CHAPTER **27**

The Wedge Shelf Osteotomy

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The Wedge Shelf Osteotomy is generally used as a closing base wedge osteotomy for metatarsus primus adductus of 16 degrees or higher. By changing the geometry of the osteotomy, it may be used for other osseous conditions, as will be discussed.

HISTORY AND CONCEPTS

The osteotomy is similar in design to the Loison-Balacescu transverse base wedge osteotomy (Fig.1A), the oblique design of the Juvara osteotomy, uses fixation principles and design similar to the Ruch osteotomy (Fig. 1B), as well as the crescentic shelf osteotomy (Fig. 1C).

ADVANTAGES OF THE OSTEOTOMY

The major advantage of the osteotomy is that once the closing base wedge osteotomy has been performed, a significant amount of bone contact remains. In addition, the surgeon is not limited by a hinge preservation, since the osteotomy is a through and through design. It simply preserves an apex. For this reason, the amount of stress to the surgeon is diminished. The osteotomy allows for uniplane, biplane, and/or triplane correction, and provides excellent visualization and easy dorsal access to the metatarsal

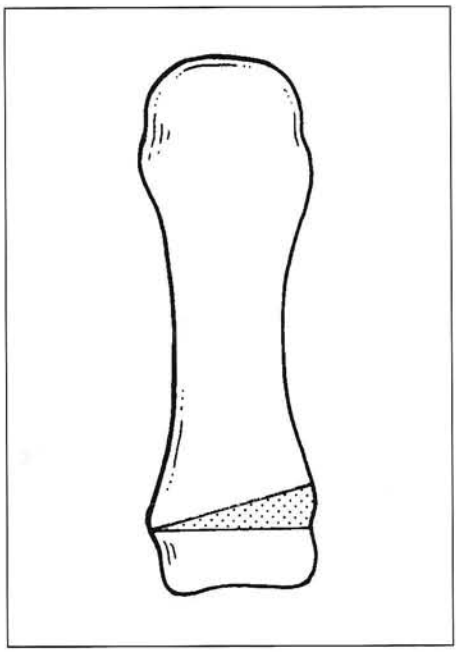

Figure 1A. Loison-Balacescu Osteotomy

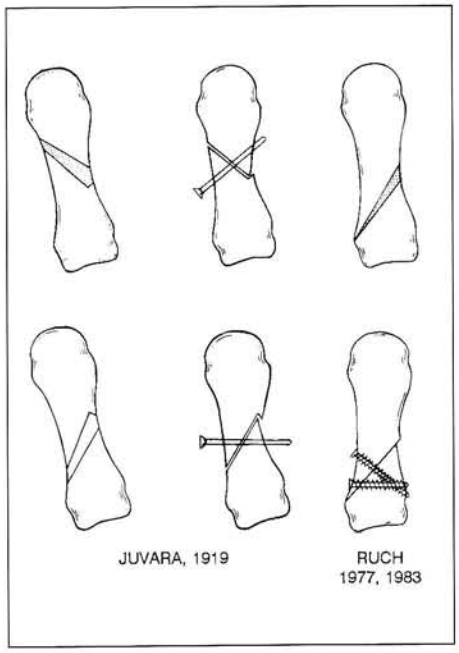

Figure 1B. Juvara, and Ruch Osteotomies

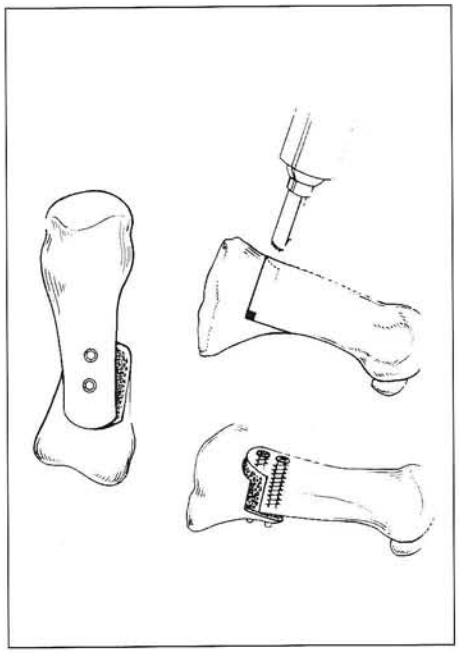

Figure 1C. Crescentic Shelf Osteotomy, Cohen et al. (1988)

