Concurrent Opening Wedge Osteotomy and Total Knee Replacement in a Patient With Posttraumatic Arthritis and a Varus Tibial Malunion

Amit Lahav, MD, and Frank R. DiMaio, MD

Combined extra-articular deformity of the tibia along with osteoarthritis of the knee joint can present a challenging reconstructive procedure for the orthopedic surgeon. The knee can be approached with staged procedures or via a 1-stage approach for full correction of the deformity and alignment at the time of joint arthroplasty. We present a case of concurrent opening wedge tibial osteotomy and total knee arthroplasty for the correction of a severe varus deformity in the presence of an extra-articular tibial deformity, medial compartment arthritis, and a leg-length discrepancy. This report presents another option for a single-stage operative procedure while combining technologies to address posttraumatic arthritis with tibial deformity.

Case Report

History

A woman in her mid 40s presented with chronic left knee pain and deformity after being involved in a motor vehicle accident and sustaining a closed, proximal tibial shaft fracture more than 20 years prior to presentation; the fracture had been treated in a long leg cast for 3 months. The patient stated that she has a progressive "bowed" leg deformity and severe medial knee pain. Her left knee symptoms prohibited her from working and performing activities of daily living.

Physical Examination

Upon physical examination, she had measured active range of motion of her left knee from 0° to 125° with no apparent collateral or cruciate ligamentous instability noted. No flexion contracture was seen. A rigid varus deformity was present that did not correct with valgus stress testing at 30°, 60°, or 90° of flexion. Her neurologic and vascular examinations were unremarkable. A true leg-length discrepancy of 9 mm was measured from the anterior superior iliac spine to the medial malleoli, with the affected left lower extremity shorter than the right one. Her gait pattern was poor because of this discrepancy, and a lateral tibial thrust was seen.

Radiographs

Radiographs (Figures 1 and 2), including standing anteroposterior and lateral views of the left knee, revealed a 12° varus deformity of the knee, bone-on-bone articulation of the medial compartment with medial tibial bone loss, marginal osteophytes globally, and a 20° varus malunion of the tibia. Standing Bell-Thompson radiographs were used to measure a 12° varus anatomic axis (Figure 3).

Procedure

The patient was taken to the operating room, and she underwent simultaneous medial opening wedge tibial osteotomy and cemented left total knee replacement. Spinal anesthesia was administered, and the patient received

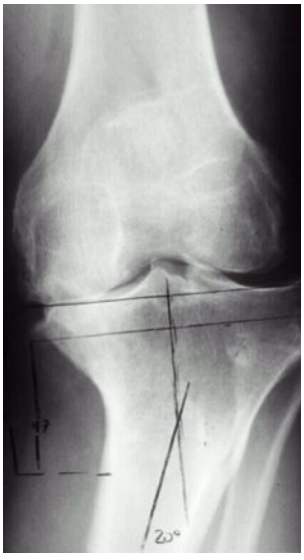

Figure 1. Preoperative anteroposterior x-ray film of the left knee.

Figure 2. Preoperative lateral x-ray film of the left knee.

Dr. DiMaio is Chairman, Department of Orthopaedic Surgery, and Chief, Division of Adult Joint Reconstruction, Winthrop-University Hospital, Mineola, New York.
Dr. Lahav is Assistant Clinical Instructor, Department of Orthopaedic Surgery, SUNY Health Science Center at Stony Brook, Stony Brook, New York.

Requests for reprints: Frank R. DiMaio, MD, Chairman, Department of Orthopaedic Surgery, Chief, Division of Adult Joint Reconstruction, Winthrop University Hospital, 259 First St, Mineola, NY 11501 (tel, 516-663-4798; fax, 516-663-3015; e-mail, fdimaio@winthrop.org).

Am J Orthop. 2007;36(8):E121-123.

Figure 3. Preoperative standing Bell-Thompson x-ray film (close-up).

