chintamani deshpande		28	M	Left knee pain	self fall	2	95	16	136	123	170	98	91	21	97	80	132	58	99	18	148	120	137	53	85	48	88	92	97	61
9	Anjana Doshi		23	F	Left knee pain	RTA	3	41	113	20	14	25	15	42	112	13	11	22	16	78	140	5	16	9	21	84	134	5	17	5	12
10	Parth Doshi		43	F	Left knee pain	self fall	3	81	24	220	183	395	239	86	22	220	179	303	179	85	30	185	26	148	72	75	53	159	102	124	101
11	Sahith Eranyakula		23	F	Left knee pain	RTA	3	7	104	127	65	289	105	3	109	179	92	284	155	8	109	179	61	284	155	3	105	133	35	283	104
12	Namrata G		42	F	Left knee pain	RTA	2	12	82	15	10	17	12	10	91	20	10	35	11	15	85	140	21	79	32	45	71	33	12	49	32
13	Sreyash Gandage		47	F	Left knee pain	RTA	2	45	123	69	29	70	48	45	123	26	17	37	23	44	123	16	41	31	35	43	123	46	47	85	44
14	Anuradha Paramshetti		25	F	Left knee pain	RTA	3	13	92	28	8	24	8	15	92	32	12	48	15	15	95	35	66	64	37	52	56	54	15	53	35
15	Madhura J		24	F	Left knee pain	RTA	3	1	114	18	10	64	18	12	93	24	14	82	39	5	121	39	58	39	55	33	77	41	19	71	44
16	Kasavva Hiremath		24	F	Left knee pain	self fall	2	18	89	19	9	18	3	36	75	12	11	6	0	20	97	14	11	12	8	18	97	15	10	14	9
17	Shanta Patil		48	F	Left knee pain	RTA	2	16	91	20	11	18	3	35	74	13	11	6	2	20	96	129	11	14	10	18	96	15	8	14	7
18	Anagha Patil		24	F	Right knee pain	Self fall	3	114	3	41	14	35	14	115	2	13	31	21	57	110	10	61	66	16	39	88	18	18	30	42	45
19	Soumya Hulmani		48	M	Right knee pain	self fall	3	9	89	48	18	59	20	7	90	49	17	82	20	24	105	24	35	83	35	19	105	63	35	90	38
20	Arvind Yadav		51	M	right knee pain	RTA	3	72	3	82	42	149	72	76	3	63	33	134	57	80	15	26	21	112	36	84	24	59	35	107	64
21	Swapnil Vharate		23	M	Right knee pain	RTA	2	12	98	22	12	38	18	13	98	22	13	43	17	18	99	15	17	78	36	18	99	37	30	84	52
22	Lizanne Vaz		33	M	Right knee pain	self fall	3	15	90	29	11	42	5	15	90	28	11	23	5	21	105	32	18	26	12	39	101	45	18	46	18
23	Behere Tanvi		67	F	Right knee pain	self fall	2	10	114	40	20	74	25	14	121	44	18	91	21	55	127	18	55	30	29	25	102	52	32	102	38
24	Deepa Suryavanshi		26	M	Right knee pain	self fall	3	4	90	19	14	24	17	8	90	19	15	23	17	21	102	27	13	20	16	15	105	18	12	19	15
25	Kinjal Shinde		28	M	Right knee pain	RTA	3	21	90	22	7	28	8	30	90	4	13	8	20	24	90	80	6	34	5	27	90	23	7	30	4
26	Mihikaa Shetye		27	M	Right knee pain	self fall	3	15	90	46	8	36	10	12	90	24	14	45	10	81	3	20	71	102	57	78	29	85	73	119	57
27	Drashti Patel		25	F	Right knee pain	RTA	3	3	108	20	12	28	8	0	108	28	11	22	7	1	108	17	11	27	5	18	90	32	10	39	3
28	Annasaheb More		22	M	Right knee pain	RTA	2	34	102	15	8	10	5	33	102	15	7	15	6	42	116	69	13	5	3	73	121	12	13	1	4
29	Rachayya Mathpathi		24	F	Right knee pain	self fall	3	33	111	61	49	64	35	3	92	38	48	50	129	11	82	22	57	61	54	21	97	64	54	80	72
30	Premlata jagajampi		24	F	Right knee pain	RTA	3	54	102	18	8	13	1	63	110	12	11	10	9	12	103	92	10	22	8	1	97	27	10	30	9
31	Parmeetha N		27	F	Right knee pain	RTA	2	24	105	57	22	92	31	20	105	52	26	75	28	31	122	35	81	85	42	36	85	63	41	84	21
32	Chajju Nouman		49	M	Right knee pain	self fall	3	18	72	56	43	223	72	9	73	108	66	170	92	25	37	25	75	152	45	24	84	94	52	155	64
33	Manoj Kamble		25	M	Right knee pain	RTA	3	13	96	24	15	35	21	12	95	23	14	40	18	19	96	25	16	78	35	22	94	36	31	83	53
34	Anil Sattigeri		22	M	right knee pain	self fall	2	23	88	23	8	27	7	31	87	5	14	9	21	22	87	54	4	30	4	25	93	24	8	32	5
35	Mahesh Desai		28	M	Right knee pain	RTA	2	10	86	51	20	57	21	8	91	50	18	80	21	23	108	20	38	80	34	18	99	60	34	91	35