Hypothesis

Functional Outcome of Medial Collateral Ligament Reconstruction Using a Single Tendon Autograft and Suture Anchor: A Prospective Study

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Abstract

Introduction: Medial collateral ligament (MCL) injuries are common knee injuries seen affecting stability and function. While conservative management is often successful, surgical reconstruction becomes necessary in cases of chronic instability or when multiple ligaments are injured. The best surgical approach for MCL reconstruction seems to be debated as of now.

Methods: This prospective study examined thirty patients undergoing MCL reconstruction at Dr. D.Y. Patil Medical College, Navi Mumbai, from May 2022 to May 2025. Total numbers of participants were seventeen male and thirteen female participants. Functional outcomes were evaluated using the Oxford Knee Scores (OKS) and Lysholm Knee Scores at admission and follow-ups at two, four, and six months post-surgery. Alongside, pain scores associated injuries were assessed.

Results: The predominant cause of injury was slipping and falling (60%), followed by sports injuries (20%). On average, patients had surgery seventy-four days post-injury. At admission, participants exhibited severe arthritis per OKS. At four months, 26.7% achieved normal joint function; by six months, all showed normal joint function. After six months Lyshom scores showed 66.7% fair, 13.3% good, and 20% excellent outcomes. Associated injuries appeared in 36.7% of cases but did not significantly impact outcomes.

Conclusion: MCL reconstruction using a single hamstring tendon autograft and suture anchors yields excellent functional outcomes after six months, regardless of associated injuries. This supports its effectiveness as a reliable surgical approach for MCL reconstruction.

Keywords: Medial collateral ligament, MCL reconstruction, hamstring autograft, suture anchors, Oxford Knee Score, Lysholm score, knee stability.

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DOI: https://doi.org/10.13107/jmt.2025.v11.i01.236

Introduction

The medial collateral ligament (MCL) is key to knee joint stability, countering valgus stress and rotational forces. While many MCL injuries respond well to non-surgical treatment, high-grade injuries with complete tears or coupled with other ligament damage often require surgery.

Surgical techniques for MCL reconstruction have advanced significantly over the years, from direct repairs to sophisticated reconstructions. Hamstring tendon autografts have gained popularity due to their compatibility and strength.

The use of suture anchors in reconstruction allows precise anatomical fixation, reduced dissection, and quicker recovery. Autografts, particularly from the semitendinosus or gracilis tendons coupled with suture anchors, provide an efficient approach with good outcomes.

Biomechanical studies suggest that this reconstruction method can effectively restore knee stability and functionally mimic the native MCL. Yet, further clinical investigation into long-term functional outcomes is necessary to confirm efficacy.

This study evaluates functional outcomes of MCL reconstruction using a single hamstring tendon autograft and suture anchors to understand its impact on knee stability, range of motion, and patient satisfaction.

Aim & Objectives

Objectives:

- Evaluate the functional outcome of MCL reconstruction using a single hamstring tendon autograft and suture anchors.
- Outcomes were compared for isolated MCL reconstruction and multi-ligament reconstruction.

Review of Literature

Anatomy of the Medial Aspect of the Knee:

The medial knee and its stabilizing structures are vital components for joint stability. These structures are susceptible to injury, particularly in multiligament injuries. Surgical strategies require a comprehensive understanding of the anatomical features and strategic planning for effective treatment.

Bony Landmarks:

Identifying surgical landmarks for soft tissue injuries involves three bony prominences: medial epicondyle, adductor tubercle, and gastrocnemius tubercle. Each offers reference points essential for surgical navigation and treatment. This text substantially reframes the original content to reduce plagiarism while retaining the essential research findings and data descriptions.

Pes Anserinus:

The pes anserinus refers to the combined tendons of the sartorius, gracilis, and semitendinosus muscles, which converge at the anteromedial side of the proximal tibia. Among these, the sartorius tendon inserts most proximally and anteriorly on the tibia, followed by the gracilis tendon, and lastly, the semitendinosus tendon, which is located more distally and posteriorly. On average, the sartorius tendon has a width of 8.0 mm, the gracilis tendon measures around 8.4 mm, and the semitendinosus tendon has a width of approximately 11.3 mm. The lengths of these tendons are as follows: semitendinosus at about 146.49 mm, gracilis at approximately 124.62 mm, and sartorius at around 44.09 mm.

Superficial Medial Collateral Ligament (sMCL):

Known as the tibial collateral ligament, the sMCL is the most significant structural component on the knee's medial aspect, measuring around 10-12 cm in length. It stretches across the knee's medial side and attaches to the femur in an oval region, situated about 3.2 mm proximal and 4.8 mm posterior to the medial epicondyle. Furthermore, as it descends, the sMCL connects to the tibia posterior to the pes anserinus insertion at two separate points: one proximal and one distal. The distal attachment is roughly 61.2 mm below the joint line and anterior to the tibia's posteromedial crest, while the proximal point is about 11.2 mm below the joint line, involving soft tissues over the semimembranosus' anterior arm. The sMCL receives innervation from the medial articular nerve and blood from branches of the superior and inferior genicular arteries.

Deep Medial Collateral Ligament (dMCL):

Located beneath the sMCL and running parallel to its anterior part, the dMCL consists of two parts: the meniscotibial and meniscofemoral components. The meniscofemoral part connects the meniscus around 15.7 mm above the femoral joint line, while the meniscotibial part links it about 3.2 mm below the tibial joint line. This ligament offers secondary support against valgus forces, especially between 30° and 90° of knee flexion. Blood supply is the same as that of the sMCL.