for internal compression fixation techniques. Since the location of the osteotomy is transverse and very proximal, less bone is needed to achieve a similar amount of correction when compared to an oblique osteotomy. In addition, a significant amount of degree of intermetatarsal angle correction may be afforded without jeopardizing bony contact. Preservation of the dorsal proximal cortex prevents proximal migration of the distal fragment upon the proximal fragment, and serves as a "stop-gap" safety feature.

PROCEDURE

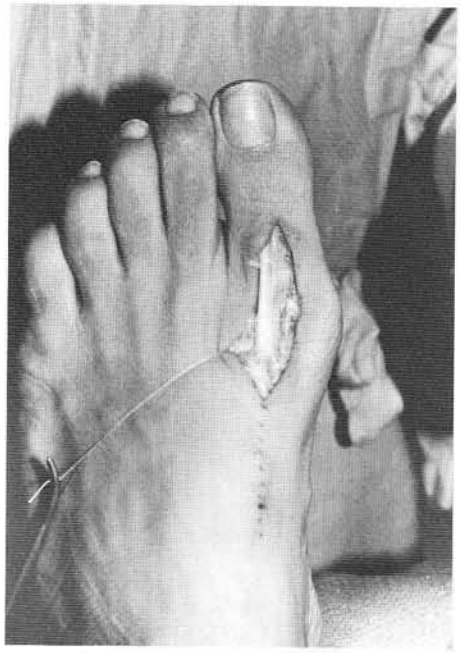

Figure 2. In hallux abducto valgus surgery, the first metatarsophalangeal joint procedures are performed prior to addressing the first metatarsal base.

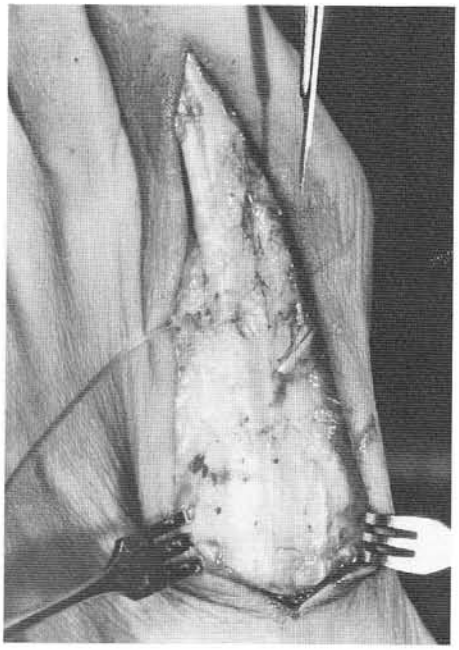

Figure 3. The first metatarsophalangeal joint incision is extended proximally, ending 2.5 cm proximal to the dorsomedial metatarsocuneiform joint.

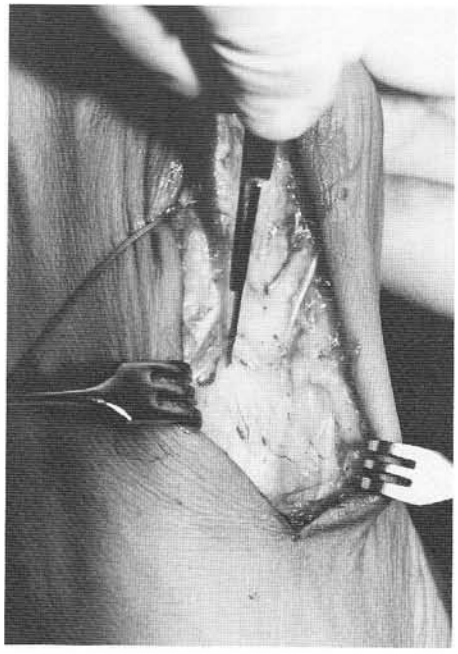

Figure 4A. The periosteal incision starts dorsally over the first metatarsocuneiform joint, and extends dorsal-lateral to allow access to the dorsal and lateral aspects of the first metatarsal base. Note that the extensor complex has been retracted laterally.

