CHAPTER **18**

OPENING BASE WEDGE OSTEOTOMY: When Length Matters

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INTRODUCTION

Hallux valgus surgery is one of the more common foot surgeries that are routinely preformed by podiatrists. There are various ways that correction of hallux valgus can be obtained. Metatarsal osteotomies are commonly performed along with soft tissue rebalancing. Osteotomies are more commonly performed at the distal metaphysis due to ease of execution and limited complications. Proximal osteotomies on the other hand, are usually avoided unless there is a larger deformity. The opening base wedge osteotomy (OBWO) of the first metatarsal is a procedure indicated for the correction of hallux valgus with a large intermetatarsal angle and a shortened first ray. In the past, the procedure has fallen out of favor due to a number of technical reasons. The most common reason for avoidance of the opening wedge procedure is the difficulty to obtain adequate fixation of the osteotomy. Other reasons include the need to obtain a cortical bone graft, prolonged period of non-weightbearing, elevatus of the first ray, loss of great toe joint motion, and fear of delayed or nonunion.

In hallux valgus with larger intermetatarsal angles, closing base wedge osteotomies and Lapidus arthrodeses are utilized more often than opening wedge osteotomies due to familiarity of those procedures. Moreover, rarely is bone grafting necessary. These methods are successful in the outcome of hallux valgus correction; however, each of these techniques may lead to shortening of the first ray owing to resection of cartilage or a wedge of bone. A shortened first ray may lead to lesser metatarsal overload attributing to second metatarsophalangeal joint pain, instability, and/or callous development. It is difficult to avoid metatarsal elevatus in a closing base wedge osteotomy; despite 8 weeks of cast immobilization. This is probably due to the typical fixation construct of 2 lag screws across the osteotomy that does not shield plastic deformation of bone.

In the past few years, new forms of fixation devices have been designed specifically for the OBWO. The tibial opening wedge plate system for tibial varum was modified for the first metatarsal. These fixation devices are plate systems with or without locking screws. Better fixation constructs allow weightbearing to commence earlier and diminish the risk of the complication of first metatarsal elevatus.

TECHNIQUE: OBWO

The patient is placed on the operating table in a supine position. Anesthesia may be obtained with IV sedation and local anesthesia or a general anesthetic. Hemostasis is achieved with a tourniquet or with local administration of epinephrine according to the surgeon's preference. A proximal first ray block is performed with local anesthesia. Location of the first metatarsal cuneiform joint is identified with fluoroscopy and marked with an ink pen.

The first part of the procedure involves the bunionectomy; removing the exostosis and performing the standard lateral release of the first metatarsophalangeal joint. Next, the incision is carried more proximal to the level of the first metatarsocuneiform joint. Dissection is carried down through the subcutaneous tissues and a large traversing vein is a constant at the proximal metatarsal level and this is usually hand tied. A scissors is used to gently undermine the deep fascia along the extensor tendon sheath. Now the tendon can be retracted laterally with a Senn retractor or with a mini Hohman. The periosteum is not stripped. A .062 inch Kirschner-wire (K-wire) is used as an axis guide and is inserted dorsal to plantar at the site of the lateral hinge. The axis guide should be perpendicular to the weightbearing surface to avoid elevatus of the metatarsal. Fluoroscopy is utilized to identify the location of the hinge, which should be about 1- to 1.5-cm from the joint. A quick tip to accurately access your location on fluoroscopy is to aim the beam of the x-ray down the K-wire (bulls eye view). Once the location of the hinge is adequate, making sure the extensor tendon is retracted dorsally and laterally, a sagittal saw is used to make a transverse osteotomy to the axis guide. A 10-mm osteotome is then inserted medially in the osteotomy and a gentle prying motion will open the osteotomy without disrupting the lateral cortex. A 0.62 inch K-wire can be inserted medially into the metatarsal head to use as a lever arm to maintain the correction while placing the appropriate sized plate over the osteotomy (Figure 1). The

wedge portion of the plate will hold the osteotomy open. The accompanied screws are inserted by predrilling, measuring, and then inserting self-tapping screws. Intraoperative images are taken to assess correction with translocation of the metatarsal head over the sesamoids. Fluoroscopy is also used to confirm screw purchase of the far cortices and not violating the metatarsocuneiform joint. Bone graft material may be placed in the remaining gap lateral to the plate wedge. Generally the bunion exostosis can be crushed up and used as graft. Usually, more graft is needed, which can be augmented with whatever allograft one has on hand. Finally, range of motion and position of the hallux is evaluated. Any other adjunctive procedure (soft tissue or osseous) can then be performed as deemed necessary. Layer closure and a compression dressing with posterior splint are applied.

