CHAPTER **23**

DISTAL TIBIAL OSTEOTOMIES

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INTRODUCTION

Supramalleolar deformities are a common cause of ankle osteoarthritis, with 80% of these present from posttraumatic sequelae (1). Treatment options include conservative measures such as bracing, orthotics and injections, while surgical procedures range from joint sparing such as tibial and fibular osteotomies and arthroscopy, to joint destructive procedures such as total ankle arthroplasty or ankle arthrodesis. This update will review the literature and discuss the indications and technique for ankle osteotomies.

INDICATIONS

Angular, rotational, or translational malalignment are all possible consequences of a traumatic injury to the distal tibia or malleoli. Angular deformity greater than 10-15 degrees in any plane is indicative of surgical correction. Frontal plane malalignment is better compensated than sagittal plane deformity, possibly due to the increased frontal plane range of motion of the subtalar and midtarsal joints. Sagittal plane deformities of 15 degrees decrease ankle joint contact by 40%, whereas an equal frontal plane deformity decreases contact by only 15-20%.

Other causes of increased ankle joint pressures and possible degenerative joint disease include fibular shortening, lateral shift, and mal-rotation.

Ankle osteotomies are performed in order to salvage the ankle joint and prevent progressive arthritic destruction as varus deformities have been experimentally shown to cause an increase in posterolateral pressure, while valgus deformities increase pressure similarly in the anteromedial ankle (2,3). Evaluation of angular deformity can be aided with the tibial ankle surface angle (TAS) or similarly the lateral distal tibial angle, talar tilt angle, and the talar lateral surface (TLS) angle, similar to the anterior distal tibial angle. The TAS is the relationship of the tibial axis to the tibial plafond (normal 89 degrees); the talar tilt is the angle between the tibial plafond and the talar dome (normal <4 degrees); and the TLS is the relationship of the tibial axis and a line from the most anterior and posterior aspect of the tibial plafond (normal 81.5 degrees) (4,5).

TECHNIQUES

Isolated Fibular Osteotomy

Mal-reduced fibular fractures can result in a malaligned or short lateral malleolus. Fibular shortening can be measured on plain radiographs by the use of the talocrural angle, which is normally 82 ± 3 degrees, and measures the relationship of the malleoli to the tibial plafond. Malalignment is much more difficult to assess, and computed tomography with 3D reconstruction may be necessary to appropriately evaluate the deformity.

Several osteotomies are optional. Although transverse is the least stable and requires the most stable fixation, it allows for maximal length and rotational correction, while an oblique or Z osteotomy can only allow for lengthening. Any defect is then packed with bone graft and fixated with the surgeon's construct of choice.

Distal Tibial Metaphyseal Osteotomies

Severe ankle fracture/dislocations or pilon fractures can lead to proximal migration of the medial and/or posterior malleolus, resulting in a varus or procurvatum deformity about the ankle joint. Possible osteotomies include a dome or crescent-shaped osteotomy, which is made with a series of drill holes above the ankle joint with the apex proximal. The bone between these holes is then sectioned with an osteotome or other similar instrument, allowing rotation and manipulation to the desired position.

Opening wedge osteotomies can be made with a Kirschner wire used as an axis guide, and a bone graft can be inserted in a wedge fashion to adjust position. Tanaka et al in 2006 (6) performed a series of medial opening wedge osteotomies on 26 ankles with a varus tilt and found that when the preoperative varus tilt was greater than 10 degrees, the joint space did not improve postoperatively. They reported that 4 of 26 ankles had a poor outcome.

Correction can also be obtained gradually with the use of an external fixation device, such as a Taylor Spatial Frame, which can be used to dial in correction in all three planes. This has the advantage of less chance of straining the surrounding neurovascular structures, which must be considered during the procedure. A closing wedge osteotomy is another option, but if proper care and planning are not performed, this technique can result in excess shortening.

