ELSEVIER

Operative Techniques in
Orthopaedics

Opening Wedge Osteotomy of the First Metatarsal Base: A Technique for Correction of Metatarsus Primus Varus Using a New Titanium Opening Wedge Plate

Dane K. Wukich, MD,* Andy J. Roussel, DPM,† and Dekarlos Dial, DPM†

Although not without controversy in technique and fixation methods, the opening-base wedge can be a successful procedure for moderate-to-severe hallux valgus deformities with significant metatarsus primus varus while preserving relative metatarsal length. Literature regarding the opening-base wedge has been limited and somewhat unfavorable. It is our purpose to present a promising new technique combining the modified McBride bunionectomy with a proximal first metatarsal opening-base wedge osteotomy. Using a standardized technique, we were able to achieve an efficient, reproducible, and stable construct, thereby minimizing intraoperative complications and postoperative morbidity. Fixation is achieved in each case using a new titanium plate designed for opening proximal osteotomies. Because of the stable fixation construct, patients are able to progress to protected weightbearing status much sooner than with previously described base wedge procedures, thus making this procedure more tolerable as well. The opening-base wedge procedure can be a reliable addition to the armamentarium of surgical options for proximal hallux valgus correction. To our knowledge, no previous studies have been published regarding this method.

KEYWORDS base wedge osteotomy, bunionectomy, first metatarsal, hallux valgus, metatarsus primus varus, proximal metatarsal osteotomy, opening base wedge

During the past century, more than 130 procedures have been described in the literature for correction of hallux valgus (HV) deformities.[1] Osteotomies at every level of the first metatarsal and proximal phalanx have been presented in detail, with many modifications and fixation alternatives. Clinical and radiographic criteria for selecting the appropriate level for corrective procedures also have been well established in the literature. When the deformity is combined with an abnormally high intermetatarsal (IM) angle or metatarsus primus varus (MPV) deformity, a diaphyseal or proximal osteotomy becomes indicated.[1-6] It is our purpose to present a technically less-demanding, reproducible, and stable method of correcting a moderate-to-severe bunion deformity by combining a distal soft-tissue procedure with a proximal opening-wedge osteotomy, using a new titanium low-profile plate and screw system (Arthrex, Inc, Naples, FL). The L-shaped, 4-hole plate comes in varying sizes (right and left sided) corresponding to the width of its unique "spacer," which is specifically designed to maintain the open wedge between 2 mm to 5 mm at its base (Fig. 1). The system uses 2.3-mm fully threaded, self-tapping cortical screws of 10 mm to 30 mm in length. The senior author has performed this new opening-wedge procedure on 14 patients during the last year. A retrospective review of these patients is in progress. Our current results are very encouraging, with consistent reduction of deformity, no instance of malunion or nonunion and, most importantly, complete patient satisfaction with the outcome.

*Foot and Ankle Division, Department of Orthopedic Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA.
†Department of Graduate Medical Education, Foot and Ankle Surgery, University of Pittsburgh Medical Center, South Side, Pittsburgh, PA.
Address reprint requests to Andy J. Roussel, DPM, University of Pittsburgh Medical Center, South Side, 2000 Mary Street, Pittsburgh, PA 15203. E-mail: rousselaj@upmc.edu

1048-6666/06/$-see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1053/j.oto.2006.01.002

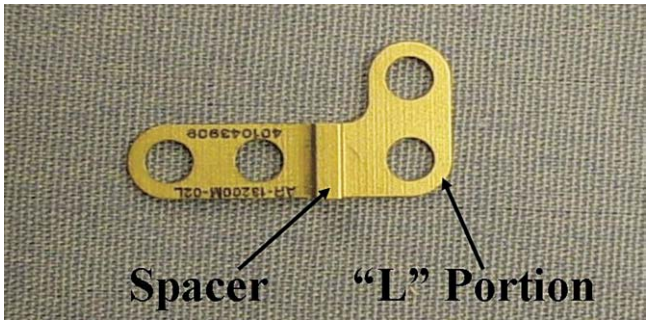

Figure 1 Low-profile titanium "L"-shaped plate with opening wedge spacer. The "L" portion lies proximal to the osteotomy and points dorsally. (Color version of figure is available online.)