Figure 1. Intraoperative photograph of placing the opening base wedge plate on the metatarsal. Note that there is an axis guide on the lateral cortex, a K-wire medially for a lever arm, and a 5-mm plate being inserted.

POSTOPERATIVE CARE

Nonweightbearing is encouraged for at least 3 weeks. Then progressive weight bearing to tolerance is performed over the next few weeks. Usually by 5 to 6 weeks, patients are full-weightbearing in the fracture boot. Transfer to shoes is typically in 6 to 10 weeks. Radiographs can take months to show complete consolidation of the graft site. Rarely is there any associated pain wearing regular shoes in 10 to 12 weeks despite lack of complete radiographic healing.

STUDY OBJECTIVE

A simple study was done to address common questions regarding the OBWO: 1) on average, how much metatarsal lengthening does one achieve?, 2) how large of a wedge is typically used?, 3) on average, how much intermetatarsal correction does one achieve?, and 4) does wedge size correlate with the amount of lengthening?

STUDY DESIGN

A retrospective radiographic review was done on 8 patients who underwent an OBWO with a standard lateral release. Excluded from the study were patients that had adjunctive osseous procedures on the first ray. Data collected included radiograph measurements on a Reina Digital X-ray processing device with Onyx-RAD DICOM viewer software. Standard antero-posterior foot radiographs were used and measurements of preoperative and postoperative intermetatarsal angles and first metatarsal lengths were obtained (Figures 2, 3). The first postoperative radiograph was used for the postoperative measurements. Three measurements were taken for each parameter and the average was used (Table 1).

Figure 2. Example of a preoperative metatarsal length obtained on a digital anterio-posterior radiograph.

Figure 3. Example of a postoperative metatarsal length obtained on a digital anterior-posterior radiograph.

RESULTS

All metatarsals were lengthened with the surgery. The range of lengthening was 2.49- to 7.07-mm, with the average lengthening 4.80-mm. The average percentage of metatarsal lengthening obtained was 7.04. Percentage reduction in intermetatarsal angles ranged from 29.41-83.4% with the average of 62.83%. The average sized plate used was 4-mm. The larger the sized wedge does not correlate with more lengthening of bone. For example patient AE had a 5-mm wedge plate and had 4.31-mm of lengthening versus patient JT, who had a 3-mm wedge plate and 4.98-m of lengthening.

CONCLUSION

The OBWO is again becoming a viable option in the correction of moderate to severe bunion deformities in cases where there is preoperative shortening of the first metatarsal. Technically, the OBWO and plate placement is simple. A small sample of patients' radiographs were reviewed and measurements of metatarsal length and intermetatarsal angles were compared preoperatively and postoperatively. Size of the wedge does not seem to correlate with the amount of lengthening of the metatarsal. According to this study, one can expect anywhere from 2.5-mm to 7-mm of lengthening following the procedure. The average length obtained in this study was 4.80-mm. It would seem likely that if the first metatarsal is at least 4-mm short then, the likelihood of over lengthening the metatarsal with the OBWO would be minimized. Certainly there are limitations to this study including a small sample of data; and many question the accuracy of measuring metatarsal length on radiographs as data can be influenced by foot position, x-ray beam positioning, and elevatus of the first ray.

Table 1

SUMMARY OF PATIENT DATA.

Patient	Plate size, ml	PreOp IMA	PostOp IMA	% Reduction IMA	PreOp ml	Postop ml	ml chg	% ml Chg
BL	4	18	11	38.9	63.53	66.02	2.49	3.77
AE	5	17.33	3.33	80.78	58.67	62.98	4.31	6.8
PK	5	16.66	5	69.99	59.02	66.09	7.07	10.7
JT	3	15.33	5.33	65.23	65.46	70.44	4.98	7.1
MH	5	16.66	8	51.98	73.1	79.18	6.08	7.68
WL	4	10	1.66	83.4	62.33	67.72	5.39	7.96
LM	3	13.66	2.33	82.94	65.54	68.6	3.06	4.46
P	5	17	12	29.41	59.03	64.05	5.02	7.84

IMA = intermetatarsal angle in degrees; ML = First metatarsal length in millimeters.