

Closing Wedge Retrotubercular Tibial Osteotomy and TKA for Posttraumatic Osteoarthritis With Angular Deformity

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Abstract

Posttraumatic osteoarthritis of the knee can be associated with angular deformities and alterations in the joint line as a result of the initial trauma and subsequent surgical procedures. These deformities can be characterized as extra-articular or intra-articular or can involve aspects of both. Conversion to total knee arthroplasty (TKA) may require either a staged or a simultaneous corrective osteotomy to restore the limb alignment and proper knee function. This article describes a closing wedge retrotubercular tibia osteotomy performed concurrently with TKA in an effort to correct an extra-articular varus deformity and to improve the patella tendon height in relation to the reconstructed joint line.

A 57-year-old man previously treated for a Schatzker type 6 tibia plateau fracture presented with symptoms of arthritis pain and instability as a result of a varus thrust with weight bearing. Radiographs revealed posttraumatic osteoarthritis, a 35° varus deformity, and patella infera. Maintaining the tibia tubercle continuity with the distal tibia allowed for correction of the varus deformity and improvement in the patella tendon height relative to the joint line. At 5-year follow-up, the patient had osteotomy healing, clinically neutral limb alignment, and improvement in joint line biomechanics with resolution of symptoms of pain and instability.

Angular deformities of the lower extremity in adults can be categorized by the bone involved, ie, femur and/or tibia, as well as the position of the deformity within the bone, ie, diaphyseal vs metaphyseal. The deformity can be secondary to metabolic bone disease, Paget's disease, malunion of fractures, and previous surgery.¹ The relationship of the deformity to the nearest joint can be described as intra-articular or extra-articular and quantified by the distance to the joint line. The position of a deformity in relation to the knee joint has important implications in the management of osteoarthritis and especially in the planning of total knee arthroplasty (TKA).

Extra-articular deformity of the tibia may need to be corrected by either staged or simultaneous corrective osteotomy along with a TKA to achieve normal alignment of lower limb.¹ However, a simultaneous procedure is technically demanding. If the osteotomy is not done correctly, the functional outcome of the TKA may be less than expected. Intra-articular tibial osteotomy and soft tissue balancing can be performed as an alternative to an extra-articular corrective osteotomy.²

Closing-wedge high tibial osteotomy as a treatment for medial compartment osteoarthritis has a long history, with numerous studies documenting its efficacy and outcome.³ The failure mode for this surgery often includes the onset of osteoarthritis in the other compartments, necessitating conversion to TKA. Numerous authors have described patella infera at the time of conversion surgery, leading to technical difficulties not commonly encountered in the primary knee arthroplasty setting.⁴⁻⁷ Additionally, the clinical results in previously osteotomized knees have been inferior to primary TKAs.⁴⁻⁷

The cause of patella infera in these cases has been elusive. Some have hypothesized that it is a result of an alteration of the patella height in relation to the joint line with subsequent shortening of the patellar ligament. Recent studies have shown that this shortening can be minimized with aggressive postoperative motion and physical therapy.⁴⁻⁶

This article describes a patient with a preexisting posttraumatic deformity, patella infera, and end-stage osteoarthritis who required a concurrent TKA and tibia osteotomy to correct the mechanical axis of the knee and to replace the damaged articular surfaces. A retrotubercular osteotomy was performed in association with a closing wedge in an effort to maintain or improve the relationship of the patellar tendon height to the reconstructed joint line with a goal of minimizing postoperative patella infera.

Case Report

A 57-year-old man sustained a comminuted Schatzker type 6 left tibial plateau fracture as a result of falling down from a ladder. He was treated with open reduction and internal fixation. Two years later, he had developed posttraumatic osteoarthritis, significant varus deformity, and a range of motion arc of 5° to 120° (Figure 1). He walked with a significant varus thrust. Pain and instability were the 2 main presenting symptoms. The medial collateral ligament was felt to be intact but difficult to assess clinically due to bone deformity.

The recommended treatment was TKA in combination with either dome or closing wedge osteotomy of the tibia in conjunction with a stemmed tibial component. The amount of the varus deformity was measured preoperatively at 35°. Preoperative planning was performed to assess the alignment and guide bone cut preparation and implant selection. Radiographs including a 3-foot standing scanogram were obtained, but accurate leg length measurements were unable to be performed due to the significant deformity.