In a prospective study, Knupp et al (7) classified supramalleolar deformities with asymmetrical arthritis that included those with a congruous ankle joint, and those with talar tilt greater than 4 degrees. These were then sub-classified into deformities with anterior translation of the talus, and the asymmetrical position of the superior portion of the talus and its degree of arthrosis. Patients with both a supramalleolar deformity and anterior translation were then treated with a biplanar supramalleolar osteotomy. Overall they found reduction of talar tilt in only 25 of 60 ankles, but clinical improvement was fairly consistent among all groups, and those with a preoperative valgus tilt did especially well. Overall, 10 of 94 patients required a total ankle arthroplasty or ankle arthrodesis (10.6%). These results were supported by a study by Lee et al (8) that found patient outcomes were better in those with a minimal varus talar tilt, as well as neutral or varus heel alignment.

Takakura and Tanaka (4,6) have developed a classification system for varus ankle deformity where stage 1 showed no joint space narrowing, but sclerosis and osteophyte formation; stage 2 showed narrowing of the medial joint space; stage 3 shows obliteration of the joint space with subchondral bone contact; and stage 4 showed complete obliteration of the joint space with total bone contact. They further subdivided stage 3 into 3a where only narrowing included the medial malleolus, and 3b where obliteration extends to the talar dome roof. From their surgical series, they have concluded that those patients with highest success rates are those in stage 2 and 3a, and that patients in stage 3b and 4 are likely past the point of joint salvage osteotomies.

Another surgical option is the so called plafond-plasty for manually reducible varus ankles that may have a component of lateral ankle instability, where an intra-articular opening medial wedge is performed when the center of rotation and angulation (CORA) lies within the ankle joint itself (9). This can also be combined with lateral ankle stabilization if necessary, and Mann and Myerson reported satisfactory results with this procedure (79% success rate) in a series of 19 patients (9).

Distal Metaphyseal-Diaphyseal Osteotomy

Distal one-third tibial fractures often can result in recurvatum and varus deformities that place incongruous stress on the ankle joint and other proximal pedal joints leading to early degeneration. While these can be caught prior to end-stage arthrosis, they often are not, leaving a degenerated ankle joint as well as subtalar joint in many cases. At this stage, a distal metaphyseal-diaphyseal osteotomy can be combined with an isolated ankle joint fusion, or a combined tibiotalocalcaneal fusion with an intramedullary rod. In this case, a similar crescent osteotomy can be made with the apex being flipped distally to allow for the locking screws of the intramedullary device to lie a safe distance from the osteotomy. This can also be combined with an external fixator for gradual correction of the osteotomy, and add to the overall stability of the fusion sites.

CASE DISCUSSION

Case 1 is a 17-year-old who presented to the senior author's clinic 6 months after open-reduction internal fixation from crush injury (Figure 1). After consultation, a decision was made for staging the reconstruction. First, a tibial osteotomy and lengthening of the fibula were performed, followed by triple arthrodesis and lateral column lengthening (Figures 2-7). Clinical evaluation demonstrated rectus alignment of the ankle joint and neutral position to the heel (Figure 8).

Figure 1. Preoperative clinical view showing deformity of the left foot and ankle.

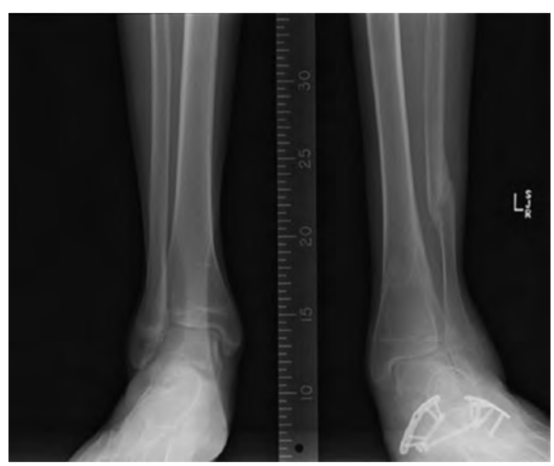

Figure 2. Bilateral preoperative ankle anterior-posterior radiograph.

Figure 3. Left ankle anterior-posterior radiograph showing angular deformity above the ankle joint.

Figure 4. Preoperative anterior-posterior view.

Figure 5. Preoperative lateral view.

