CHAPTER **39**

FIRST RAY MALADIES: STATUS POST HALLUX ABDUCTO VALGUS REPAIR – A Case Study

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INTRODUCTION

Iatrogenic deformity of the first ray is not an uncommon complication following first metatarsal osteotomy for correction of hallux valgus deformity. Multiplanar derangements can occur and are seen principally as shortening, elevation, and transverse plane deformity. Dysfunction of the first ray can lead to an "overload" syndrome of the lesser metatarsals. Metatarsalgia, "predislocation," digital deformities, and stress fractures are some of the more pathoneumonic sequelae. Actual deformity of the first ray can include the hallux, metatarsophalangeal joint, and first metatarsal itself. To relieve symptoms and address the deformity, one can address the inciting problem, that being the first ray, or the secondary problems/pathologies. Keep in mind that when the lesser ray deformities alone are addressed, the original pathology still exists. If osteotomies are performed of the lesser metatarsals, it is not uncommon to "chase" the pathology from one metatarsal to the next over time. Therefore, it is highly recommended to consider correction of the first ray, the primary pathology in conjunction with correcting any concurrent pathologies.

Prior to surgical intervention, one must understand or establish a general surgical strategy. Each plane of deformation must be addressed separately, therefore, understanding each specific planar malady must be thoroughly analyzed (Figures 1-3). If there is a salvageable first metatarsal, addressing the primary pathology is recommended. Lengthening of the metatarsal can be accomplished through revision osteotomies, osteotomy with bone graft (autogenous, allogenic) or callus distraction. Sagittal Z and wedge osteotomies of the metatarsal can correct sagittal plane deformity. Similarly, transverse plane malformation can be corrected via horizontal Z (Scarf) and wedge osteotomies. Accomplishing multiplanar correction can be difficult, but through a thorough thought process, preparation, and proper surgical technique the realignment can be accomplished.

Many adjunctive procedures can be attempted to alleviate symptomatology associated with the first ray pathology. When first ray procedures are performed, secondary procedures can be done to supplement the reconstruction. Salvage procedures may also be done when there may not be a reconstructable first ray. In those cases, the lesser ray pathologies and/or secondary pathologies (i.e., lesser metatarsalgia, stress fractures, predislocation syndrome, and digital deformities) have to be addressed. More definitive, joint destructive procedures may be necessary in some cases including arthrodeses with or without panmetatarsal head resections. In most cases, a first metatarsophalangeal joint implant is not indicated. This procedure does not address the pathology in a manner that would provide enough pain relief or correct the presenting deformity.

A surgical plan for reconstruction of the first ray should include specific components: osteotomy design, bone grafting, fixation techniques, adjunct to bone healing (i.e., orthobiologics or bone growth stimulators).

Figure 1A. Preoperative radiograph.

Figure 1B. Postoperative radiograph demonstrates plantarflexion of the first metatarsal utilizing a base osteotomy of the first metatarsal.

Figure 2A. Preoperative radiographs.

Figure 2B. The postoperative radiograph demonstrates lengthening of the first metatarsal utilizing a horizontal Z (Scarf) osteotomy.

Figure 3A. Preoperative view.

Figure 3B. Postoperative radiograph (8 weeks) status post sagittal Z osteotomy for multiplanar correction of the first metatarsal.

The osteotomy design must address each and every plane that is affected. Whether or not bone grafting is necessary as well as which type of bone graft desired must be determined. Autogenous bone grafting has proven desirable in most cases, yet allogenic bone grafting, including calcaneal tuber graft is a consideration depending on the amount of graft necessary and the orientation of the graft needed.

The surgical strategy used for our specific case addressed each dimension of the pathology that the patient presented and included: 1. Lengthening (callus distraction, revisional osteotomy, osteotomy with bone graft), 2. Re-alignment of the MPJ, 3. Osteotomy design, 4. Bone grafting, 5. Fixation techniques, and 6. Adjuncts to bone healing (orthobiologics and bone growth stimulators).

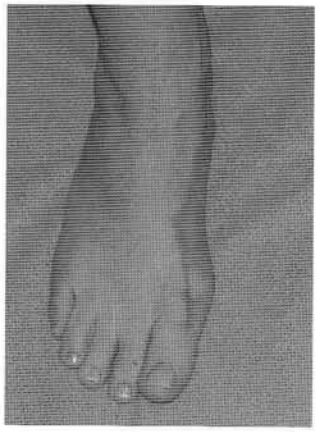

Figure 4A. Peroperative DP clinical view.