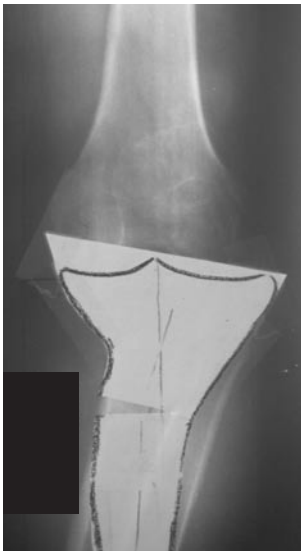

Figure 4. Preoperative cutout plans.

Figure 5. Two years postoperative anteroposterior x-ray film of the left knee.

Figure 6. Two years postoperative lateral x-ray film of the left knee.

preoperative administration of antibiotics. The left leg was prepared and draped in the usual sterile fashion. A tourniquet was used.

The knee was approached using a midline incision with a paramedial patella arthrotomy. As the knee arthroplasty portion of the procedure was initiated, femoral preparation was completed first, using standard technique with the Natural Knee II instrumentation (Zimmer, Warsaw, Ind). The distal femoral resection was 11 mm in 6° of valgus.

Next, tibial preparation was completed with an extramedullary tibial cutting guide. Referencing off the lateral tibia was performed in preparation for a 13-mm proximal tibial resection made perpendicular to the proximal tibial anatomy in 5° of posterior inclination. This resection adequately bottomed the medial tibial defect. The tibial preparation tray was fixed to the cut surface of the tibia in slight external rotation. Peg drill hole preparation was then performed. Tissue balancing was then completed with a medial sleeve release at the level of the medial joint line only; the pes tendons did not require release. Trial components were inserted at this time, and the knee was extended for patella preparation.

Next, the proximal tibial malunion was exposed via a small medial incision. A 15° uniplanar opening wedge osteotomy was performed just distal to the tibial tubercle using the Arthrex system (Naples, Fla). Fluoroscopy was used during the osteotomy. This type of osteotomy allowed for correction of the 20° malunion of the tibia at this level as seen on the preoperative cutouts (Figure 4). In addition, 10 mm of lengthening was expected via this 15° opening wedge that addressed the leg-length discrepancy. Autograft from the distal femoral resections was used as bone graft at the osteotomy site. Rigid internal fixation was achieved, and intramedullary fixation was avoided. Only a resurfacing of tibial component was necessary as a cemented total knee arthroplasty was completed.

Postoperative Course

Postoperatively, the patient remained non–weight bearing and was placed in a collateral knee brace. A standard postoperative continuous passive motion machine regimen was used. Weight bearing was advanced upon radiographic evidence of healing of the osteotomy site over 6 weeks.

At 5 years the patient had active range of motion of 0° to 122° and a stable knee to varus and valgus stress testing; no anteroposterior instability was appreciated; no leg-length inequality was measured.

Two-year follow-up radiographs revealed healing of the osteotomy and correction of alignment (Figures 5 and 6).

Discussion

Total knee replacement can be complicated by extra-articular deformity, necessitating additional procedures in order to obtain proper anatomic and mechanical alignment of the limb. Posttraumatic deformity frequently requires careful evaluation of bone loss because of malunion or nonunion. Identification of the deformity at the joint line, metaphysis, or diaphysis is paramount in determining its effect on extremity alignment. This dilemma can be approached with staged procedures or via a 1-stage approach for full correction of the deformity and alignment at the time of joint arthroplasty.

This report presents a patient with a metaphyseal-diaphyseal malunion of a tibial fracture (20°), which predisposed this patient to eventual medial compartment arthritis. Although more traditional approaches to this knee reconstruction were considered, the surgeons believed that a 20° deformity this close to the joint line and the measured 9-mm leg-length inequality prohibited correction via a large proximal tibial resection. This simpler approach certainly would not have addressed the patient's limb length.

