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Tackling Post-TKR Complications: Achilles Allografts in Extensor Mechanism Reconstruction

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Abstract

Revolutionizing post-TKR care, novel use of Achilles tendon allografts emerge as a game-changer for displaced extensor mechanism, tackling one of the most challenging complications of total knee replacement. By restoring active knee extension and preventing lateral patellar subluxation, this technique empowers patients with improved mobility and independence.

The study included three patients with persistent patellar instability and malalignment were treated with a lateral retinacular release and Achilles tendon allograft fixation around the quadriceps mechanism. At 12 months, functional outcomes improved significantly: the Kujala score increased from 50 to 85, Knee Society Score (KSS) from 60 to 90, and Tegner Activity Level from 2 to 6. Postoperative imaging confirmed successful graft incorporation and alignment correction.

This technique, combining soft-tissue release with robust Achilles tendon allograft reconstruction, offers a promising solution for complex post-TKR patellar maltracking, highlighting the strength and adaptability of the Achilles tendon in restoring knee dynamics.

Overcoming the limitations of autografts and other traditional methods, this novel approach offers unmatched strength and adaptability while addressing critical surgical complexities. Despite potential challenges like stiffness and availability, the outcomes highlight enhanced function, stability, and patient satisfaction. With its innovative approach and tailored rehabilitation protocols, this procedure sets a new benchmark in orthopedic reconstructive surgery, combining precision and patient-centric care to redefine recovery.

Keywords: Quadriceps displacement, extensor mechanism repair, achilles tendon allograft, post-TKR complications

Introduction

Extensor mechanism displacement is a rare but debilitating complication of total knee replacement (TKR). It significantly impairs knee function, leading to an inability to achieve active extension, instability, and difficulty walking. This case study highlights the innovative use of allograft tendons, specifically Achilles tendons with or without bone, in the reconstruction of the quadriceps mechanism in patients experiencing such displacement.

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Case Presentation

The study includes 3 patients (age: 45-70) who underwent primary total knee replacement, some with patellar resurfacing and others without. All the patients had experienced trauma post-TKR, leading to severe lateral subluxation of the patella and displacement of the extensor apparatus. This condition resulted in: 1. Inability to actively extend the knee or stand unsupported and 2. Direct exposure of the knee joint prosthesis beneath the skin, raises risks of infection and further complications.

Patient Inclusion and Exclusion Criteria

Inclusion Criteria:

- Post-total knee replacement (TKA) patients with symptomatic patellar maltracking (e.g., lateral patellar tilt, subluxation, or instability).
- Persistent anterior knee pain unresponsive to conservative management.
- Evidence of patellar maltracking on imaging (e.g., CT-confirmed tibial tubercle-trochlear groove [TT-TG] distance >20 mm).

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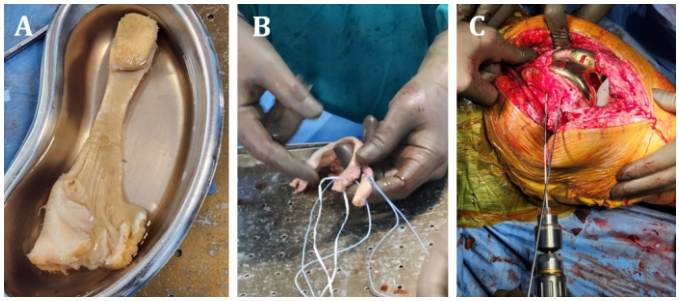

Figure 1: A. Achilles Tendon with bone block allografts, B. Preparation of allograft, C. Surgical technique: drilling tunnel on the medial femoral condyle

• Stable TKA components without malrotation or loosening.

Exclusion Criteria:

• Active infection around the knee prosthesis.
• Gross malalignment of the TKA prosthetic components.
• Medical contraindications to surgery or rehabilitation (e.g., poor vascular health, uncontrolled diabetes).
• Severe patellofemoral joint degeneration (e.g., patella osteonecrosis

Challenges in Management

Autograft tendons such as semitendinosus or peroneus were deemed unsuitable due to their inadequate width, strength, and collagen quality. Reconstruction of the displaced extensor mechanism required a graft with sufficient strength and flexibility to achieve dual objectives:

1. Restoring active knee extension.
2. Preventing lateral patellar subluxation via a medial checkrein mechanism.

Preoperative Evaluation

MRI:

• Evaluated soft-tissue integrity, including medial patellofemoral ligament (MPFL) status, quadriceps mechanism pathology, and cartilage health.

