

Primary Total Knee Arthroplasty with Tibial Tubercle Advancement Osteotomy in a Young Adult with Severe Deformity: A Case Report

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ABSTRACT

Keywords

total knee arthroplasty, tibial tubercle advancement, valgus deformity, patella baja, young adult

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Received: 3rd May 2025; Accepted: 5th
November 2025

Doi:
<https://doi.org/10.31436/10.31436/imjm.v25i04/2948>

Total knee arthroplasty (TKA) in young patients with complex deformities and prior surgical interventions presents unique technical challenges. We report the case of a 32-year-old male with post-traumatic arthritis, fixed valgus deformity, patella baja, and limited motion secondary to previous femoral and patellar fractures with subsequent infection. He underwent primary TKA with tibial tubercle advancement (TTA) osteotomy. Intraoperative findings included severe scarring and patellar maltracking. A non-constrained implant was used with good intraoperative balance. The patient maintained good function at a five-year follow-up with no pain or instability. This case highlights the feasibility of non-constrained TKA with TTA in young patients when guided by thorough preoperative planning and soft tissue management.

INTRODUCTION

Total knee arthroplasty (TKA) is an effective and dependable management strategy for advanced knee osteoarthritis, yielding reproducible functional outcomes.¹⁻³ However, a subset of patients presents with complex issues that complicate surgery and may lead to poorer outcomes. Outcomes may be less predictable due to deformities, joint stiffness, and involvement of the extensor mechanism.^{1,3-6} Tibial tubercle advancement (TTA) osteotomy, while rarely used in primary TKA, may be necessary to address exposure difficulty, patella baja, or extensor tensioning.⁷ This report details a challenging case of TKA in a young male with a history of trauma, knee joint infection, and multiple surgeries, necessitating TTA to improve patellar alignment.

CASE REPORT

A 32-year-old man presented with pain, stiffness, and a multi-axial deformity of the left knee. Ten years earlier, he sustained a closed supracondylar femoral fracture

with an intercondylar split and a closed fracture of the ipsilateral patella following a motor vehicle accident. These were treated with internal fixation at another facility. His recovery was complicated by deep peri-prosthetic infection requiring implant removal, serial debridement, and prolonged antibiotics. Although the infection resolved, the fracture united with malalignment, and no further intervention has been done for the last eight years.

Upon presentation, he ambulated with a single crutch due to lateral knee pain. Clinical assessment revealed a non-correctable valgus deformity of 25° and limited knee motion (30°-70°). Scarring from previous surgeries, including a long lateral para-patellar scar and two smaller anterior scars, was evident. There was mild effusion, but no clinical signs of active deep-seated infection were present. The patella was low-seated and laterally subluxated. Pre-operative investigations showed normal blood counts and negative synovial fluid assays for

infection. Weight-bearing radiographs indicated severe osteoarthritis, femoral condyle deformity, and patella baja (Figure 1). MRI confirmed significant osteochondral defects, absent lateral meniscus, a partially torn anterior cruciate ligament, and extensive soft tissue fibrosis (Figure 2).

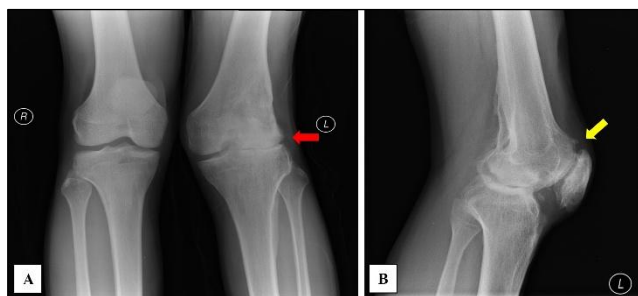


Figure 1: Preoperative plain radiographs. (A) Anteroposterior (AP) view of the bilateral knees demonstrates valgus deformity of the left knee with a malunited lateral femoral condyle and severe osteoarthritis in the lateral compartment (indicated by the red arrow). (B) Lateral view of the left knee reveals severe osteoarthritis in the left patellofemoral compartment with patella baja (indicated by the yellow arrow).

