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Lateral Collateral Ligament Reconstruction Using Semitendinosus Autograft for Lateral Instability Following Total Knee Replacement: A Prospective Case Series

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Abstract

Background: Instability following total knee replacement (TKR) is a major cause of patient dissatisfaction and revision surgery. Lateral instability caused by lateral collateral ligament (LCL) insufficiency is relatively uncommon but can significantly compromise knee stability and prosthetic longevity. When prosthetic components are well aligned and stable, ligament reconstruction may represent a joint-preserving alternative to revision arthroplasty. **Aim:** To evaluate the clinical and radiological outcomes of LCL reconstruction using semitendinosus autograft in patients presenting with lateral instability following total knee replacement. **Methods:** A prospective case series of 15 patients with symptomatic lateral instability following primary TKR was conducted. Patients underwent LCL reconstruction using semitendinosus autograft. Clinical and radiological outcomes were assessed using Knee Society Score and stress radiographs with a minimum follow-up of 6 months. **Results:** The mean Knee Society Score improved significantly from 56 ± 7 preoperatively to 84 ± 5 postoperatively ($p < 0.001$). Varus instability was corrected in 14 of 15 patients. Range of motion improved from 95˚ ± 12˚ to 105˚ ± 10˚ ($p = 0.02$). No major complications such as graft failure, infection, or peroneal nerve injury were observed. **Conclusion:** LCL reconstruction using semitendinosus autograft is an effective treatment option for managing lateral instability following TKR in patients with well-aligned prosthetic components. Ligament reconstruction may serve as a joint-preserving alternative in carefully selected patients with well-aligned and well-fixed prosthetic components. In the present study, reconstruction allowed preservation of implants in all cases during short-term follow-up; however, longer follow-up is required before concluding its role in avoiding revision arthroplasty.

Keywords

Total Knee Replacement, Lateral Collateral Ligament, Posterolateral Corner, Knee Instability, Semitendinosus Autograft

1. Introduction

Total knee replacement (TKR) is widely recognized as one of the most successful surgical procedures in orthopaedics, providing significant pain relief and functional improvement in patients with advanced degenerative arthritis of the knee joint. Advances in implant design, surgical technique, and perioperative management have significantly improved long-term outcomes of the procedure. Despite these improvements, postoperative complications such as instability remain an important cause of patient dissatisfaction and revision surgery.

Instability after TKR can occur due to several factors including improper ligament balancing, malalignment of prosthetic components, trauma, and progressive soft-tissue attenuation. Among these causes, coronal plane instability resulting from lateral collateral ligament insufficiency is relatively uncommon but can significantly affect knee biomechanics and prosthetic function. Previous studies have reported that ligament imbalance accounts for a considerable proportion of revision procedures following total knee arthroplasty [1] [2].

The lateral collateral ligament (LCL), also known as the fibular collateral ligament, is a key stabilizing structure of the knee joint. It originates from the lateral femoral epicondyle and inserts onto the fibular head, forming an essential component of the posterolateral corner (PLC) of the knee [1]. Together with the popliteus tendon and popliteofibular ligament, the LCL contributes to resistance against varus stress, posterior tibial translation, and external rotation of the tibia [3]. Earlier biomechanical studies have also confirmed the important role of the posterolateral corner and cruciate ligaments in maintaining knee stability [4] [5].

Biomechanical studies have demonstrated that the LCL is the primary restraint to varus stress in early knee flexion, particularly between 0˚ and 30˚ [6]. Injury to this ligament results in increased lateral compartment opening and abnormal load distribution across the knee joint. In the setting of total knee replacement, such instability may lead to increased stresses on the prosthetic components, potentially resulting in accelerated wear and early implant failure [7].

Anatomical studies have improved understanding of the posterolateral corner structures and their role in maintaining knee stability. LaPrade *et al.* described the detailed morphology of the posterolateral knee structures and emphasized the critical role of the fibular collateral ligament in maintaining varus stability [1]. Other anatomical investigations have further clarified the relationships between the LCL, iliotibial tract, and surrounding structures [2] [7].