CT Scan:

• Assessed TT-TG distance to quantify patellar maltracking (>20 mm confirmed malalignment).
• Checked prosthetic component rotation and alignment to rule out primary mechanical issues.

Surgical Technique

The chosen solution was the use of Achilles tendon allograft, both with and without bone, due to its superior strength, width, and adaptability.

Positioning and Preparation:

• Patients were positioned supine with a pneumatic tourniquet applied. The surgical field was prepped aseptically.

Exposure:

• A midline skin incision was made over the previous TKA scar to expose the extensor mechanism and patella.

Lateral Release:

• A step-by-step lateral retinacular release was performed to alleviate excessive tension and correct lateral patellar malalignment.

Femoral Tunnel Creation:

• A 5-mm tunnel was drilled in the medial femoral condyle near the adductor tubercle. Placement was confirmed with fluoroscopy.

Graft Preparation:

• Achilles tendon allograft (with calcaneal bone block) was trimmed to appropriate dimensions for strength and adaptability.
• The graft was pre-tensioned to mimic physiological ligament properties.

Graft Wrapping and Fixation:

• The Achilles tendon was circumferentially wrapped around the quadriceps mechanism, enhancing medial restraint.
• The graft was anchored anteriorly to the patella using suture anchors and fixed proximally in the femoral tunnel with an interference screw.

Closure:

• The surgical site was irrigated thoroughly, and the incision was closed in layers.

Postoperative Rehabilitation

Post-surgery, patients were managed with a strict rehabilitation protocol:

Phase 1 (0–2 weeks):

• Knee immobilized in extension with a brace; partial weight-bearing with crutches.
• Initiation of isometric quadriceps exercises.

Phase 2 (3–6 weeks):

• Gradual range-of-motion exercises (up to 90° flexion).
• Continued partial weight-bearing and progressive quadriceps strengthening.

Phase 3 (6–12 weeks):

• Full weight-bearing as tolerated.
• Introduction of proprioception and functional strengthening exercises.

Phase 4 (>12 weeks):

• Advanced strengthening and return-to-activity protocols tailored to individual patient needs.

Follow up & Outcomes

All patients achieved the following:

1. Restoration of active knee extension with good strength in the extensor mechanism.
2. Correction of patellar alignment with the elimination of

Table 1. Comparison of novel Achilles tendon technique with other techniques

Aspect	Achilles Tendon Allograft + Lateral release	MPFL Reconstruction	Tibial Tubercle Osteotomy
Graft Strength	Superior strength and coverage	Adequate for most cases	N/A
Soft-Tissue Correction	Comprehensive circumferential support	Medial patellar stabilization	Limited
Bone Realignment	Indirect correction of TT-TG	None	Direct correction of TT-TG
Postoperative Recovery	Moderate; requires soft-tissue healing	Faster; less invasive	Prolonged due to osteotomy site

lateral subluxation.

3. Full range of motion over time, allowing for improved mobility and independence.

Postoperative Imaging:

• CT scans confirmed central patellar alignment and correction of TT-TG distance to <15 mm.

• MRI at 6 months demonstrated good graft incorporation and no evidence of loosening or failure.

Functional Scores:

On average, patients treated with the Achilles tendon allograft technique for post-TKA patellar maltracking demonstrated significant functional improvement. The Kujala score increased by 35 points (from 50 to 85) for one patient, while the Knee Society Score (KSS) improved by 30 points (from 60 to 90) for another. Additionally, the Tegner Activity Level rose by 4 levels (from 2 to 6), reflecting enhanced activity and stability. These outcomes suggest the procedure effectively restores patellar function and improves patient-reported outcomes within 12 months.

Complications:

No major complications, such as infection, graft rejection, or instability, were observed during the 12-month follow-up.

Discussion

This series demonstrates the superiority of Achilles tendon allografts in reconstructing the extensor mechanism in cases of post-TKR displacement. The procedure not only restored function but also provided stability by simultaneously addressing lateral patellar subluxation. The use of allografts offers flexibility in size and strength, overcoming the limitations of autografts.

Research supports the Achilles tendon allograft as a superior option for extensor mechanism reconstruction compared to synthetic materials or other graft types, with reliable and durable outcomes over long-term follow-up periods. It is particularly suitable for cases involving multiple prior surgeries that compromise native tissue.