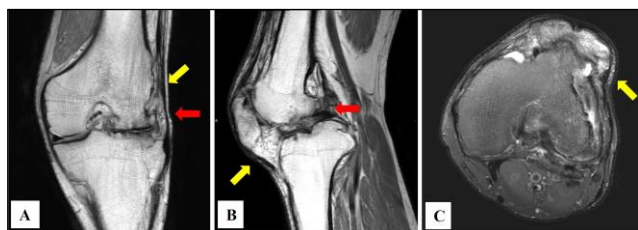


Figure 2: MRI of the left knee. (A) T1-weighted image (coronal plane) showing contracture and fibrosis at the lateral aspect of the knee, including involvement of the lateral collateral ligament (yellow arrow) and presence of a chondral defect in the lateral compartment (red arrow). (B) T1-weighted image (sagittal plane) showing patella baja with patella ligament contracture (yellow arrow). The lateral femoral condyle is deformed with an extensive chondral defect in the posterior aspect of the joint (red arrow). (C) T2-weighted image (axial plane) showing a deformed patella, which is laterally subluxated (indicated by the yellow arrow).

The patient, a young businessman with a family, strongly desired a painless and mobile knee. Given the patient's goals, TKA was recommended, with discussions about potential outcomes and the necessity for a semi-constrained or fully constrained implant depending on intra-operative findings. Key surgical concerns included fixed flexion deformity, patellar maltracking, extensive fibrosis, and valgus malalignment. The main goal was to achieve a functional, pain-free, and mobile knee rather than full anatomical correction of deformities. Objective measurement of patellar height (e.g., Insall-Salvati index) could not be reliably performed due to the patient's

limited flexion and distorted bony anatomy on lateral radiographs. Additionally, long-leg radiographs were not available at our institution at the time, and mechanical alignment was assessed intraoperatively and on standard AP radiographs.

The surgery was performed with a tourniquet, utilizing the existing lateral parapatellar scar to preserve anterior skin vascularity and facilitate valgus deformity correction. The patellar tendon was thin and contracted, contributing to patella baja and lateral subluxation. Extensive fibrosis was observed posteriorly and laterally. Intraoperative cultures were taken due to the infection history; all returned negative.

A 3° valgus distal femoral cut with an additional 2 mm resection was made. A standard tibial cut accommodated a 10 mm insert. To correct the extensor mechanism and improve patellar tracking, a 2-cm TTA was performed and fixed with cancellous screws after confirming intraoperative flexion of 120° (Figure 3). Grafting or tendon lengthening procedures were avoided due to the prior infection risk and the fragile nature of the patellar tendon. The goal of TTA was to optimize tracking and exposure, not necessarily to fully restore patellar height. Soft tissue balancing included posterolateral release and pie-crusting of the lateral collateral ligament and iliotibial band. This achieved a well-balanced knee without releasing the popliteus. A non-constrained implant was used with satisfactory intraoperative stability.

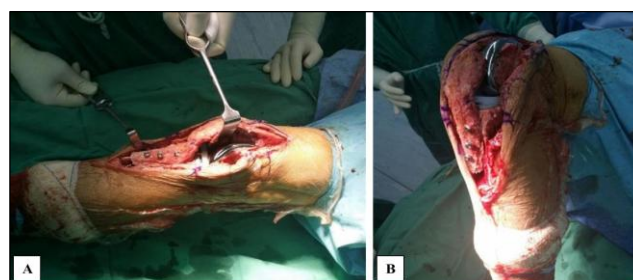


Figure 3: Intra-operative images of the left knee with completed TKA and TTA osteotomy. (A) The knee in full extension. (B) The knee in 120° of flexion with the patella fully relocated.

Postoperatively, the patient used a hinged knee brace and remained non-weight-bearing for 12 weeks. Flexion

was restricted to 60° for 6 weeks (Figure 4(A)), then progressed with physiotherapy. At six months, the range of motion (ROM) improved to 5°-115°. The tibial tubercle screws were later removed due to local tenderness after union was confirmed. At the five-year follow-up, the patient remained pain-free and functional with no instability and maintained ROM. The Knee Society Score (KSS) improved from 35 (pre-operation) to 85 (five-year follow-up). Radiographs showed a small area of tibial radiolucency, but there were no symptoms or signs of loosening or infection (Figure 4(B) and (C)).