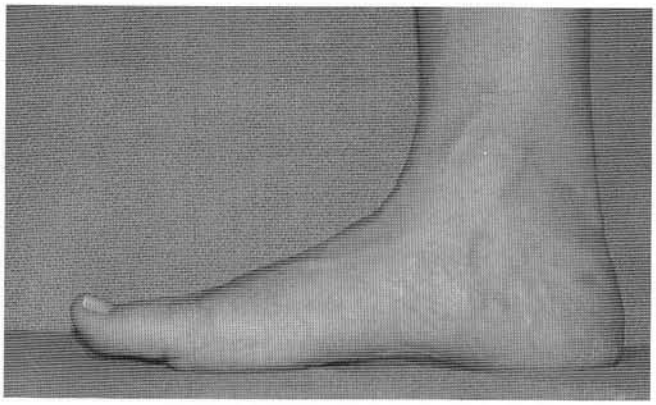

Figure 4B. Preoperative lateral view.

CASE PRESENTATION

The patient was a 56-year-old female that had previous HAV repair consisting of an Austin osteotomy of the first metatarsal and an Akin osteotomy of the proximal phalanx. The surgery was performed approximately 1 year prior to our revisional surgical intervention. The original postoperative sequelae included swelling and discomfort over the first MPJ and a "knot-like" pain under the second MPJ. The revisional surgical intervention was devised to correct the first ray pathology alone.

Preoperatively, on clinical examination, the patient had significant shortening and slight elevation of the first ray. Radiographs demonstrated significant shortening and significant transverse plane medial angulation of the metatarsal head with resultant malalignment at the first MPJ. No significant sagittal plane angulation of the first metatarsal was evident (Figure 4). The planned technique included removal of the previous fixation, release of soft tissue contracture and a horizontal Z-osteotomy of the first metatarsal with multiplanar correction. Allogenic calcaneal tuber graft was used to fill the deficit after lengthening of the metatarsal.

During the initial soft tissue dissection, the adductor tendon was released and tagged for possible later transfer or future use. The first metatarsal was then exposed to assess the degree and angle of deformity. A medial-to-lateral "Z" osteotomy was incorporated and axis guides were inserted to establish the parameters of the metatarsal cuts. The distal axis guide (0.045 inch Kirschner-wire) was inserted into the dorsal 1/3 of the center of the metatarsal head medially. The proximal axis guide was then inserted into the planter 1/3 of the proximal shaft, taking care to maintain the same planal orientation as the distal axis wire. The central osteotomy was then marked into the metatarsal followed by the proximal-plantar and the distal-dorsal cuts. The osteotomies were then performed and examined to be

Figure 4C. Preoperative AP radiograph demonstrating shortening and medial deviation of the first metatarsal head.

certain all were through-and-through (Figure 5). The most important technique while performing the osteotomies is to keep the plane of the saw blade in-line with the axis guides. Any deviation may result in an incongruous fit of the osteotomy with shifting of the plantar, capital fragment.

The capital fragment was then shifted with the use of a mini AO distractor until the desired lengthening of the metatarsal and transverse plane rotation of first MPJ was accomplished. Once the correct position was accomplished, two alligator clamps were utilized to maintain the position. Intraoperative radiographs were taken to assess the correction (Figure 6). The metatarsophalangeal joint was taken through range of motion and deemed to be adequate. The AO distractor was then removed while the clamps remained in place.

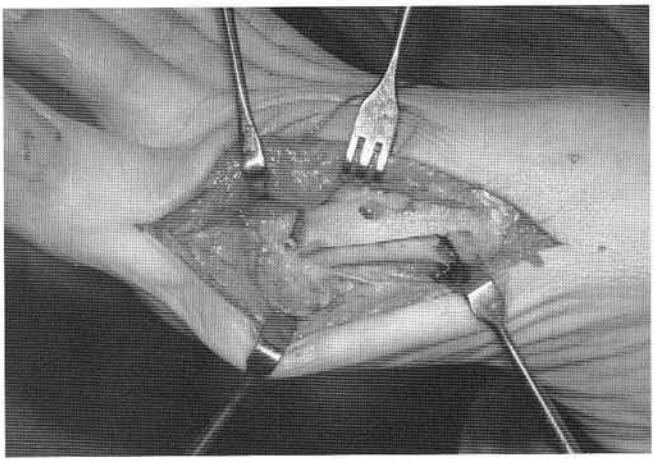

Figure 5. Horizontal Z-osteotomy (Scarf) performed to lengthen and derotate the first metatarsal.