Figure 4B. The periosteal incision is then directed dorsal and medial, giving access to the medial side of the first metatarsal base.

Figure 5. The periosteum is then reflected giving access to the proximal one-third of the first metatarsal base. Baby Hohmann and/or Seeburger malleable retractors work very well for this purpose.

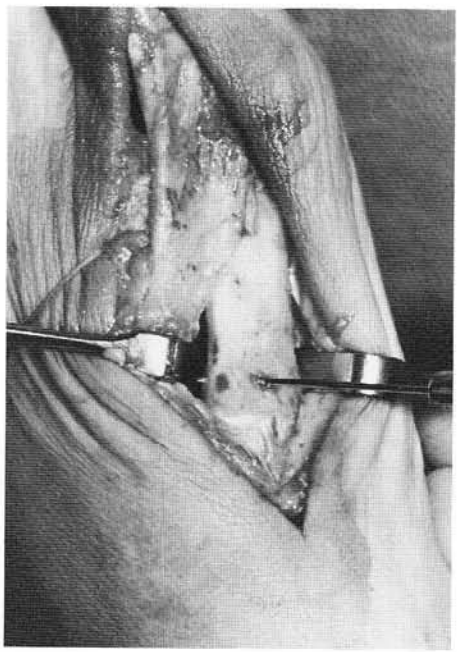

Figure 6. A .045 Kirshner wire is then driven from medial to lateral through the superior one-eighth of the metatarsal, 1 cm distal to the first metatarsocuneiform joint. This K-wire will serve as an axis guide to help determine the angle of the osteotomies.

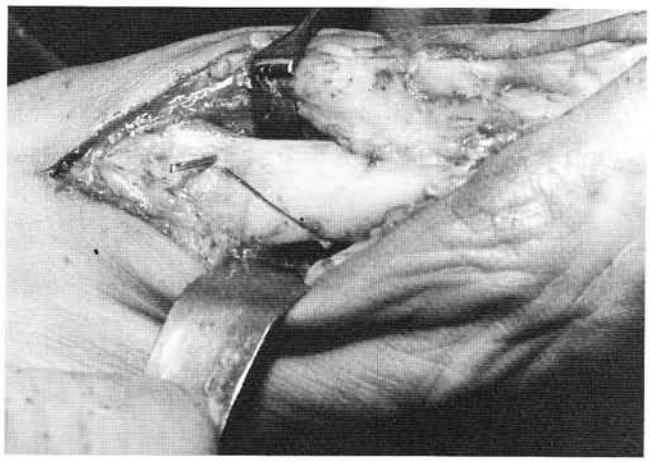

Figure 7. A through and through osteotomy is made in the first metatarsal, from medial to lateral. The osteotomy starts at the entry of the K-wire dorsomedially, and is angled plantar-distally 60 degrees to the long access of the metatarsal.

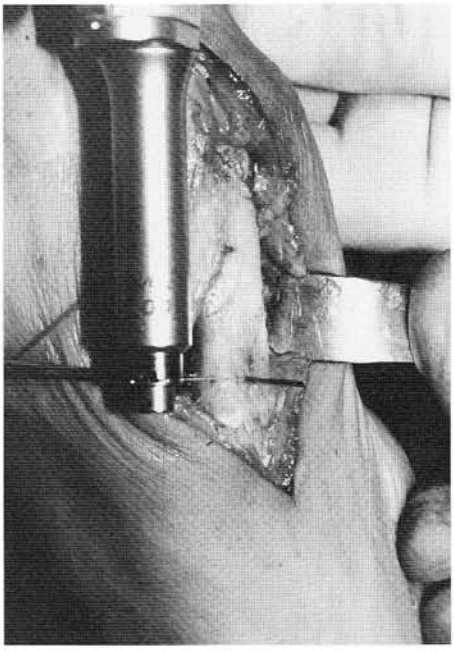

Figure 8. A second osteotomy is then made on the dorsal side of the metatarsal, directly in line with the transversely directed K-wire.