Historical Information

Trethowan,[7] in 1923, was the first to describe the proximal opening wedge osteotomy using the resected medial eminence of the first metatarsal as a structural autogenous bone graft.[7-10] He used no fixation other than keeping the lateral cortex intact, repairing the periosteum and maintaining strict nonweightbearing. In 1957, Stamm presented his method of combining a Keller arthroplasty with the opening-base wedge osteotomy, and he used the resected base of the proximal phalanx as autogenous graft.[8,10] More recent reports discuss using autogenous iliac crest for more substantial bone graft and adding internal fixation for enhanced stability of the osteotomy, including, k-wires, staples, first to second metatarsal transfixation screw, or even mini-external fixators.[8-11] The opening-wedge osteotomy has not become a popular procedure secondary to its technical limitations and its potential complications. Of primary concern has been the need for structural bone graft and the inability to achieve stable fixation resulting in the fear of osteotomy fracture, malunion, or nonunion.[1]

The dependence on a structural bone graft requires precise shaping and sizing of both the graft and osteotomy to achieve an adequate reduction of deformity without gapping or fracture of the lateral cortex. At the same time, the surgeon must be aware of not causing sagittal plane deformity or overcorrection of the first metatarsal. These complications are not unique to the opening-wedge osteotomy and have been reported for any proximal metatarsal osteotomy.[3,12,13] Dorsiflexion of the first metatarsal can result in metatarsalgia and/or hallux rigidus, whereas overcorrection can lead to hallux varus.[1,3,12-14] The main benefit of a classic opening wedge compared with a closing wedge is the preservation of metatarsal length, decreasing the chance for lesser metatarsalgia.[15] Also, with a closing wedge, it can be technically difficult to resect an accurate amount of bone.[1,2] Our technique has the added benefit of stable internal fixation, which prevents elevation of the metatarsal, allows early joint mobility, and allows rapid progression to weightbearing status. Functional rehabilitation is essential to reduce the incidence of first metatarsal phalangeal joint (MTP) stiffness, which is a common complication in patients undergoing basal osteotomies.[1]

Indications for Surgical Procedure

Trethowan valued correcting the adducted position of the first metatarsal along with realigning the hallux in reference to the long axis of the metatarsal.[7] In fact, Hardy and Claphman found the 1 to 2 IM angle to be the most important factor when considering a basal osteotomy.[16,17] The greater the IM angle, the greater the MPV deformity, and thus, the increased lever arm needed for adequate reduction. According to Coughlin's radiographic criteria, bunion deformities are classified as moderate when the HV angle is between 20 and 40° (accepted normal <15°) and the IM angle is less than 16° (accepted normal IM <9°). HV angles greater than 40° and IM angles greater 16° are considered severe deformities.[17] Limbers and Robinson[1] described similar criteria, but they defined moderate deformities as those with an IM angle between 14 and 20° and severe deformities as those with an IM greater than 20°.[1] The other standard radiographic parameters for analyzing bunion deformities must be addressed as well, such as sesamoid position, hallux interphalangeal angle, and the distal and proximal articular set angles (first MTP articulation angles).[17,18] At times multiple osteotomies must be considered, especially if there is a concomitant congruent first MTP or hallux interphalangeus; a distal metatarsal osteotomy to realign the articular surface of the metatarsal head and/or an Akin osteotomy of the proximal phalanx may be needed in addition to the proximal metatarsal osteotomy.[18] When selecting an appropriate procedure, the clinical severity of the deformity, including pain and limitation of function, also must be considered, as well as the patient's age, activity level, and the ability to be nonweightbearing.

For our patients, we consider the proximal opening-wedge osteotomy when (1) MPV exists and (2) an IM 14° or greater in a rectus foot, or less in a metadductus foot, exists, with a clinically significant HV deformity (ie, HV ≥ 20). The growth plates must be closed, and the metatarsal protusion distance must be analyzed. The opening wedge is ideal when the second metatarsal is longer than or the same length as the first, where bone loss would not be tolerated. There must be normal first MTP range of motion without significant degenerative joint disease of the first MTP or first tarsometatarsal joint (TMT). If there is consideration for an additional distal metatarsal osteotomy and/or Akin osteotomy of the proximal phalanx, the patient is consented for this possibility and the final decision is made intraoperatively. Often the correction is so great that the surgeon finds no need for further bone work. Finally, and most importantly, the patient must present with pain and/or limitation of activity with failure of standard conservative therapy.

The option of using autologous versus allogenic bone graft is discussed with the patient during the preoperative consultation, during which time the patient consents to one or the other. Having used both sources of graft with no cases of nonunion to present, the patient is allowed, in most cases, to choose the source of bone graft. There are a variety of allogenic bone products on the market suitable for the opening-