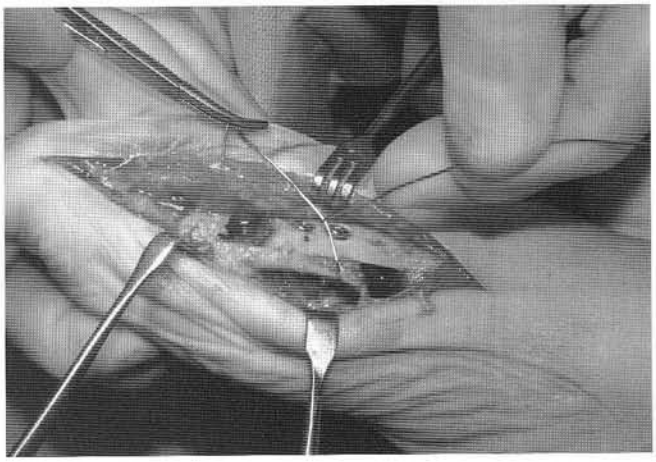

Figure 7. Cerclage wire loop hooked around the proximal screw to prevent shortening or telescoping of the first metatarsal.

Figure 6. Intraoperative radiograph taken to assess the multiplanar correction.

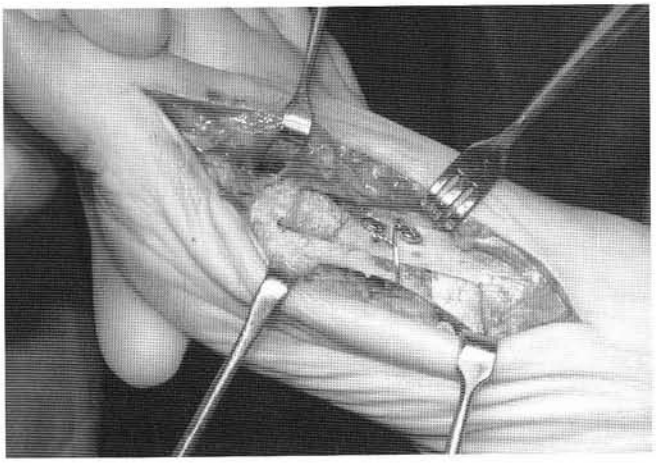

Figure 8. Allogenic calcaneal graft was inserted to fill the deficits in the first metatarsal.

Once intraoperative radiographs were evaluated, fixation was added consisting of two 2.7 mm fully threaded cortical screws inserted in typical AO fashion and a 22 gauge cerclage wire loop. The proximal screw was inserted first through the previous fixation hole. Next, the distal screw was inserted. A small spicule of medial overhang was removed utilizing power instrumentation until the bone was smooth. Once again, intraoperative radiographs were taken to assess fixation and alignment. At this point, cerclage wire was used as a third device of fixation to supplement the existing fixation acting as an "anchor." The wire loop hooked around the distal edge of the head of the proximal screw and around the proximal edge of the tip of the screw plantarly (Figure 7). This orientation resists "telescoping" or shortening of the "Z" osteotomy. Utilizing cerclage wire in this application prevents any shortening that may occur as a result of axial compression by essentially locking the proximal screw and metatarsal in place. This application attempts to prevent screw fixation failure and provide an "anchor" function to the fixation already in place.

Once fixation was in place, the deficits were measured and matching pieces of allogenic calcaneal tuber graft were inserted into the dorsal and plantar defects. Each graft was carefully cut into perfectly sized trapezoidal wedges to fill the deficits (Figure 8). Cutting of the graft requires a good understanding of spatial or three dimensional relationships. Particular attention was taken to ensure that the cortices of the graft and the metatarsal aligned both medially and laterally. The graft

Figure 9A. Postoperative radiograph demonstrating derotation and lengthening of the first metatarsal.

Figure 9B. Postoperative radiograph.

was also flush with the respective dorsal and plantar surfaces of the shaft. Once all grafts were inserted, final intraoperative radiographs was obtained (Figure 9).

The procedure accomplished 1 cm of lengthening, derotation, and stable fixation of the first ray. Continual assessment of the malalignment and realignment was performed throughout the case. Conceptualizing the three dimensional or spatial relationship of the first ray was integral for repair.

The patient was followed postoperatively with non-weightbearing for approximately 8 weeks. She proceeded with progressive weightbearing in a fracture boot and progressed on to a regular shoe at 10 weeks. The metatarsal osteotomy and graft sites healed uneventfully with no shift, displacement or delayed union (Figure 10).

Figure 10. Three and a half month postoperative radiograph.