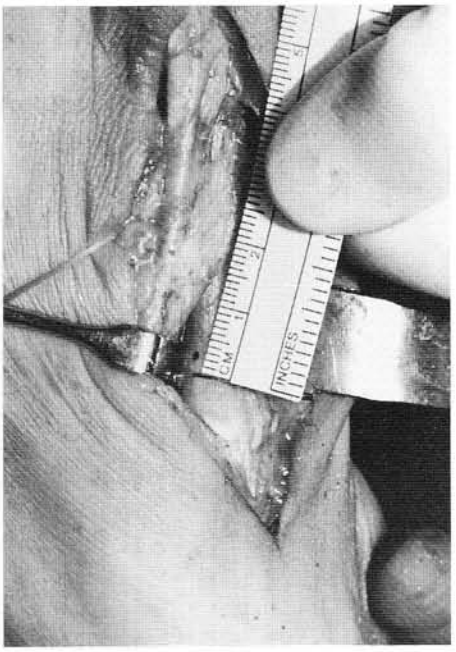

Figure 9. The osteotomy is deepened to the level of the K-wire. The amount of bone removal necessary for correction can be determined preoperatively, and marked on the dorsolateral cortex of the first metatarsal intra-operatively.

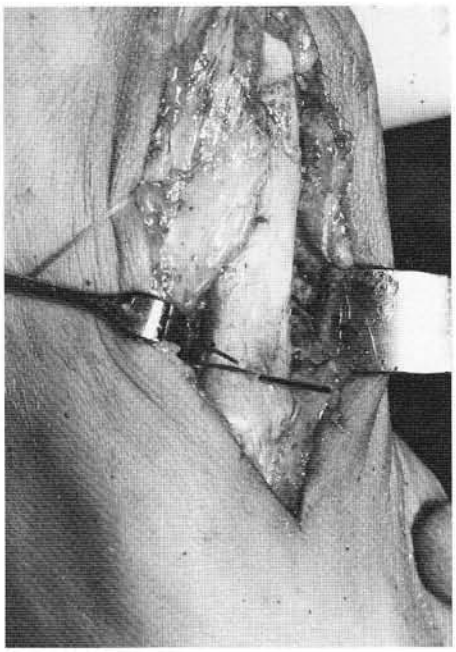

Figure 10. A second dorsal osteotomy is then made distal to the transverse cut. This creates a wedge-shaped osteotomy, removing a wedge of bone to allow for reduction of the intermetatarsal angle. The second dorsal arm of the osteotomy enters dorsally and stops dorsomedially at the level of the apical axis guide. It also stops laterally at the level of the inferior arm of the first oblique osteotomy.

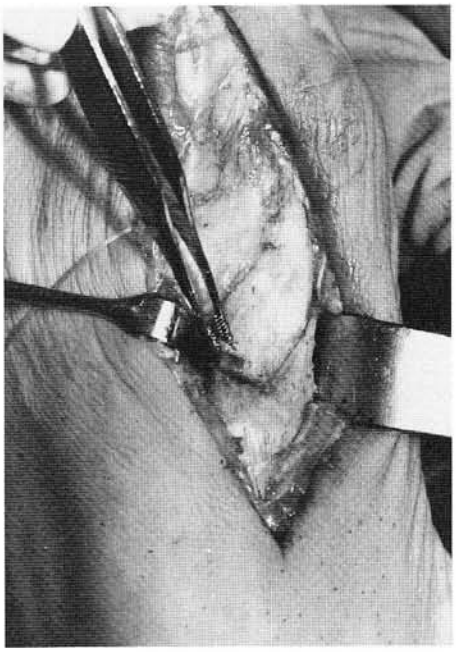

Figure 11. The wedge of bone is then removed. Note the size of the bone wedge necessary to correct the intermetatarsal angle.