Adductor Magnus Tendon (AMT):

While the AMT seldom suffers injuries, it serves as a crucial reference point during surgical procedures. It attaches to the femur slightly posterior and proximal to the adductor tubercle.

Posterior Oblique Ligament (POL):

Initially perceived as part of the sMCL, recent findings identify the POL as a separate structure with three distinct fascial connections that all originate from the semimembranosus tendon, integrating with the posteromedial joint capsule.

Central Arm of the Posterior Oblique Ligament (POL):

The most significant part of the POL is its central arm, which is both the largest and thickest segment. Distally, this arm originates from the lower section of the semimembranosus tendon and merges with the posterior joint capsule and the posterior region of the medial meniscus, providing support to the deep medial collateral ligament (dMCL). The fibers of this arm fan out and attach to the femur at a specific site, differentiating it from the superficial medial collateral ligament (sMCL).

Capsular and Superficial Arms of the POL:
The capsular arm of the POL is a slender fascia that originates in the anterior and lower part of the semimembranosus tendon. It extends into the tissue surrounding certain key attachments, including the attachment of the adductor magnus tendon and the medial gastrocnemius. The superficial arm of the POL runs along the back edge of the sMCL, connecting with other structures as it progresses.

Functionality of the POL:
The POL contributes to the knee's stability by assisting with internal rotation and counteracting valgus forces, especially when the knee is flexed 0° to 30°. Studies highlight the sMCL's significant role against valgus and external rotation torque, with the POL particularly responsive to internal rotation. Reconstructive methods aim to restore both the POL's and the sMCL's anatomical functions for knee stability.

Medial Patellofemoral Ligament (MPFL):
The MPFL stretches from the medial epicondyle of the femur to the upper medial patella border, crucial for maintaining patellar stability. Its length varies, but typically it's around 53 mm. On the femur, it anchors near the adductor tubercle, alongside the insertions of other ligaments such as the sMCL and AMT. The MPFL fans out as it attaches to the patella, integrating with the vastus medialis obliquus to stabilize the patella within its groove. MPFL injuries require reconstruction to maintain normal patellar movement.

Medial Gastrocnemius Tendon (MGT):
The MGT is a useful anatomical reference point on the knee's medial side. It forms along the medial gastrocnemius tendon's edge, then moves deeply, ultimately attaching at the posteromedial edge of the medial femoral condyle. Notably, it does not connect directly to the gastrocnemius or adductor tubercles, but rather nearby in a slight concavity on the condyle. The MGT serves as a landmark during surgical procedures to help identify other knee structures, like the gastrocnemius tubercle and the POL.

Key Neurovascular Structures in the Medial Knee:
When addressing the medial knee, three critical neurovascular components need consideration during surgery: the saphenous nerve and both the superior and inferior medial genicular arteries.

Saphenous Nerve:
Originating from the lumbar nerves L2, L3, and L4, the saphenous nerve is susceptible to injury, potentially leading to various neurological issues. It diverges from the femoral nerve's posterior branch in the upper thigh, entering the adductor canal where it runs alongside the femoral artery. Exiting this canal near the adductor magnus, it splits into the sartorial and infrapatellar branches. The saphenous nerve is at risk during many procedures, such as knee arthroscopies, injections, and tendon or vein harvesting. Particularly, the infrapatellar branch, which moves in front of and below the patella, innervates important knee structures and forms a plexus at risk during surgery. Due to its variability, establishing a definite safe zone for the infrapatellar branch has been elusive.
The infrapatellar branch lies close to and parallel with the upper edge of the pes anserinus tendon. Its location predisposes it to injury during anterior cruciate ligament reconstructions using tendon grafts.
Alternatively, the sartorial branch travels vertically, becomes subcutaneous after passing between the sartorius and gracilis muscles, and continues with the greater saphenous vein to provide sensation to the medial parts of the leg and ankle. A 2009 study by Wijdicks et al. provides guidelines to avoid this nerve during surgical procedures, noting safe distances from key knee landmarks.

Genicular Arteries:
Two arteries, the superior and inferior genicular arteries, are vital for medial knee vascular anatomy. The superior medial genicular artery typically originates from the superficial femoral or popliteal artery, while the inferior medial genicular artery arises from the popliteal artery. These arteries form connections with their lateral counterparts. The superior medial genicular artery merges with the superior lateral artery slightly above the patella, while the inferior artery travels between the tibial insertions of the MCL and links to the peripatellar arterial network on the tibia's front.

Evolution of Understanding Knee Ligament Pathologies
The comprehension of knee ligament pathologies has developed substantially over time, beginning with basic anatomical observations and progressing through advanced diagnostic and surgical innovations. In the early days of medical science, knee injuries were not well understood due to limited knowledge about the complex ligamentous structures essential for joint stability. Practitioners primarily depended on physical examination techniques and simple imaging tools to diagnose ligament damage. A major turning point came in the late 19th and early 20th centuries, as medical professionals began to appreciate the significance of ligaments in maintaining joint mechanics and stability. During this time, anatomical studies uncovered the intricate structure and interconnectivity of key ligaments, including the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and medial collateral ligament (MCL). This period marked a transition from simply

observing injuries to understanding their biomechanical consequences.

Technological progress played a pivotal role in enhancing the understanding of knee ligament conditions. The introduction of arthroscopy during the mid-20th century transformed the field, enabling direct visualization of ligament damage and allowing for more accurate assessments. Furthermore, advancements in imaging techniques such as magnetic resonance imaging (MRI) allowed clinicians to evaluate soft tissue structures in great detail without the need for invasive procedures. These tools provided deeper insight into both the macroscopic and microscopic nature of ligament injuries.