Leg-length discrepancy is another issue that must be addressed when considering osteotomies for correction of malalignment. Open wedge versus closing wedge osteotomies can alter leg length significantly and alter the mechanics of the limb and soft-tissue tension and laxity. The presented patient had a concurrent ipsilateral leg-length inequality, making an opening wedge osteotomy more appealing. A closing wedge osteotomy would have further shortened the extremity at the time of the deformity correction. In addition, the patella-femoral mechanics were preserved without infrapatellar shortening or patella baja so often seen with closing wedge osteotomies.[1,2] This opening wedge technique was performed below the level of the tibial tubercle attachment of the infrapatellar tendon, therefore avoiding this issue.

Wang and Wang[3] have shown that total knee arthroplasty in conjunction with intra-articular bone resection is an effective procedure for arthritis and extra-articular deformity. Radke and Radke[4] have also shown that total knee arthroplasty in combination with a 1-stage tibial osteotomy had good results. Another option to consider includes a diaphyseal osteotomy with intramedullary stem fixation, but this osteotomy type may have a higher risk of nonunion or other complications.[5,6] The use of a long-stemmed tibial component was considered in this case. Traditionally, these devices work best with simple transverse osteotomies or step-cut osteotomies. Our preoperative planning thwarted these techniques because it is difficult to lengthen an extremity with these osteotomy types unless, of course, an intercalary bone graft is used. It was the surgeon's opinion that the risk of nonunion of a diaphyseal tibial osteotomy would greatly increase if an intercalary graft were used. The osteotomy performed in this case was completed at the metaphysis, below the tibial tubercle attachment of the patellar tendon, and allowed for 10 mm of lengthening via a planned 15° opening wedge at this level of the tibia. A limited incision with minimal soft-tissue dissection was used as described in the Arthrex technique.

Limitation of this reconstructive technique includes the need for a "keel-less" cemented tibial implant, which may not provide resistance to the typical shear and rotational forces placed upon a "keeled or stemmed" implant. In addition, concerns regarding the strength of the open wedge osteotomy site fixation device, as discussed by Stuart and colleagues,[7] may lead one to reconsider the use of our technique. Certainly, intramedullary fixation is mechanically superior and usually allows for immediate weight bearing. For this reason, this patient was forbidden to bear weight until evidence of osteotomy healing was noted radiographically.

Conclusions

This case presents another option addressing posttraumatic arthritis with tibial malunion and leg-length discrepancy: a single-stage reconstruction using an opening wedge tibial osteotomy and a resurfacing tibial component without a keel.

Authors' Disclosure Statement

Dr. Lahav reports no actual or potential conflict of interest in relation to this article. Dr. DiMaio wishes to note that he is a surgical consultant to Zimmer Holdings, Warsaw, Indiana.

References

1. Scuderi GR, Windsor RE, Insall JN. Observations on patellar height after proximal tibial osteotomy. *J Bone Joint Surg Am.* 1989;71(2):245-248.
2. Westrich GH, Peters LE, Haas SB, Buly RL, Windsor RE. Patella height after high tibial osteotomy with internal fixation and early motion. *Clin Orthop Relat Res.* 1998;354:169-174.
3. 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.
4. Radke S, Radke J. Total knee arthroplasty in combination with a one-stage tibial osteotomy: a technique for correction of a gonarthrosis with a severe (>15 degrees) tibial extra-articular deformity. *J Arthroplasty.* 2002;17(5):533-537.
5. Kaartinen E, Paavolainen P, Holmstrom T, Slatis P, Happonen RP. Different healing patterns of experimental osteotomies treated by intramedullary nailing. *Arch Orthop Trauma Surg.* 1993;112(4):171-174.
6. Kempf I, Grosse A, Abalo C. Locked intramedullary nailing: its application to femoral and tibial axial, rotational, lengthening, and shortening osteotomies. *Clin Orthop Relat Res.* 1986;212:165-173.
7. Stuart MJ, Beachy AM, Grabowsky JJ, An KN, Kaufman KR. Biomechanical evaluation of a proximal tibial opening-wedge osteotomy plate. *Am J Knee Surg.* 1999;12:148-153.