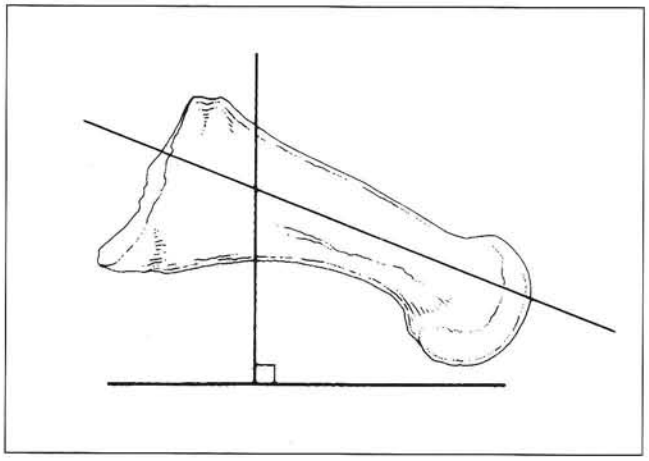

Figure 12. The direction of the osteotomy as viewed from a superior direction, is from dorsal to plantar, perpendicular to the transverse weight-bearing plane, not the long axis of the first metatarsal.

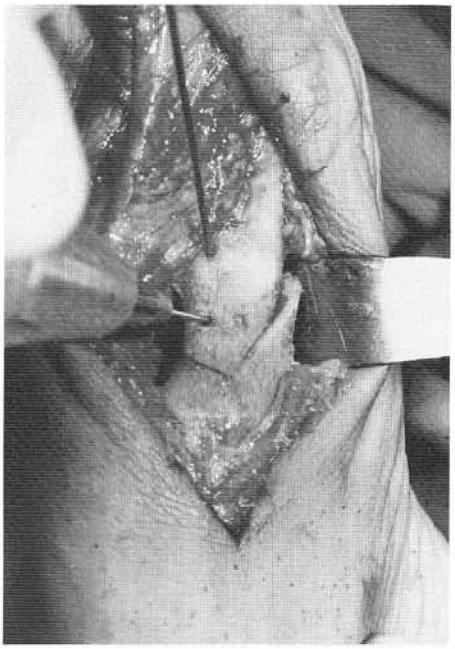

Figure 13A. The distal fragment is then rotated laterally upon the proximal fragment, apposing the cut edges of the dorsal osteotomy. A bone reduction forceps is used to hold alignment, followed by insertion of K-wires in the direction in which the screws will be placed.

Figure 13B. An x-ray is taken to assess the degree of correction of the intermetatarsal angle and appropriate alignment of the first metatarsal.

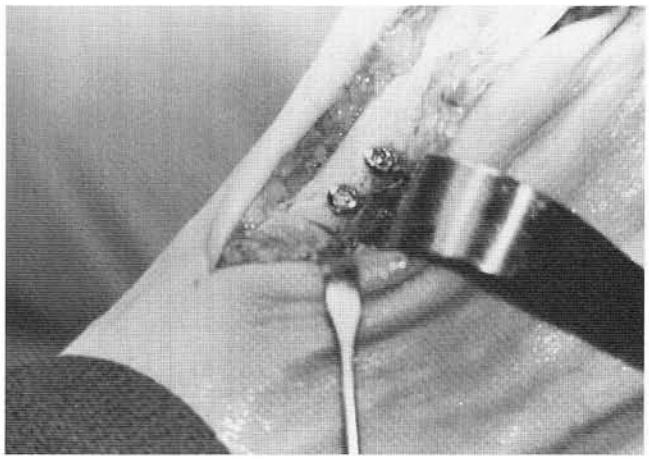

Figure 14A. A 2.7 mm cortical screw is placed perpendicular to the transverse plane (anchor screw). A second screw is placed distal to the first screw, and is perpendicular to the osteotomy site (compression screw). The average depth of the first metatarsal base at the level of this osteotomy will measure approximately 22-26 mm. Since 2.7 mm cortical screws measure no greater than 24 mm, the surgeon must be prepared to use alternative forms of fixation, including the 3.5 mm fully threaded, 3.5 mm cortical-cancellous screws, or a 4.0 mm cancellous screw. The author has also had success using the Acutrak headless cortical screw. The osteotomy is checked for rigidity.