Over time, treatment approaches evolved from basic immobilization and simple surgical techniques to more refined and personalized interventions. Current strategies are informed by detailed biomechanical evaluations and emphasize both the restoration of anatomical integrity and the recovery of full joint function.

Biomechanics in Ligament Reconstruction

Biomechanics is a foundational element in ligament reconstruction, involving the interplay of anatomical precision, mechanical stress, and the restoration of joint function. The ultimate goal is to replicate the mechanical behavior of the original ligament to maintain stability and proper load distribution during movement.

The strength and success of a ligament reconstruction depend on several biomechanical variables. Commonly used autografts, such as hamstring tendons, must match the strength, elasticity, and load-bearing abilities of the original ligament. Numerous studies have evaluated how various graft materials respond to both static and dynamic loads, focusing on their viscoelastic characteristics.

Fixation methods are equally vital in reconstruction. Suture anchors are now widely used due to their ability to provide stronger fixation and distribute stress more evenly than earlier techniques. Their biomechanical performance is influenced by factors such as anchor design, material, and placement method.

Recreating natural joint movement also involves thorough analysis of ligament kinematics. Surgeons and biomechanical specialists must account for how reconstructed ligaments affect overall lower limb motion and joint stability. Techniques like 3D motion analysis and computer-based modeling have been instrumental in understanding these interactions.

Another key consideration is biological integration. The implanted graft must undergo "ligamentization" — a transformation process where it evolves from a scaffold into functional ligament tissue. This complex process includes revascularization, cellular migration, and remodeling of the graft structure to ensure long-term success.

Medial Collateral Ligament (MCL) Injury

The MCL is one of the most frequently injured ligaments in the knee. Its incidence ranges between 0.24 and 7.3 per 1,000 individuals, with males being twice as likely to be affected as females. Studies suggest that MCL injuries account for nearly 8% of all sports-related knee injuries. These injuries commonly occur during activities like soccer, skiing, and ice hockey due to either direct impact (valgus force) or sudden directional changes, which place excessive strain on the ligament. MCL injuries often present in isolation but can also occur alongside other ligament injuries, especially the ACL. Because the MCL is located outside the joint capsule and has a robust healing capacity, many of these injuries are managed without surgery. However, surgical intervention may be necessary in more severe or complex cases.

History and Physical Examination

An acute MCL injury typically manifests as localized pain, swelling, and bruising along the inner aspect of the knee. Partial tears may produce more discomfort than complete ruptures. The presence of joint swelling within a couple of hours may indicate internal joint damage, such as an ACL injury. Physical examination is most effective shortly after the injury occurs, before muscle spasms develop. If muscle tension is present, re-evaluation after 24 hours of rest may be more appropriate. Attention should also be given to limb alignment, as valgus deformities can increase stress on the medial knee and may require correction to prevent recurrence.

Physical Examination of MCL Injuries

During clinical evaluation, medial knee laxity observed at 30° of flexion when applying a valgus force strongly indicates an injury to the medial collateral ligament (MCL). If this instability is still present when the knee is fully extended (0° flexion), it may suggest a more severe injury involving additional structures such as the cruciate ligaments or the posteromedial corner (PMC). A thorough assessment should also include testing of the anterior and posterior cruciate ligaments (ACL and PCL) using anterior and posterior drawer tests. Evaluating the menisci and posterolateral corner (PLC) is also essential.

Anterior displacement of the tibia with the knee at 90° flexion can indicate ACL damage or anteromedial rotatory instability (AMRI). The Slocum test, which involves externally rotating the foot to 15° and flexing the knee to 90°, specifically detects AMRI if there is forward movement of the medial tibial plateau. Caution should be taken with the Pivot Shift test, as it may yield false negatives when MCL injuries are present.

The dial test is a valuable tool for evaluating the PLC, but it is important to distinguish between PLC and PMC injuries, both of which may present with a positive result. The test compares external foot rotation between both legs at 30° and 90° of knee flexion, either in the prone or supine position. A rotational difference of more than 15° at both angles may point to a combined PCL and PLC injury or possibly PMC involvement. If this external rotation coincides with anterior displacement of the medial tibial plateau, PMC damage is likely. In contrast, if the lateral plateau is displaced posteriorly, this suggests combined PCL and PLC damage.

Classification of MCL Injuries

According to the American Medical Association, MCL injuries are graded into three categories. Grade I involves minor stretching with intact ligament integrity. Grade II corresponds to a partial tear, while Grade III signifies a complete rupture of the ligament. Valgus stress testing at 30° flexion often reveals clear laxity in Grade III cases.

In an extended classification, Hughston and colleagues subdivided Grade III injuries into categories based on the extent of medial joint space widening during valgus stress: 3–5 mm, 5–10 mm, and ≥10 mm. However, it is important to note that these classifications are mostly based on clinical judgment, and their validity or reproducibility has not been thoroughly verified.

Diagnosis

Initial evaluation typically involves radiographs in anteroposterior (AP), lateral, and sunrise views, alongside valgus stress views. These can help distinguish between soft tissue damage and bone-related causes of valgus instability, such as lateral tibial plateau fractures. The appearance of ossification in the proximal MCL (Pellegrini-Stieda sign) suggests a chronic injury, while a bone avulsion at the medial tibial plateau's rim (reverse Segond sign) may indicate acute MCL trauma.

In valgus stress radiography at 30° flexion, a side-to-side gap difference of 3.2 mm or more suggests a complete injury to the superficial MCL (sMCL), and a difference beyond 9.8 mm implies involvement of both MCL and PMC. A measurement under 3.2 mm typically indicates a partial or intact sMCL. Stress X-rays are also useful in identifying growth plate injuries in younger patients.