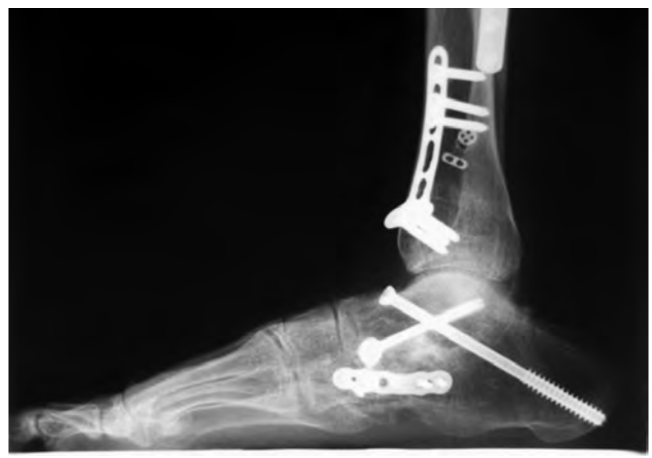

Figure 6. Lateral ankle view after supramalleolar osteotomy and rearfoot arthrodeses.

Figure 7. Anterior-posterior ankle radiograph following supramalleolar osteomies and rearfoot arthrodeses.

Figure 8. Postoperative clinical view demonstrating rectus alignment of the ankle joint and rearfoot.

Case 2 is a 55-year-old woman who presented after a tendo-Achilles lengthening and primary repair of the posterior tibial tendon (Figures 9,10). The patient's main symptom was pain along the medial column with callus formation to the inferior navicular and heel. Radiographic evaluation demonstrated valgus positioning of the ankle joint (Figures 11-13). A decision was made on staging the procedure with alignment of the ankle joint with closing wedge tibial osteotomy, followed by medial column fusion if needed. Radiographic evaluation demonstrated neutral alignment of the ankle joint (Figures 14-16). Clinical evaluation demonstrated a more neutral alignment of the ankle joint and better positioning of the medial column (Figure 17). The patient improved so well that the second staging procedure was not needed.

Distal tibial and fibular malalignment can have deleterious effects to the function of the ankle joint while asymmetrically increasing joint pressures leading to early degeneration. When surgical correction is being considered, preoperative planning should include the determination of the CORA, and ideally the osteotomy should be performed as close to this point as possible to maximize correction and avoid creation of an additional deformity. While deformity obviously must be present in order to consider surgical correction, it is clear that certain angular deformities, such as a very high degree of talar tilt, as well as extensive arthrosis, carry a lower chance for a favorable result, and in these cases an ankle arthrodesis or total ankle arthroplasty should be considered as a first line option.

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Figure 9. Preoperative clinical view demonstrating angular deformity.

Figure 10.Preoperative heel view demonstrating deformity.

Figure 11. Preoperative anterior-posterior radiograph of the left foot.

Figure 12. Preoperative anterior-posterior ankle radiograph demonstrating supramalleolar angular deformity.

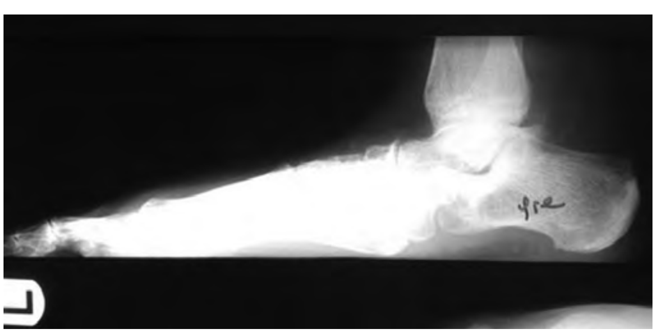

Figure 13. Preoperative lateral radiograph.

Figure 14. Intraoperative fluoroscopy demonstrating fixation for supramalleolar osteotomy.

Figure 15. Postoperative anterior-posterior foot radiograph demonstrating more rectus alignment.

Figure 16. Postoperative lateral radiograph.

Figure 17. Postoperative clinical view demonstrating more rectus foot alignment.