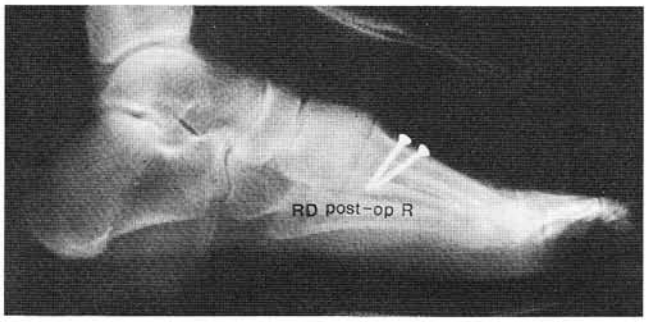

Figure 14B. This lateral radiograph demonstrates that the proximal screw is perpendicular to the horizontal plane (anchor screw), while the distal screw is perpendicular to the osteotomy (compression screw).

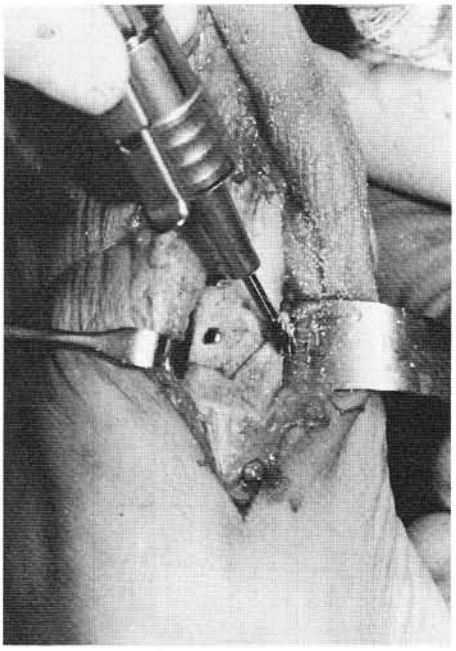

Figure 15. The overhanging bone on the medial aspect of the proximal side of the osteotomy is reduced to a smooth finish.

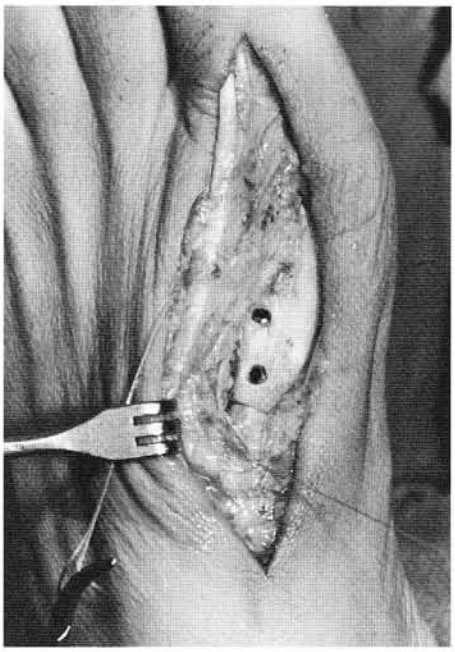

Figure 16A. The periosteum is closed with 4.0 absorbable sutures.

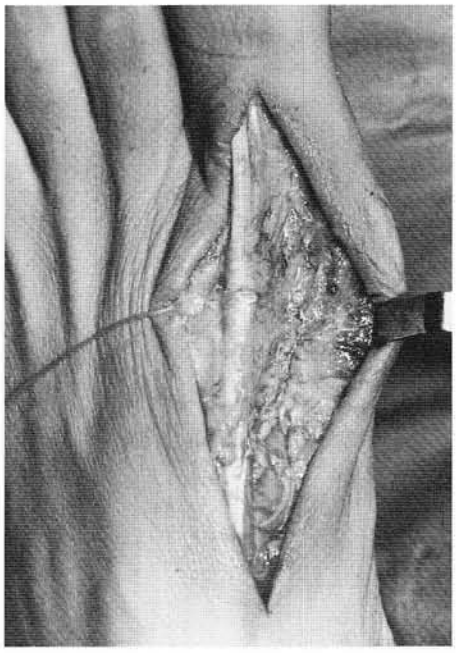

Figure 16B. Completed periosteal and capsular closure.