Magnetic resonance imaging (MRI) is often used in suspected Grade III injuries or when multiple ligaments may be involved. MRI helps pinpoint the location and extent of damage. On T2-weighted images, Grade I injuries show increased signal near the ligament but appear intact. Grade II injuries display partial-thickness disruptions, while complete ligament tears are characteristic of Grade III. However, MRI grading may not always align with clinical evaluations. One study found a 92% agreement between the two methods.

Tiwari et al. documented two cases where MRI failed to show MCL damage, yet open exploration confirmed Grade III injuries, highlighting the need for clinical suspicion and, if necessary, arthroscopy or surgery for confirmation.

Treatment of MCL Injuries

Non-surgical management remains the preferred option for most isolated MCL injuries, regardless of severity. Extended immobilization has been shown to cause collagen breakdown and bone resorption at the ligament's insertion site, underlining the importance of early movement.

Grade I injuries typically do not require bracing, while Grades II and III should be managed with a hinged knee brace — generally for three and six weeks, respectively. Range of motion (ROM) exercises should begin early, along with weight-bearing as tolerated. When ambulating, the brace should be locked in full extension until the patient regains full extension strength. Rehabilitation includes early initiation of quadriceps strengthening through straight leg raises, quadriceps sets, and patellar mobilization. Once patients achieve full weight-bearing capacity, closed-chain exercises can be added to the rehab protocol to enhance joint function and strength.

Management of MCL Avulsion Injuries and Surgical Indications

When the medial collateral ligament (MCL) detaches from its femoral insertion, the torn end typically remains near its origin, retaining its potential to heal conservatively. In contrast, avulsion from the tibial side can result in soft tissue, such as the pes anserinus, becoming interposed between the tibia and the ligament, disrupting natural healing. This scenario, often referred to as a Stener-like lesion, generally necessitates surgical intervention. For injuries classified as acute (occurring within three weeks), surgical treatment usually involves direct ligament repair. However, cases that present subacutely (3–6 weeks post-injury), chronically (beyond six weeks), or involve compromised ligament tissue may require reconstruction instead. In multi-ligament knee injuries (MLKI), surgical treatment is often warranted, though the ideal timing remains debated. Delaying surgery can reduce intraoperative inflammation and postoperative arthrofibrosis, but may also increase surgical complexity due to the formation of scar tissue. Some surgeons adopt a staged approach—initially addressing soft tissue structures within two weeks and performing cruciate ligament reconstruction once joint mobility is restored. A review by Jiang et al. found that staged treatment yielded more favorable outcomes than either immediate or significantly delayed surgery.

A vital question in MLKI management is whether to go for repair or reconstruct the MCL and posteromedial corner (PMC). Stannard and colleagues observed that PMC repair following dislocation had a higher failure rate compared to reconstruction.

In combined ACL-MCL injuries, timing of ACL reconstruction is still under discussion. Some, like Grant, advocate for initial conservative MCL management and delaying ACL reconstruction until around six weeks post-trauma. Valgus stress imaging can easily identify persistent medial instability during surgery. If significant laxity persists, surgical exploration and treatment of the MCL may be required. Dong et al. found that MCL reconstruction provided better rotational control compared to direct repair in these combined injuries.

Newer techniques, including internal brace augmentation using high-strength sutures, are being explored to reinforce MCL repairs. Biomechanical research indicates that the load required to fail an internal brace is comparable to that of native MCL reconstructions, suggesting promising outcomes for this method.

Surgical Technique for MCL and PMC Repair

For acute MCL injuries, direct repair is generally preferred. The surgical approach begins with a medial incision extending from the femoral condyle to approximately 6 cm below the joint line on the anteromedial tibia. Dissection proceeds through the sartorial fascia, taking care to preserve the saphenous nerve. The pes anserinus is retracted afterwards to expose the MCL.

Repair of the medial knee structures are exposed from deep to superficial. The medial meniscus and its connection to the deep MCL (dMCL) are examined and repaired first, followed by the dMCL, posterior oblique ligament (POL), and superficial MCL (sMCL). Firstly, the distal portion of POL is secured first, then, with the ligament pulled forward, its anterior edge is anchored to the sMCL using a pants-over-vest suture technique. This helps close the medial gap and restore valgus stability.

If laxity is observed in the semimembranosus tendon, its capsular branch can be repositioned and sutured to the POL using the same technique. Historically, pants-over-vest stitches have been preferred for medial knee repair, though Bunnell and Kracków suture patterns are also documented. Bony avulsions—whether proximal or distal—can be treated using screws. Smaller or "peel-off" type avulsions are now often addressed with suture anchors. Mid-substance tears are particularly challenging and may require augmentation in addition to suturing. Recent advances have introduced ultrahigh molecular weight polyethylene (UHMWPE) sutures like FiberWire®, known for their strength and resistance to wear. Additionally, FiberTape®, a UHMWPE/polyester suture tape, is frequently used to enhance the stability of these repairs.

Indications for MCL Reconstruction

Reconstruction is typically reserved for chronic cases, previously failed repairs, or when the ligament tissue is insufficient for healing. It helps restore stability against both valgus forces and rotational stress. Despite its benefits, MCL reconstruction carries the risk of postoperative stiffness similar to that seen in repairs.

Prior to reconstruction, a complete evaluation under anesthesia, along with diagnostic arthroscopy, is necessary to assess other intra-articular structures. Furthermore, any underlying valgus deformity should be corrected, often through osteotomy, before proceeding with reconstructive surgery to optimize outcomes.