Management of instability following TKR traditionally involves revision arthroplasty using constrained or hinged prosthetic designs. Although effective in restoring mechanical stability, revision surgery is associated with greater surgical complexity, increased bone loss, and higher complication rates. Therefore, in selected cases where prosthetic components remain well aligned and securely fixed, reconstruction of the deficient ligament may provide a less invasive and joint-preserving treatment option.

Recent advances in surgical techniques for reconstruction of the posterolateral corner have emphasized anatomical reconstruction using tendon grafts. Several graft options have been described, including semitendinosus autograft, Achilles tendon allograft, and patellar tendon graft [8]-[10]. Among these, the semitendinosus tendon autograft has gained popularity due to its favourable biomechanical properties, adequate length, and minimal donor site morbidity.

The present study evaluates the clinical and radiological outcomes of lateral collateral ligament reconstruction using semitendinosus autograft in patients with symptomatic lateral instability following total knee replacement.

2. Aims and Objectives

2.1. Primary Aim

To evaluate the effectiveness of lateral collateral ligament reconstruction using semitendinosus autograft in restoring knee stability following total knee replacement.

2.2. Objectives

1) To assess improvement in knee stability following LCL reconstruction.

2) To evaluate functional outcomes using the Knee Society Score.

3) To analyse radiological correction of varus instability.

4) To evaluate whether ligament reconstruction can serve as a joint-preserving alternative in selected patients.

3. Materials and Methods

3.1. Study Design

This study was designed as a prospective case series conducted at BIRRD Hospital, Tirupati, between January 2024 and June 2025.

3.2. Ethics Approval and Consent

Institutional Ethics Committee approval was obtained prior to commencement of the study. Written informed consent was obtained from all patients before inclusion.

3.3. Patient Recruitment

Patients were prospectively recruited from those presenting to our outpatient and arthroplasty follow-up clinics with symptomatic instability following primary total knee replacement.

3.4. Inclusion Criteria

- Lateral instability following primary TKR
- Varus laxity on clinical examination
- Varus opening on stress radiographs
- Well-aligned and well-fixed prosthetic components
- Age > 40 years

3.5. Exclusion Criteria

- Prosthetic joint infection
- Implant loosening
- Malalignment of prosthetic components
- Multiligament knee injuries
- Patients requiring revision arthroplasty

3.6. Preoperative Evaluation

All patients underwent detailed clinical, laboratory, and radiological evaluation:

3.6.1. Infection Exclusion

- ESR and CRP levels were assessed in all patients
- Patients with elevated inflammatory markers underwent joint aspiration
- Synovial fluid analysis (cell count, differential count, culture) was used to rule out infection

3.6.2. Implant Loosening and Malalignment

- Evaluated using weight-bearing AP, lateral, and long-leg alignment radiographs
- Radiolucent lines, component migration, and malalignment were assessed
- CT scan was used in selected cases for component rotation assessment

3.6.3. Instability Assessment

- Varus stress testing was performed at 0˚ and 30˚ of knee flexion. Comprehensive physical examination remains essential in evaluating ligamentous instability around the knee [11].
- Stress radiographs were obtained using standardized manual varus stress. Stress radiography has been shown to be a reliable and reproducible method for quantifying lateral instability and posterolateral corner injury [12].
- Lateral joint opening > 5 mm compared to the contralateral side was considered significant.

Clinical examination revealed varus instability of the knee on stress testing in all patients.

Radiological assessment included weight-bearing anteroposterior and lateral radiographs of the knee. Preoperative weight-bearing radiographs demonstrated lateral joint opening suggestive of lateral collateral ligament insufficiency (**Figure 1**). The presence of lateral instability was confirmed by varus stress radiographs and clinical examination findings. MRI may be useful in selected patients for assessment of associated soft-tissue injuries around the posterolateral corner [13].

3.7. Surgical Technique

Under spinal anaesthesia, the patient was positioned supine. The semitendinosus tendon was harvested and prepared as an autograft.

Figure 1. A representative preoperative weight-bearing anteroposterior radiograph showing lateral joint opening consistent with LCL insufficiency.