Figure 4: Plain radiographs of the left knee. (A) Lateral and AP views at six weeks post-operation show stable fixation of the unconstrained primary TKA implant alongside the TTA osteotomy construct (indicated by the yellow arrows). (B) AP view and (C) lateral view at five years post-operation reveal a healed TTA osteotomy construct, with cortical screws removed and good fixation of the primary TKA component (red and yellow arrows), demonstrating no signs of loosening. The TTA osteotomy construct has successfully achieved union (indicated by the yellow arrow).

DISCUSSION

TKA is a well-established procedure for managing severe osteoarthritis and related deformities, typically yielding highly satisfactory long-term outcomes and improved patient lifestyles.^{1,2,8} While many primary TKAs can be successfully performed with non-constrained implants, complex cases involving prior trauma, infection, or deformity necessitate tailored strategies, meticulous planning, and intraoperative adaptability to optimize results. These patients often have less predictable outcomes and should not be

evaluated by the same expectations as typical primary TKA cases.⁵⁻¹⁰

Patella baja, commonly encountered in revision TKA, is rarely addressed in primary cases unless it compromises function or exposure. In this case, a TTA was performed to realign the extensor mechanism and improve patellar tracking. Full correction of patellar height was not achieved, but this was not the primary objective. Due to limited preoperative flexion and distorted anatomy, standard indices such as the Insall-Salvati ratio could not be reliably calculated from lateral radiographs. Similarly, long-leg radiographs to assess mechanical alignment were not available; however, clinical and intraoperative assessments confirmed satisfactory alignment postoperatively. TTA is not routinely used in primary TKA but can be an effective adjunct when addressing challenges such as patella baja, difficult exposure, limited flexion, and extensor mechanism tensioning.^{6,7} Though associated with complications like skin necrosis or fracture, its use is justified when essential, and success depends heavily on preoperative planning and careful execution.

This case exemplifies the challenges posed by a deformed patella and extensive soft tissue scarring, including lateral subluxation due to prior fractures and contracted patellar tendons leading to patella baja. The malunited supracondylar left femur resulted in a severe fixed valgus deformity, further compounded by deep fibrosis from previous surgeries. In revision or post-infective cases, patella baja and poor exposure are significant challenges. In this patient, TTA enhanced exposure and corrected patellar maltracking and extensor alignment. Soft tissue balancing was achieved through targeted posterolateral release and pie-crusting of the iliotibial band and lateral collateral ligament. This allowed for the successful correction of the valgus deformity without compromising ligament function. A constrained implant was avoided, as sufficient stability was achieved with a non-constrained component. While young age is a relative contraindication for TKA due to higher lifetime revision risks, realistic counselling and

shared decision-making can facilitate functional restoration.

To maintain knee stability, additional procedures on the patellar tendon were avoided to prevent weakening the extensor mechanism, especially since TTA had already been incorporated. Post-operative care, including bracing and physiotherapy, was pivotal in protecting the osteotomy site and optimizing functional recovery, particularly given the patient's youth and concerns regarding implant longevity and increased lifetime revision risk.¹ At 5 years, the patient demonstrated stable implant fixation, a functional ROM, and a substantial improvement in KSS. There were no signs of infection or instability. However, the case also highlights potential shortcomings, including incomplete correction of patella baja and reliance on clinical rather than radiographic alignment assessment. These limitations were accepted in favour of minimizing surgical risk in a previously infected and structurally compromised knee.

CONCLUSION

This case illustrates that even in complex scenarios, TKA with adjunct procedures like TTA can yield durable, satisfying results in young patients when guided by sound surgical principles. The successful outcome was attributed to meticulous planning, effective communication between the patient and the managing team, utilization of existing surgical scars, and intraoperative adaptability.

ACKNOWLEDGEMENT

The authors would like to thank the Medical and Healthcare Research Cluster, Office of the Deputy Vice-Chancellor of Research and Innovation, Universiti Sultan Zainal Abidin, for the invaluable support and assistance that greatly facilitated the successful completion of the report.

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