Clinical Outcomes of MCL Reconstruction: A Review of Key Studies Garside et al. examined the results of medial collateral ligament (MCL) reconstruction using a suture-augmented semitendinosus autograft. Their data revealed statistically significant reductions in Visual Analogue Scale (VAS) pain scores and WOMAC scores postoperatively, while functional scores such as KOOS, SANE, and VR-12 Physical showed marked improvement. Notably, MARS and VR-12 Mental scores remained relatively unchanged. Four cases required additional surgical intervention—three for arthrofibrosis and one for ACL reinjury, although the latter did not involve the reconstructed MCL.

Sanada et al. conducted a study focusing on MCL reconstruction with gracilis tendon in athletes. All participants resumed sports at their prior competitive level. Average return-to-sport timelines were 6.2 months for isolated MCL cases, 9.8 months when combined with ACL reconstruction, and 11.7 months for combined PCL procedures. Radiographic evaluation showed medial joint gapping decreased from 3.5 mm pre-surgery to 0.2 mm at one-year follow-up. One case of graft rupture was recorded. Shivanna et al. retrospectively reviewed 22 cases of combined ACL and MCL injuries treated at their center. Road traffic accidents were the leading cause, accounting for 45.5% of cases. Simultaneous ACL and MCL reconstruction produced positive outcomes, with 63.6% of patients rated as "good" and 22.8% as "excellent" based on the Lysholm score. The authors highlighted benefits such as expedited rehabilitation and lower treatment costs due to single-stage surgical management.

Etinger et al. performed a biomechanical analysis comparing suture anchor repair with traditional transosseous suture techniques. Their findings showed superior resistance to gap formation and higher failure loads with suture anchors. The main modes of failure were suture pullout or rupture, depending on anchor type.

Rao et al. conducted a systematic review addressing treatment options for concurrent ACL and MCL injuries. They concluded that a lack of standardized outcome measures and limited randomized trials hinder definitive treatment guidelines. However, favorable outcomes have been documented for surgical repair, reconstruction and conservative management of the Medial collateral ligament when performed alongside Anterior Cruciate Ligament reconstruction.

Khetan et al. assessed a modified reconstruction method and found a significant increase in Kujala scores from a preoperative average of 45.85 to 92.72 postoperatively ($p < 0.01$). Approximately 72.5% of patients had excellent outcomes with 15% good and 10% fair results. Only one case showed poor result.

Khatri et al. compared quadriceps tendon and hamstring tendon autografts using suspensory fixation for ligament reconstruction. Both groups experienced significant improvements in Lysholm and IKDC scores six months postoperatively. Most patients (91%) returned to their pre-injury level status of activity. A few reported postoperative stiffness that limited full range of motion, such as squatting or sitting cross-legged. No major differences were observed between graft types in longer-term functional scores.

Materials and Methods

Study Design: Prospective cohort

Location: Department of Orthopaedics, Dr. D. Y. Patil Medical College, Navi Mumbai

Study Period: May 2022 – May 2025

Study Phases:

1. Problem Identification and Questionnaire Development
Time Allocation: 5–10%
Timeline: May 2022 to December 2022
2. Pilot Testing, Questionnaire Validation, and Data Collection
Time Allocation: ~80%
Timeline: January 2023 to July 2023
3. Data Analysis and Interpretation
Time Allocation: 5–10%
Timeline: August 2023 to September 2023
4. Dissertation Writing and Submission
Time Allocation: 5–10%
Timeline: October 2023 to November 2023

Sample Size: 30 patients

Inclusion Criteria:

Individuals aged 18–45 with MCL tears Patients consenting to surgical intervention

Closed knee injuries

Any gender

Exclusion Criteria:

Infected joints

Polytrauma cases

Non-consenting patients

Open fractures

Methodology:

This single-site, prospective cohort study was conducted at Dr. D. Y. Patil Medical College and Hospital to evaluate the functional outcomes of medial collateral ligament (MCL) reconstruction using a single hamstring tendon autograft and suture anchors. The study protocol was approved by the institutional ethics committee prior to patient enrollment.

Patient Selection and Pre-operative Assessment:

The study included patients aged 18-45 years who presented with MCL tears involving adjacent complex structures. A comprehensive pre-operative assessment was conducted for each patient, which included detailed medical history documentation, demographic data collection (age and sex), evaluation of existing comorbidities, and specific information regarding the mechanism of trauma. Each patient underwent thorough clinical examination and pre-operative radiological evaluation including plain radiographs and magnetic resonance imaging (MRI) of the affected knee.

Surgical Technique:

All surgeries were performed under appropriate anesthesia following standard sterile protocols. The patient was positioned supine on the operating table, and the surgical site was prepared and draped using standard aseptic technique. The procedure began with diagnostic arthroscopy through standard anterio-medial and anterio-lateral portals to confirm the MCL tear and assess any concomitant intraarticular pathology.

The surgical reconstruction proceeded with harvesting of the hamstring tendon autograft. Careful attention was paid to graft preparation and sizing. The tibial and femoral tunnels were created under fluoroscopic guidance, ensuring anatomical positioning based on previously identified landmarks. The MCL reconstruction was performed using the prepared hamstring tendon autograft, which was secured using suture anchors at both the femoral and tibial attachment sites.

Post-operative Management and Follow-up:

Post-operative radiographs were obtained to verify appropriate tunnel and anchor placement. A standardized rehabilitation protocol was initiated based on individual patient factors and associated procedures. Patients were followed regularly in the post-operative period with scheduled visits at specific intervals.

Outcome Assessment:

The assessment parameters included both structural and functional outcomes. Structural evaluation was performed through serial imaging studies, including plain radiographs and MRI when indicated.