A lateral incision was made over the fibular head. The proximal fibula was exposed and cleared of surrounding soft tissues while protecting the common peroneal nerve.

A tunnel was drilled through the fibular head and gradually enlarged using sequential reaming.

Through a split in the iliotibial band, the anatomical femoral attachment of the LCL was identified and a femoral tunnel was created.

The graft was passed through both tunnels, replicating the natural course of the LCL.

With the knee positioned at 20˚ of flexion and valgus stress applied, the graft was fixed using interference screws.

3.8. Postoperative Rehabilitation

- Knee immobilizer for 2 weeks
- Passive range of motion exercises after 2 weeks
- Partial weight bearing for 4 weeks
- Progressive strengthening exercises thereafter

Patients were followed up at 6 weeks, 3 months, and 6 months postoperatively.

- Final outcome analysis was performed at 6 months

3.9. Instability Outcome Definition

- Clinical success: absence of varus laxity on examination

- Radiological success: <3 mm lateral joint opening on stress radiographs
- Functional success: improvement in Knee Society Score

3.10. Statistical Analysis

Statistical analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation. Preoperative and postoperative outcomes were compared using the paired Student's t-test.

A p-value < 0.05 was considered statistically significant.

4. Results

A total of 15 patients with symptomatic lateral instability following total knee replacement underwent lateral collateral ligament reconstruction using semitendinosus autograft during the study period. The mean age of the patients was 62 ± 6 years, and all patients were followed for a minimum period of six months postoperatively (**Table 1**). The mean follow-up duration was 8 ± 2 months (range, 6 - 12 months).

Table 1. Patient demographics.

Parameter	Value
Total patients	15
Mean age	62 ± 6 years
Sex	9 males, 6 females
Operated side	8 right, 7 left
Time from TKR to instability	14 ± 5 months
Indication for primary TKR	OA (13), RA (2)
Implant type	Posterior stabilized (15)

Functional outcomes showed significant improvement following reconstruction (**Table 2**). The mean Knee Society Score improved from 56 ± 7 preoperatively to 84 ± 5 at the final follow-up, which was found to be statistically significant ($p < 0.001$).

Table 2. Clinical outcomes.

Parameter	Preoperative	Postoperative at 6 months	p-value
Knee Society Score	56 ± 7	84 ± 5	<0.001
Range of Motion	95˚ ± 12˚	105˚ ± 10˚	0.02
Varus instability	Present in 15	Corrected in 14	-

Similarly, knee range of motion improved from a mean preoperative value of 95˚ ± 12˚ to 105˚ ± 10˚ postoperatively, demonstrating a statistically significant improvement ($p = 0.02$).

Varus instability was corrected in 14 out of 15 patients, as confirmed by postoperative clinical examination and radiographic assessment. One patient demonstrated mild residual laxity; however, the patient remained functionally stable and did not require further surgical intervention.

Radiological Outcomes

Preoperative weight-bearing radiographs demonstrated varus opening of the lateral compartment in all patients, indicating lateral collateral ligament insufficiency.

Following LCL reconstruction using semitendinosus autograft, postoperative radiographs demonstrated restoration of lateral stability and absence of varus opening in 14 out of 15 patients.

Representative postoperative radiographs are shown in **Figure 2** (anteroposterior view) and **Figure 3** (lateral view), demonstrating restoration of joint alignment and stable prosthetic components.

Figure 2. Postoperative AP view showing restored alignment.

Figure 3. Postoperative lateral view demonstrating stable prosthesis.

No cases of graft failure or need for revision surgery were observed during the follow-up period.

5. Discussion

Instability following total knee replacement remains one of the leading causes of patient dissatisfaction and revision surgery. While sagittal plane instability is more commonly encountered, coronal plane instability due to lateral collateral ligament insufficiency represents a relatively uncommon but clinically significant problem. Restoration of stability in such cases is essential to prevent abnormal load distribution, polyethylene wear, and early implant failure. Chronic posterolateral rotatory instability has long been recognized as an important cause of persistent functional instability and gait disturbance if untreated [14].