The management of extensor mechanism displacement after total knee arthroplasty (TKA) involves diverse surgical techniques tailored to the underlying causes, including soft-tissue imbalances, extensor mechanism misalignment, or prosthetic component malpositioning. Traditional methods include lateral retinacular release, medial plication, and V-Y quadricepsplasty for soft-tissue correction, while MPFL reconstruction using tendon grafts provides medial stabilization in cases without component malrotation [1]. Extensor mechanism realignment, through proximal (Insall procedure) or distal (Hauser, Emslie-Trillat, and Fulkerson procedures) approaches, addresses bony misalignments. Prosthetic component revisions are necessary when maltracking stems from malrotated implants. For complex cases, combined techniques integrating soft-tissue procedures, MPFL reconstruction, and tibial tubercle realignment are used, and lateral patellar facetectomy addresses persistent lateral overload. Despite advances, patient outcomes vary, underscoring the importance of individualized surgical planning and preoperative imaging [1]. The novel Achilles tendon allograft technique builds on these principles, offering enhanced soft-tissue support and adaptability for challenging cases.

The use of the Achilles tendon in reconstructing the torn extensor mechanism has established its utility in restoring knee dynamics due to its superior strength, width, and adaptability. This precedent underscores the graft's ability to effectively restore the functional integrity of the extensor mechanism, as evidenced by significant improvements in clinical outcomes like Knee Society Scores (KSS) and Kujala scores reported in

Table 2. Summary and Key learning points

Novelty of the Procedure	• Combines the strengths of soft-tissue reconstruction and lateral release with a robust allograft to provide durable medial support.
	• First described use of Achilles tendon allograft in managing post-TKA patellar maltracking.
Suitable Patient Profiles	• Post-TKA patients with recurrent patellar maltracking unresponsive to traditional methods.
	• Those with complex extensor mechanism disruptions or failed prior soft-tissue reconstructions.
	• Patients with normal TKA component alignment but persistent patellar instability.
	• This novel technique can be further studied in young, active individuals with severe or recurrent maltracking, with failed prior reconstructions and cases requiring robust soft-tissue and structural support due to combined etiologies.
Impact on Indian Healthcare	• Relevance: Offers a solution for severe post-TKA patellar complications in a population with increasing TKA adoption.
	• Challenges: Limited access to Achilles allografts may limit widespread adoption.
	• Potential: With cost optimization and training, this technique could significantly enhance outcomes for challenging cases.

various studies. The current case series further expands on this established role by innovatively utilizing the Achilles tendon allograft to address extensor mechanism displacement and patellar maltracking post-TKA. For instance, Crossett et al. reported a reduction in extension lag from 44° to 3° and improved walking ability, highlighting the functional reliability of Achilles tendon allografts. Early mobilization protocols have shown minimal differences in failure rates between early and late mobilization (10.3% vs. 7.7%, respectively), with early protocols yielding better knee flexion outcomes [2, 3, 4].

These findings underline the importance of tailored rehabilitation strategies to optimize outcomes. These outcomes reaffirm the Achilles tendon's value in not only repairing but also reconfiguring the extensor mechanism to correct malalignment and improve knee stability. The adaptation of this robust graft to a complex problem like post-TKA maltracking highlights its versatility and sets a new standard for tackling challenging extensor mechanism pathologies while building on its proven efficacy. The choice of technique should be tailored to the specific circumstances and limitations of each case. Harvesting autografts in post-traumatic or elderly patients often results in inferior graft quality and can lead to donor site complications, such as saphenous nerve damage and unintended tendon loss. Allografts are considered a reliable option, offering satisfactory outcomes when proper surgical techniques ensure appropriate graft tension during extension. However, Achilles tendon allografts come with potential drawbacks, including stiffness, infection risks, and limited availability, which must be carefully evaluated against traditional methods.

Conclusion

The Achilles tendon allograft technique, while innovative, reflects an evolution of combining established concepts (MPFL reconstruction, lateral release, and TTO) into a single robust procedure. Its novelty lies in its ability to address severe maltracking while leveraging the superior strength and adaptability of the Achilles tendon. This approach provides a reliable solution for restoring knee function and improving patient quality of life, marking a notable achievement in orthopedic surgery.

However, further comparative studies are needed to establish its long-term outcomes and define its place among traditional approaches.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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