The following parameters were specifically assessed:

Structural Assessment:

MRI evaluation of the reconstructed ligament

Assessment of bone tunnel placement and healing

Documentation of time to radiological union

Evaluation of graft incorporation

The study protocol included regular follow-up visits where both objective and subjective outcome measures were recorded. Imaging studies were performed at predetermined intervals to assess structural healing and ligament integrity. These evaluations helped track the progression of healing and identify any potential complications early in the post-operative period.

Data Collection and Documentation:

All pre-operative, intra-operative, and post-operative data were systematically recorded in standardized forms. This included detailed operative notes, complications if any, and post-operative progress. The imaging studies were evaluated by experienced musculoskeletal radiologists who were blinded to the clinical outcomes.

Statistical Analysis

Results were presented in tabular and graphical forms Mean, median, standard deviation and ranges were calculated for quantitative data. Qualitative data were expressed in terms of frequency and percentages. Student t test (Two Tailed) was used to test the significance of mean and P value < 0.05 was considered significant.

Results

The present study was conducted in the Department of Orthopaedics, Dr D. Y. Patil Medical College, Nerul, Navi Mumbai from May 22 to May 25 to Study Functional outcome of the Medial Collateral ligament Reconstruction using a single Hamstring Tendon Autograft and Suture Anchors. Total of 30 patients were included in the study.

Following are the results of the study:

Distribution of patients according to gender
Gender Frequency Percentage
Female 13 43.3%
Male 17 56.7%
Total 30 100%
Out of the total 30 patients, 13 (43.3%) were female and 17 (56.7%) were male. The study had a slight majority of male participants, with a relatively balanced gender distribution that suggests the sample is representative of both genders.

Distribution of patients according to laterality

Laterality Frequency Percentage
Left 14 46.7%
Right 16 53.3%
Total 30 100%
The laterality table indicates the distribution of knee injuries across left and right knees. 14 patients (46.7%) had injuries to the left knee, while 16 patients (53.3%) had injuries to the right knee. This distribution closely mirrors the gender distribution, showing a nearly even split between left and right knee injuries.

Distribution of patients according to mode of injury

Mode of injury Frequency Percentage
Fall from height 1 3.3%
Slip and fall 18 60%
Sports injury 6 20%
RTA 5 16.7%
Total 30 100%
The most common mode of injury was slip and fall, accounting for 18 patients (60%). Sports injuries were the second most frequent, affecting 6 patients (20%), followed by road traffic accidents (RTA) with 5 patients (16.7%), and fall from height with 1 patient (3.3%). This suggests that everyday accidents like slipping are the primary cause of knee injuries in this study population.

Distribution of patients according to duration from injury to surgery
Duration from injury to surgery
Mean 73.87
SD 57.3
Minimum 10
Maximum 180
The mean time from injury to surgery was 73.87 days, with a standard deviation of 57.3 days. The shortest interval was 10 days, while the longest was 180 days. This wide range suggests variability in patient treatment timelines.

Distribution of patients according to associated injuries

Associated injuries Frequency Percentage
Midshaft tibial fracture 1 3.3%
Proximal shaft tibial fracture 2 6.7%
ACL tear 2 6.7%
Midshaft radius and ulna fracture 2 6.7%
Compression fracture 1 3.3%
ACL+PCL+MCL injuries 3 10%
None 19 63.3%
Total 30 100%
The associated injuries table shows multiple concurrent conditions. Notable findings include 3 patients (10%) with ACL+PCL+MCL injuries, while other associated injuries like midshaft tibial fracture, ACL tear each affected 2 patients (6.7%) and compression fracture in 1 patient (3.3%). This highlights the complexity of knee injuries and potential multiple-structure involvement.

Distribution of patients according to oxford knee scores at different intervals

Oxford knee scores At admission At 2 months At 4 months At 6 months
Normal joint function (40-48) - - 8 (26.7%) 30 (100%)
Mild arthritis (30-39) - - 19
(63.3%) - Moderate arthritis (20-29) - 12 (40%) 3 (10%) -
Severe arthritis (0-19) 30
(100%) 18 (60%) - -
At admission, all patients (100%) showed severe arthritis. By 4 months, 8 patients (26.7%) had normal joint function, 19 (63.3%) had mild arthritis, and 3 (10%) had moderate arthritis. By 6 months, all patients (100%) had returned to normal joint function, indicating significant improvement.

Distribution of patients according to lysholm knee scores at different intervals

Lysholm knee scores At admission At 2 months At 4 months At 6 months

Poor (<65) 30(100%) 25 (83.3%) 13 (43.3%) -
Fair (65-83) - 5 (16.7%) 12 (40%) 20 (66.7%)
Good (84-90) - - 5 (16.7%) 4 (13.3%)
Excellent (91-100) - - - 6 (20%)

Lysholm knee scores similarly show progressive improvement. Initially, all patients (100%) had poor knee function. At 2 months, 25 (83.3%) were still poor, but by 4 months, the distribution became more varied. At 6 months, 20 patients (66.7%) had fair scores, 4 (13.3%) had good scores, and 6 (20%) achieved excellent scores, demonstrating substantial functional recovery.

Association oxford knee scores at 4 months with gender

Gender Oxford knee scores at 4 months p-value
Normal joint function Mild arthritis Moderate arthritis
Female 3 (37.5%) 7 (36.8%) 3 (100%)
0.11
Male 5 (62.5%) 12 (63.2%)
0
Total 8 (100%) 19 (100%) 3 (100%)

The relationship between gender and knee function at 4 months. While there are some variations (e.g., females representing 100% of moderate arthritis cases), the p-value of 0.11 suggests no statistically significant difference in knee function between males and females.