The posterolateral corner of the knee plays a crucial role in maintaining varus and rotational stability. It comprises key structures including the fibular collateral ligament, popliteus tendon, and popliteofibular ligament, which act synergistically to resist varus stress and external rotational forces. Previous anatomical and biomechanical studies have highlighted the importance of the fibular collateral ligament as the primary restraint to varus stress, particularly in early knee flexion angles [1] [15].

Biomechanical investigations have demonstrated that disruption of the lateral collateral ligament leads to significant varus laxity and altered knee kinematics. Coobs *et al.* showed that anatomical reconstruction using a semitendinosus autograft can restore near-normal stability of the fibular collateral ligament, supporting the rationale for reconstruction in cases of isolated lateral instability [16].

In the setting of total knee arthroplasty, ligament imbalance may result from intraoperative factors, trauma, or progressive soft-tissue degeneration. When instability is caused primarily by soft-tissue insufficiency rather than implant-related factors, ligament reconstruction offers a joint-preserving alternative to revision arthroplasty. This approach avoids the morbidity associated with revision procedures, including bone loss, increased operative time, and higher complication rates.

In the present study, ligament reconstruction was performed in carefully selected patients with well-fixed and well-aligned prosthetic components, isolated lateral instability, and no evidence of infection or implant loosening. This selection strategy ensured that reconstruction was reserved for cases in which soft-tissue insufficiency was the primary cause of instability, thereby optimizing the likelihood of successful outcomes.

The findings of the present study are consistent with previous reports demonstrating improved stability following anatomical reconstruction of the posterolateral corner. LaPrade *et al.* reported favorable clinical outcomes following fibular collateral ligament reconstruction, while Geeslin *et al.* demonstrated improved functional outcomes in patients undergoing reconstruction for posterolateral instability [17] [18]. Biomechanical studies have further shown that reconstruction using semitendinosus graft can restore near-normal knee stability [16]. Our results are in agreement with these findings, supporting the role of anatomical reconstruction in restoring knee stability and function.

Earlier literature has also shown that repair of posterolateral corner injuries is associated with higher failure rates compared with reconstruction. Levy *et al.* demonstrated superior outcomes with reconstruction techniques, which has led to a shift toward anatomical reconstruction as the preferred management strategy [19].

Radiological evaluation plays an important role in both diagnosis and postoperative assessment of instability. Stress radiography has been shown to be a reliable method for quantifying lateral joint opening and assessing posterolateral corner injuries [12]. In the present study, radiological outcomes correlated well with clinical findings, with correction of varus instability observed in the majority of patients.

Recent literature continues to support anatomical reconstruction techniques for posterolateral instability. Figueroa *et al.*, in a contemporary review, emphasized the importance of restoring native knee biomechanics through anatomical reconstruction to achieve optimal clinical outcomes [20]. General epidemiological studies have also shown that knee soft-tissue injuries remain clinically relevant across active populations [21] [22].

In our study, LCL reconstruction using semitendinosus autograft resulted in significant improvement in both knee stability and functional outcomes. The Knee Society Score improved significantly, and most patients demonstrated correction of varus laxity on both clinical examination and radiographic assessment. These findings suggest that ligament reconstruction is an effective treatment option in appropriately selected patients.

Importantly, this technique allowed preservation of the existing prosthetic components in all patients during short-term follow-up. While these results are encouraging, the role of ligament reconstruction as an alternative to revision arthroplasty requires further validation through larger studies with longer follow-up durations.

This study has several limitations, including a relatively small sample size, short follow-up duration, and lack of a control group. Additionally, variability in patient characteristics and primary TKR indications may influence outcomes. Future studies with larger cohorts and longer follow-up are necessary to assess the durability of reconstruction and its long-term clinical effectiveness.

6. Conclusion

LCL reconstruction using semitendinosus autograft is a safe and effective option for managing lateral instability following total knee replacement in carefully selected patients with well-aligned and stable prosthetic components. The procedure provides significant improvement in knee stability and functional outcomes in the short term. Further studies with longer follow-up are required to confirm its long-term effectiveness.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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