CHAPTER 6

CURRENT INDICATIONS FOR THE CLOSING BASE WEDGE OSTEOTOMY OF THE FIRST METATARSAL

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In recent years there has been a reduction in the number of patients undergoing closing base wedge osteotomy for the repair of hallux abducto valgus. There are a number of reasons for the recent utilization trends. First, the base wedge is a technically demanding procedure, and given a choice, many surgeons prefer a distal osteotomy. Although the complications associated with proximal procedures can often be avoided, there may remain a certain stigma in the minds of those who recall a day when problems such as significant first metatarsal elevatus were commonplace.

As foot surgery progressed in the 1980s, surgeons expanded the use of distal metaphyseal osteotomies. Patients, who in previous years would have needed base wedge procedures, based on angular measurements alone, were now sustaining good correction of deformity with the Austin or other distal approaches. This was obviously more convenient for patients who would have otherwise been subjected to a significant period of non-weight bearing as part of their postoperative course. In addition, procedures such as the Mau and Scarf have also been used with frequency by surgeons who may have employed a base wedge procedure for similar situations in the past.

It would appear that the base wedge osteotomy has been relegated by some surgeons to a procedure of last resort. The base wedge can provide effective correction of deformity and excellent function when executed well in compliant patients. Yet one may ask what is the role of this procedure in modern day foot surgery? The author will propose reasonable indications for the base wedge osteotomy in light of current trends. While these guidelines are not meant to be all-inclusive, they will offer a basis for discussion. The opinions represented herein are only one approach to treating a variety of problems.

COMPLICATIONS AND COMPARISONS

Historically, significant complications have been reported with the closing base wedge osteotomy. When reviewing the literature one must keep in mind that many of these reports were published prior to the current fund of knowledge and technical advancements. Therefore, one may have a jaded, inaccurate view of the base wedge procedure. In most instances, these problems have been the direct result of weight bearing prior to consolidation of the osteotomy. Delayed unions, first metatarsal elevation, and shortening may be avoided as most surgeons recognize the importance of non-weight bearing as part of the normal follow-up regimen. Lesser metatarsalgia is also a direct result of the sagittal plane deviation of the first metatarsal.

One complication that has been grossly misunderstood is the purported shortening that accompanies the base wedge. Surgeons have been fearful that the proximal wedge resection renders a greater degree of shortening, significantly more than with other procedures. While lecturing in 1995, the author noted that most of the foot surgeons in Italy had abandoned the base wedge procedure based largely on this premise alone. However, experimental data gathered at the Podiatry Institute has for the first time definitely demonstrated the degree of shortening that one may anticipate as a consequence of the base wedge osteotomy alone.

In a paper that has been submitted for publication, Banks, et al., using saw bone models and mathematical analysis, demonstrated the amount of shortening which takes place with the base wedge. Removing a ten degree wedge of bone resulted in the first metatarsal being shortened a mean of 1.77 mm. This amount of wedge resection seemed to be representative of most procedures performed in clinical experience. Obviously, this is a very small amount of shortening, and probably is comparable to the loss of bone seen with most osteotomies.

The improved fixation techniques and instrumentation that are available today afford more precise resection of bone and excellent stabilization which might eliminate any further major concerns, provided the patient refrains from weight bearing. Accordingly, the procedure may be performed with great success provided certain basic parameters are observed.

INDICATIONS FOR BASE WEDGE OSTEOTOMY

High Intermetatarsal Angle

Traditionally, the closing base wedge osteotomy was employed for patients with first intermetatarsal angles that measured 15 degrees or more. As noted earlier, capital osteotomies are now used in many of these situations, but this does not imply that the base wedge procedure is a poor choice. On the contrary, the base wedge osteotomy provides excellent and reliable correction of deformity and should still be a consideration in patients fitting this profile. Although capital osteotomies may be adequate, the entire medial column will demonstrate a more rectus and narrow appearance with a proximal procedure. As the intermetatarsal separation is maximally decreased, the sesamoid apparatus will lie in a more anatomic position, enhancing overall function. Sagittal plane aberrations may be adequately addressed from the proximal aspect of the metatarsal as well.