Association oxford knee scores at 4 months with mode of injury

Mode of injury Oxford knee scores at 4 months p-value
Normal joint function Mild arthritis Moderate arthritis
Fall from height 0 1 (5.3%)
0 0.05
Slip and fall 4
(50%) 11 (57.9%) 3 (100%)
Sports injury 0 6 (31.6%)
0
RTA
4
(50%) 1 (5.3%)
0
Total 8 (100%) 19
(100%) 3 (100%)

The mode of injury to knee function at 4 months. While slip and fall injuries dominate the mild and normal joint function categories, the p-value of 0.05 indicates statistically significant relationship between injury mode and knee function.

Association oxford knee scores at 4 months with associated injuries

Associated injuries Oxford knee scores at 4 months p-value
Normal joint function Mild arthritis Moderate arthritis
Present 2 (25%) 7 (36.8%) 2 (66.7%)
0.44
Absent 6 (75%) 12 (63.2%) 1 (33.3%)
Total 8 (100%) 19
(100%) 3 (100%)

The relationship between associated injuries and Oxford knee scores at 4 months post-surgery. Among patients with normal joint function, 25% had associated injuries, while 75% did not. In the mild arthritis category, 36.8% of patients had associated injuries, compared to 63.2% without and in the moderate arthritis group, 66.7% had associated injuries and 33.3% did not. Statistically, the p-value of 0.44 is crucial, indicating no significant association between associated injuries and knee function. This high p-value suggests that the surgical technique used for reconstruction was equally effective regardless of whether patients had additional concurrent injuries.

Discussion

The Medial Collateral Ligament (MCL) is a critical stabilizing structure of the knee joint, providing primary resistance to valgus stress and contributing to rotational stability. As one of the most commonly injured ligaments in the knee, MCL injuries account for approximately 42% of all knee ligament injuries, with an incidence rate of 0.24 per 1000 person-years in the general population. While isolated grade I and II MCL injuries typically respond well to conservative management, there remains considerable debate regarding the optimal treatment approach for grade III injuries, chronic instability, and cases with concomitant ligamentous injuries. Traditional non-operative management, though successful in many cases, may lead to persistent instability and functional limitations in severe or chronic cases, particularly in athletically active individuals. Recent advances in surgical techniques and understanding of knee biomechanics have led to increased interest in surgical reconstruction of the MCL, especially in cases of chronic medial instability or multiple ligament injuries. Various surgical techniques have been described, including direct repair, augmented repair, and complete reconstruction using different graft options. Among these, hamstring tendon autografts have gained popularity due to their accessibility, appropriate size match, and minimal donor site morbidity. The use of suture anchors in ligament reconstruction has also evolved, offering potential advantages in terms of surgical efficiency and anatomic fixation. However, there remains a paucity of clinical studies evaluating the functional outcomes of MCL reconstruction using a single hamstring tendon autograft combined with suture anchor fixation, particularly in terms of return to function and patient-reported outcomes

Demographics and Injury Patterns

Our study population showed a slight male predominance (56.7%) compared to females (43.3%), which aligns with the demographic distribution reported by Sanada T et al who also show male predominance. The gender distribution in our study corresponds with Dong et al. findings where 57.8% of the males were included in the study.

The predominant mechanism of injury in our series was slip and fall (60%), followed by sports injuries (20%). This differs from Gupta S et al where MCL injuries are most common in contact sports like football and hockey. Another study Kitamura N et al 105 also showed mostly sports-related injuries (24 cases), with fewer motor vehicle accidents (3) and work-related injuries. Our higher proportion of slip and fall injuries might reflect the local population's activity patterns and environmental factors.

Surgical Timing and Associated Injuries

The mean time from injury to surgery in our study was 73.87 days (SD=57.3), which is comparable to the ndings of Liu et al. , who reported a mean delay of 68 days in their series of 45 patients. Despite this relatively extended interval, our functional outcomes remained excellent, supporting Feeley et al.'s conclusion that delayed reconstruction does not necessarily compromise results when proper patient selection is maintained.

Our study found that 36.7% of patients had associated injuries, with ACL+PCL+MCL injuries being the most common combination (10%).This aligns with the Gupta S et al 's observation that MCL reconstruction is often necessary in cases of multiligament injuries. Another study by Kitamura et al focused entirely on multiligament injuries like 16 had MCL/ACL, 5 had MCL/PCL, and 9 had MCL/ACL/PCL injuries.

The presence of associated injuries in 36.7% of our cases, with no significant difference in outcomes between isolated and combined injuries (p=0.44), supports the findings of Marx et al. Their study of 54 patients similarly showed no significant difference in functional outcomes between isolated MCL reconstructions and those with concurrent ligament injuries when appropriate surgical techniques were employed.

Functional outcomes

The progression of Oxford Knee Scores (OKS) in our study showed remarkable improvement, with all patients achieving normal joint function (40-48 points) by 6 months. This success rate compares favorably with Lubowitz et al.'s series where 89% of patients achieved good to excellent OKS scores at final follow-up. The absence of significant gender-based differences in outcomes (p=0.11) suggests the technique's universal applicability.

The Lysholm score improvements in our study showed a gradual but consistent progression, with 20% of patients achieving excellent scores (91-100) and 13.3% achieving good scores (84-90) at 6 months, totaling 33.3% in the good-to-excellent category. These results parallel those reported by Sanada T et al where it is improved from 69.1 preoperatively to 94.4 postoperatively. Another study by Kitamura N et al also reported better overall Lysholm scores averaging 94.8 points across all patients. Our ndings differ notably from those reported by Shivanna S et al, who achieved superior outcomes with 86.4% of patients showing excellent and good results, and an average postoperative Lysholm score of 89.9. Another study by Halinen et al also reported that 83% of patients achieving excellent and good scores which is in contrast to our study.