The procedure was performed under general anesthesia in the supine position. A previous midline anterior knee skin incision was used, followed by a medial parapatellar arthrotomy. Multiple adhesions were noted in the medial and lateral gutters. The patella was everted and knee flexed to 90°. A previous anterior cruciate ligament repair was evident. A free-hand proximal tibial plateau cut was made as preoperatively templated and was assisted by an extramedullary alignment guide (Figure 2). Femoral component preparation was performed in a standard fashion using intramedullary guidance as per the surgical technique for the chosen implant (LCCK; Zimmer, Warsaw, Indiana). Extensive medial release was performed on the tibia, ending at the posteromedial cortex.

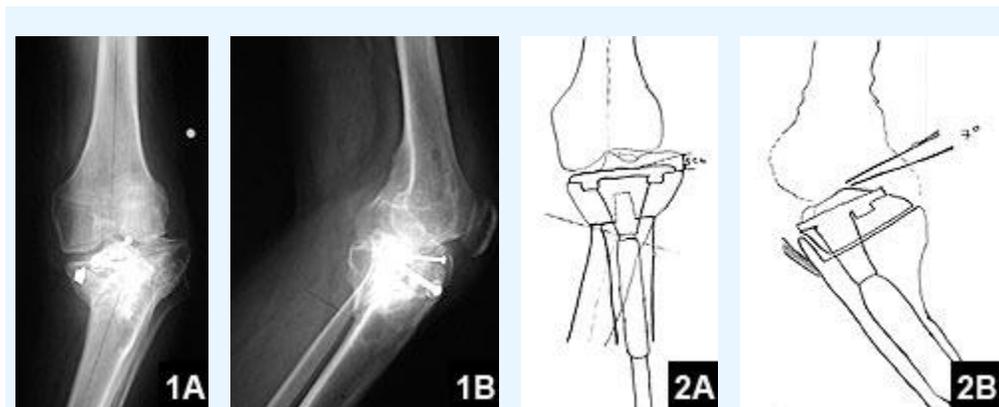


Figure 1: Preoperative AP radiograph of the knee shows severe osteoarthritis and varus deformity (A). Preoperative lateral radiograph of the knee shows hardware (B). Figure 2: Preoperative AP template shows the level of tibial osteotomy and proximal tibial cutting (A). Preoperative lateral template shows the retrotubercle tibial osteotomy level and amount of posterior slop.

The fascia overlying the proximal anterior compartment of the leg was incised with a scalpel and the periosteum elevated to achieve exposure for the closing wedge osteotomy. An oblique fibular osteotomy was performed through

a separate 4-cm incision over the midlateral aspect of the fibula. Intraoperative examination of the deformity confirmed the plan to perform the osteotomy at the level of or just proximal to level of the patellar tendon insertion. A smooth K-wire was placed in the tibial tuberosity to protect the patellar tendon insertion.

The anterior tibial cortex was then drilled with a 2.5-mm drill from lateral to medial along both the superior and inferior osteotomy lines. The proximal osteotomy was parallel to the joint line and the distal osteotomy perpendicular to the mechanical axis of the tibia. After drilling, osteotomes and an oscillating saw were used to complete the osteotomies. The wedge of bone was then removed in pieces and ultimately the posteromedial cortex was released. The cortex at the site of the patellar tendon attachment was osteotomized longitudinally, leaving the patellar tendon and tibial tubercle fully attached to the distal bone segment with a 0.5- to 1.0-cm bridge of bone.

The proximal tibial fragment measuring 3.5 cm in thickness was then brought down into proper alignment with 2 cm of lateral closing. The anterior aspect of the cortex was fashioned to allow for the proximal tibial fragment to be inset on the distally based tibial tuberosity bone. An intramedullary drill hole was made through the previously drilled tibial plateau. The canal was then sequentially hand reamed to a diameter 13 mm using an intramedullary alignment technique, and the tibial component size was selected. The osteotomized surfaces were reduced and the tibial canal was prepared with reamers and broached for a short-stem implant. After confirmation of alignment with an extramedullary alignment jig and while maintaining the reduction, the tibial component was affixed with proximal cementation on the plateau and distal stem press-fit fixation. Care was taken to avoid any cement in the osteotomy site.

After the cement had cured, there was some persistent instability at the osteotomy site, and a medial 4-hole T-shaped tibial plateau plate was applied. Morselized local autograft was applied to the osteotomy site. The femoral component preparation was then completed with application of the component with cement distally and with use of a press-fit stem. A lateral release was then performed to correct patellofemoral tilt. The patella was not resurfaced due to the overall healthy appearance of the patellar cartilage.