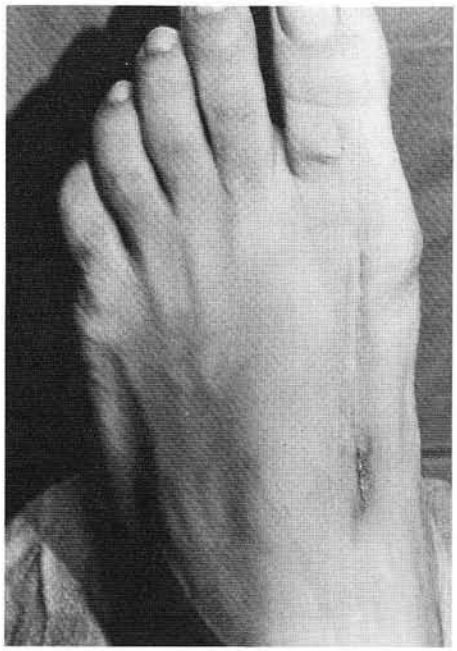

Figure 16C. Postoperative view shows excellent reduction of the deformity.

POSTOPERATIVE COURSE

A modified Jones compression-cast dressing is applied for approximately 7 days, and the patient is maintained non-weightbearing with crutches. The patient is then placed in a lower leg brace. If rigidity and excellent correction is maintained, the patient may be allowed to come out of the lower leg brace and begin range of motion exercises of the ankle and metatarsophalangeal joints. With this brace, the patient is allowed to apply mild heel pressure for balance only. Full weightbearing is not allowed. Six weeks after surgery, repeat x-rays are taken. Once alignment is noted to be appropriate and healing is progressing on schedule, the patient is then placed in a surgical shoe or a regular sneaker with a longitudinal arch support, and allowed to weight bear to tolerance.

OTHER POTENTIAL INDICATIONS FOR THE OSTEOTOMY

Other conditions in which the osteotomy will be helpful include pes valgo planus and metatarsus primus elevatus to plantarflex the first ray, pes cavus to dorsiflex the first ray, Tailor's bunionectomy to decrease the fourth intermetatarsal angle, hallux interphalangeus, and lesser metatarsal surgery. By changing the angle of the apical axis guide, the design of the osteotomy may be changed to establish uniplane, biplane and/or triplane correction (Fig. 17).

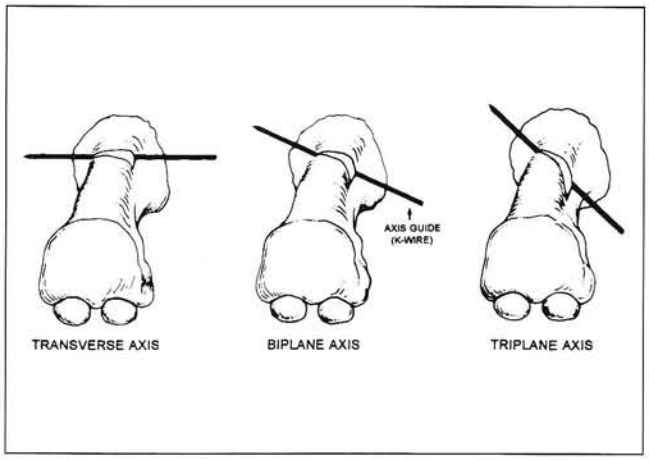

Figure 17. The Kirshner wire that is used as an apical axis guide can be positioned to create uniplane, biplane, or triplane correction.

The osteotomy may be a consideration in repair of iatrogenic deformities where a metatarsal has been shortened significantly (i.e. hallux varus). In such a case, the osteotomy may be performed but instead of removing a wedge of bone, the osteotomy can simply be opened to create an opening base wedge osteotomy. The defect created can be filled with autogenous or allogeneic bone graft (Fig. 18).