The variance in our results might be attributed to several factors such as different patient demographics and injury patterns, with our study having a higher proportion of slip and fall injuries (60%) compared to typically sports-dominated cohorts and variation in post-operative rehabilitation protocols and the timing of final assessment, as some studies may have evaluated outcomes at different post-operative intervals and our study's inclusion of cases with associated injuries (36.7% of patients), which might have influenced recovery trajectories

Pain Management and Recovery

Pain score distribution in our study showed that 60% of patients reported moderate pain scores (6-7), with gradual improvement over time while Dong et al.'s study reported that 76.6% of patients achieved normal/nearly normal outcomes with some patients still experiencing medial knee pain and tenderness. Another study by Garside JC et al reported signicant decrease in VAS scores post operatively.

The findings from our study demonstrate that MCL reconstruction using a single hamstring tendon autograft and suture anchors provides excellent functional outcomes in patients with MCL injuries. The progressive improvement in both Oxford Knee Scores and Lysholm scores, from severely impaired function at admission to normal function in all patients by 6 months post-surgery, validates the effectiveness of this surgical technique. Furthermore, the successful outcomes observed in patients with associated injuries (36.7% of cases) suggests that this reconstruction method is robust and reliable even in complex cases. The statistically significant relationship between mode of injury and functional outcomes (p=0.05) provides valuable insight for pre-operative planning and patient counseling.

Our research contributes meaningfully to the existing literature on MCL reconstruction, particularly in demonstrating the efficacy of a single hamstring tendon autograft technique. The consistent improvement pattern across all functional parameters, regardless of gender or associated injuries, suggests this technique can be confidently employed across diverse patient populations. While longer-term follow-up studies would be beneficial, the strong functional outcomes at 6 months postsurgery, with 100% of patients achieving normal Oxford Knee Scores and 20% achieving excellent Lysholm scores, indicates that this surgical approach provides reliable and reproducible results for MCL reconstruction. These findings support the incorporation of this technique into standard surgical practice for managing MCL injuries.

Conclusion

Medial collateral ligament reconstruction using a single hamstring tendon autograft and suture anchors represents a reliable surgical approach that can be effectively utilized across diverse patient populations. The technique's adaptability to various injury patterns and timing of intervention makes it a valuable addition to the surgical arsenal for managing MCL injuries. While further research with larger cohorts and longer follow-up periods would be beneficial, the current evidence supports this procedure as a dependable surgical option that can provide satisfactory functional outcomes. The findings of this study contribute to the growing body of evidence supporting surgical management of MCL injuries and offer insights that can help guide surgical decision-making in clinical practice.

The future of MCL reconstruction lies in continued refinement of surgical techniques and postoperative rehabilitation protocols. As our understanding of knee biomechanics and ligament healing continues to evolve, this surgical technique offers a foundation upon which further improvements can be built. The integration of this approach into the standard treatment algorithm for MCL injuries could potentially lead to more predictable outcomes and enhanced patient care. Moving forward, focus should be placed on developing standardized protocols for patient selection, surgical timing, and rehabilitation strategies to optimize the benefits of this reconstruction technique.

Summary

Our study entitled "functional outcomes of medial collateral ligament reconstruction using a single hamstring tendon autograft and suture anchors" This prospective study evaluated 30 patients who underwent medial collateral ligament reconstruction using a single hamstring tendon autograft and suture anchors.

The objective of our study was: To study Functional outcome of the Medial Collateral ligament Reconstruction using a single Hamstring Tendon Autograft and Suture Anchors.

Following outcomes were noted from the study:

The study population comprised 17 males (56.7%) and 13 females (43.3%), with a nearly equal distribution between right (53.3%) and left (46.7%) knee injuries. Slip and fall was the predominant mode of injury (60%), followed by sports injuries (20%), road traffic accidents (16.7%), and falls from height (3.3%).

Associated injuries were present in 36.7% of cases, with combined ACL+PCL+MCL injuries being the most frequent (10%).

Oxford Knee Scores progressed from severe arthritis (100% of patients) at admission to complete recovery with normal joint function (100%) by 6 months.

Lysholm knee scores demonstrated a similar pattern of improvement. Initially, all patients scored in the poor category (<65). By 6 months post-surgery, no patients remained in the poor category.

No significant correlation between gender and functional outcomes (p=0.11) or between associated injuries and functional outcomes (p=0.44). A significant relationship was found between the mode of injury and functional outcomes at 4 months (p=0.05), with slip and fall injuries showing more favorable recovery patterns. Pain scores ranged from 5 to 9, with the majority of patients (33.3%) reporting a score of 6, followed by 26.7% reporting a score of 7, indicating moderate to high pain levels in the study population.

Thus, in conclusion, the success rate observed in our study supports the use of single hamstring tendon autograft with suture anchors as an effective technique for MCL reconstruction. The technique showed consistent results across different patient subgroups, suggesting its versatility in various clinical scenarios. The progressive improvement in functional scores indicates that this technique provides reliable and predictable outcomes, which is crucial for surgical planning and patient counseling.

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Conflict of Interest: Nil
Source of Support: None

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Year of Acceptance of Thesis: 2025

How to Cite this Article: Gehlot O, Kale S, Bhati A, Vyas A, Darvesh M | Functional Outcome of Medial Collateral Ligament Reconstruction Using a SingleTendon Autograft and Suture Anchor: A Prospective Study | Journal of Medical Thesis | 2025 January-June; 11(1): 10-21.