Rigid First Ray

The ability of a surgeon to correct hallux abducto valgus deformity in patients with large intermetatarsal angles is predicated upon the first ray being flexible. In this scenario, much of the correction depends upon the release of soft tissue tension at the first metatarsophalangeal joint and the associated redirection of forces (dynamic deformity). Therefore, if the first ray is rigid, the reverse buckling effect will be eliminated and there will be a limited reduction in the intermetatarsal angle once the metatarsal head has been translocated (structural deformity). As a consequence, one may tend to resect a greater degree of bone from the first metatarsal head in an attempt to reduce the remaining bunion. Radiographically, the postoperative appearance may be that of a "C-shaped" metatarsal.

Often the lateral displacement of the sesamoids or adaptive joint contracture will prevent the surgeon from recognizing the full degree of transverse plane flexibility in the first ray. However, the transverse plane flexibility of the first ray can be assessed indirectly. By placing the metatarsal through its range of motion in the sagittal plane, one will have a reliable, although not absolute, estimate as to the flexibility of the first ray in the transverse plane. In cases where the motion is questionable (i.e. a more rigid deformity), then the base wedge procedure should be considered a primary option.

One may also derive some indication of first ray flexibility by evaluating the dorsoplantar radiograph. Patients with a more pronounced articulation between the bases of the first and second metatarsals will tend to have less mobility (Figs. 1A, 1B).

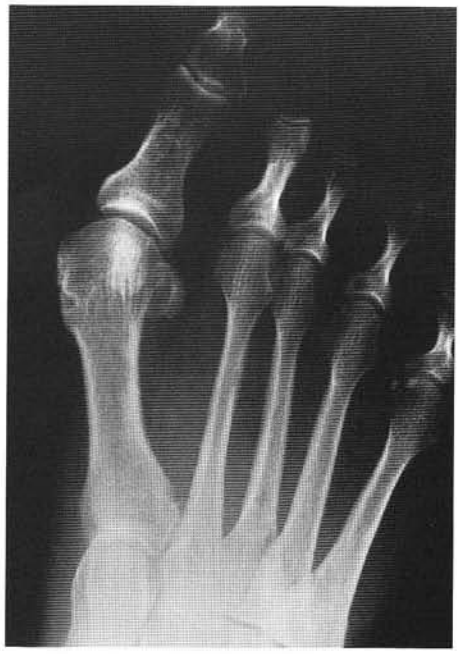

Figure 1A. The base wedge procedure is very effective in reducing the IM angle of patients with a rigid first ray. Mobility was limited in this patient due to the nature of the articulation between the first and second metatarsals.

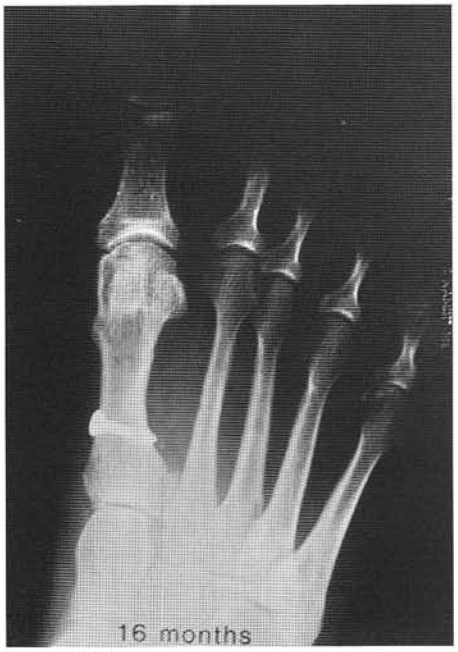

Figure 1B. View at 16 months postoperative.

Juvenile Hallux Abducto Valgus

The development of hallux abducto valgus deformity in the young or adolescent patient is typically an indication of a significant deforming influence. Because of this, the author believes that a base wedge osteotomy should be a primary consideration when repairing hallux abducto valgus deformity in a young individual. A more proximal osteotomy will afford one the opportunity to close the intermetatarsal angle to zero degrees, thereby providing maximum correction, and theoretically, minimizing the potential for any recurrence of deformity.

This is particularly important considering that a large number of patients with juvenile hallux abducto valgus will also possess metatarsus adductus deformity. A number of authors have highlighted the potential association of these two conditions. In one study involving repair of hallux abducto valgus in patients under age twenty, 66% of those were noted to have greater than 15 degrees of metatarsus adductus. Furthermore, there was a direct association between an increasing amount of hallux valgus with increased levels of metatarsus adductus.