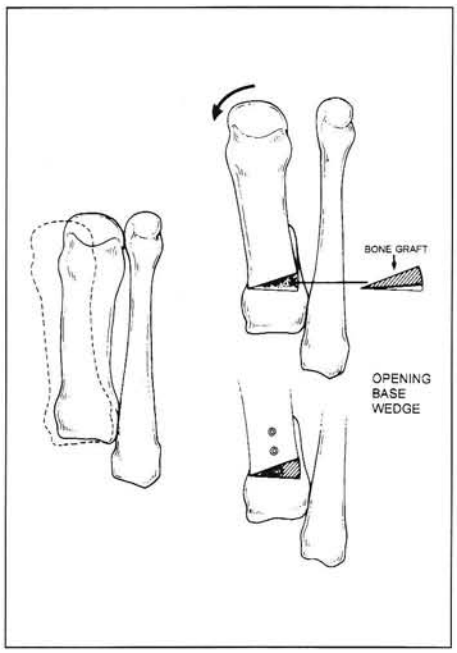

Figure 18. The Wedge Shelf Osteotomy has been performed for a negative intermetatarsal angle in a patient with hallux varus. As the distal fragment is displaced distally and medially, an opening osteotomy is created. The defect is filled with bone graft.

Figures 19A-E demonstrate a case in which the Wedge Shelf Osteotomy has been performed.

Figure 19A. Preoperative view.

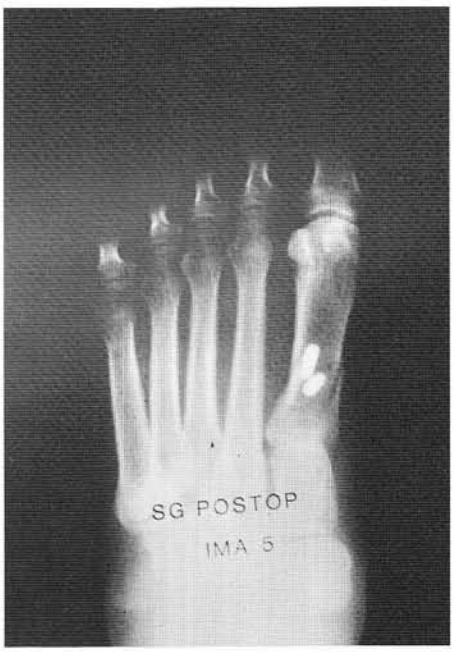

Figure 19B. Postoperative view shows reduction of the first intermetatarsal angle from 16 degrees to 5 degrees.

Figure 19C. Postoperative lateral view shows reduction held in place with a headless, self-tapping and self-compressing cannulated screw.

Figure 19D. Three months postoperative view shows excellent primary bone healing. The patient has been ambulatory for 6 weeks.

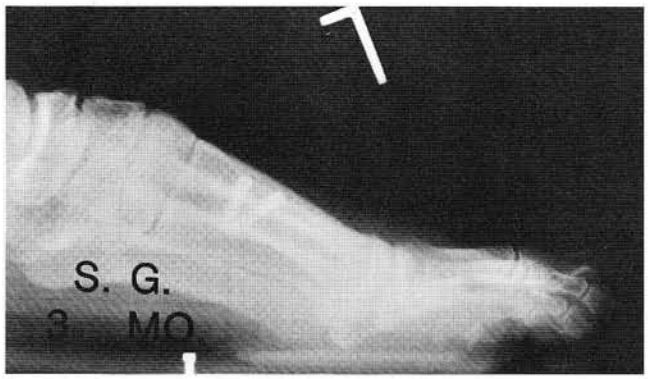

Figure 19E. Three months postoperative view.

SUMMARY

The Wedge Shelf Osteotomy is an excellent procedure for osseous reduction of a high first intermetatarsal angle. Additional areas of usage include: metatarsus primus elevatus, rigid plantarflexed first ray, elevated fourth intermetatarsal angles for Tailor's bunion repair, hallux interphalangeus, negative intermetatarsal angle as in hallux varus, and other iatrogenic conditions.

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