Discussion

The correction of extra-articular angular deformities in combination with TKA can be technically challenging. Some authors have advised a staged corrective osteotomy before TKA if the deformity is $>15^\circ$. The major disadvantage of such an approach is the need for 2 surgeries with additive surgical morbidity (infection, fracture, instability, arthrofibrosis) as well as the risk of osteotomy nonunion.^{8,9}

Roffi and Merritt⁹ reported the surgical technique and results of extra-articular tibial deformity correction in 9 cases. Of these, only 3 were corrected with intra-articular tibial bone resection. The other 6 cases were treated with simultaneous TKA and corrective extra-articular osteotomy at the apex of the tibial shaft deformity with a long fluted tibial stem. Of these 6, 1 had an unintended penetration of the tibial shaft by the tip of the long fluted stem. Wang and Wang¹ have shown favorable results with performing a TKA in conjunction with intra-articular bone resection for patients with varus coronal deformity of $<20^\circ$ in the femur or $<30^\circ$ in the tibia.

Raymond et al¹⁰ described a retrotubercular tibial osteotomy with an opening wedge tibial osteotomy to correct varus deformity in the proximal tibia. In their technique, the anterior portion of the osteotomy ends distally to the tibial tubercle. The potential advantages of this technique are a lower risk of patella infera, improved bone healing due to larger surface area, and excellent mechanical stability. This osteotomy technique maintains the integrity of the patellar tendon and preserves the contact between proximal tibia and the tibial tubercle.

The goal of the osteotomy in our case was to increase the patellar height in relation to the joint line and prevent the patella infera commonly observed with a closing wedge lateral tibia osteotomy. Recent studies have confirmed that

changes in bone architecture after lateral closing wedge osteotomy actually increase the patellar height, whereas a medial opening wedge osteotomy lowers patellar height by raising the tibiofemoral joint line.¹¹ In the absence of patella tendon contracture, the lowering of the joint line from the osteotomy site combined with elevation of the tubercle in relation to the joint line created a restoration of patellar height compared to the preoperative position. The patellar height in relation to the joint line has been maintained during the radiographic follow-up period of 5 years (Figure 3). Additionally, the patient has had excellent osteotomy healing, symmetric lower extremity alignment, equal clinical leg lengths, and excellent function with his knee during this time (Figure 4).



Figure 3: Five-year follow-up AP (A) and lateral (B) radiographs of the knee show well-healed osteotomy, good knee alignment, and good patellar height. Figure 4: One-year follow-up standing view photograph shows good knee alignment (A) and side view photograph shows good knee flexion (B).

References

1. Wang JW, Wang CJ. Total knee arthroplasty for arthritis of the knee with extra-articular deformity. *J Bone Joint Surg Am.* 2002; 84(10):1769-1774.
2. Krackow KA, Holtgrewe JL. Experience with a new technique for managing severely overcorrected valgus high tibial osteotomy at total knee arthroplasty. *Clin Orthop Relat Res.* 1990; (258):213-224.
3. Wright JM, Crockett HC, Slawski DP, Madsen MW, Windsor RE. High tibial osteotomy. *J Am Acad Orthop Surg.* 2005; 13(4):279-289.
4. Amendola A, Rorabeck CH, Bourne RB, Apyan PM. Total knee arthroplasty following high tibial osteotomy for osteoarthritis. *J Arthroplasty.* 1989; (4 suppl):s11-7.
5. Figgie HE III, Goldberg VM, Heiple KG, Moller HS III, Gordon NH. The influence of tibial-patellofemoral location on function of the knee in patients with the posterior stabilized condylar knee prosthesis. *J Bone Joint Surg Am.* 1986; 68(7):1035-1040.
6. Nicholls DW, Dorr LD. Revision surgery for stiff total knee arthroplasty. *J Arthroplasty.* 1990; (5 suppl):s73-77.
7. Nizard RS, Cardinne L, Bizot P, Witvoet J. Total knee replacement after failed tibial osteotomy: results of a matched-pair study. *J Arthroplasty.* 1998; 13(8):847-853.
8. Cameron HU, Welsh RP. Potential complications of total knee replacement following tibial osteotomy. *Orthop Rev.* 1988; 17(1):39-43.
9. Roffi RP, Merritt PO. Total knee replacement after fractures about the knee. *Orthop Rev.* 1990; 19(7):614-620.
10. Raymond LD, Laflamme GY, Ranger P, Zhim F, Girard J. Open-wedge retro-tubercular tibial osteotomy: an innovating technique [in French]. *Rev Chir Orthop Reparatrice Appar Mot.* 2007; 93(6):588-593.

11. Wright JM, Heavrin B, Begg M, Sakyrd G, Sterett W. Observations on patellar height following opening wedge proximal tibial osteotomy. *Am J Knee Surg.* 2001; 14(3):163-173.

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