Hallux Abducto Valgus with Metatarsus Adductus

The presence of metatarsus adductus has direct implications on the development and subsequent treatment of patients with hallux abducto valgus. La Reaux and Lee evaluated 460 radiographs, half of which demonstrated hallux abducto valgus, the other half were selected at random. They noted that 35% of the patients with hallux abducto valgus possessed metatarsus adductus. Those patients evaluated at random demonstrated an incidence of metatarsus adductus of only 13%. Griffiths and Palladino found a statistically significant and direct relationship between patients with an increasing metatarsus adductus and hallux abductus angles. In addition, when the metatarsus angle was greater than 15 degrees there was a stronger pattern to this relationship.

Radiographically, patients possessing these two conditions generally demonstrate a very large bunion or hallux abducto valgus condition, yet with little intermetatarsal splay. However, one should not be mislead by the intermetatarsal angle. Anytime metatarsus adductus is present, the foot functions as if the intermetatarsal angle is larger. This may be expressed mathematically:

True IM angle = IM angle + (metatarsus adductus angle - 15 degrees)

Several authors have noted the importance of providing maximal correction of the intermetatarsal angle in these situations. It has been recommended that the IM angle be reduced to zero, if not a negative value. Capital osteotomies do not afford one the ability to achieve this type of correction, and as a result, may tend to be associated with greater recurrence of the hallux abducto valgus deformity (Figs. 2A-2C).

Iatrogenic Forefoot Deformities

The base wedge may also be a primary procedure in patients with recurrent hallux abducto valgus or other postoperative complications. In cases where there has been an overly aggressive resection of the first metatarsal head, one may have difficulty performing or obtaining adequate correction with a distal metaphyseal osteotomy. The best bone substance will be found proximally. Even if the intermetatarsal angle is not that large, the base wedge may provide a more reliable means of correction (Figs. 3A, 3B).

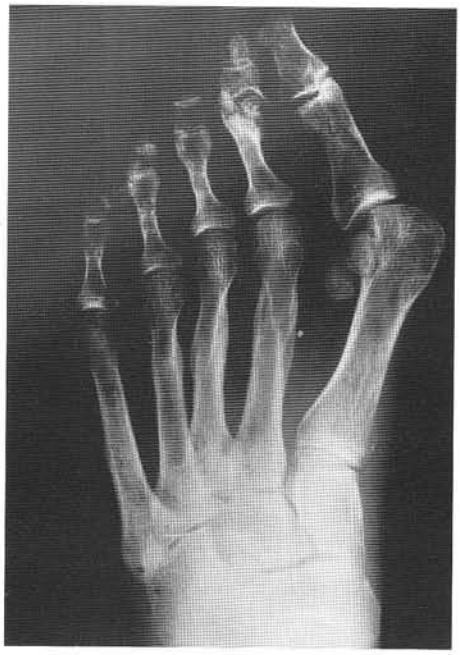

Figure 2A. Hallux abducto valgus deformity with concomitant metatarsus adductus. Notice the significant hallux abductus with a relatively low IM angle.

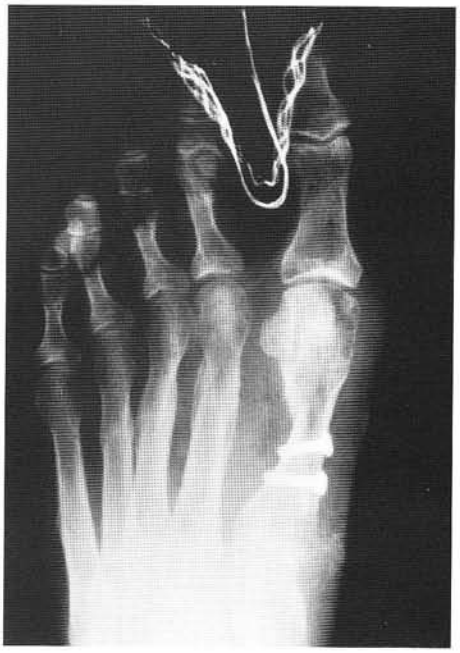

Figure 2B. Intraoperative radiograph. Notice that the IM angle is slightly negative.

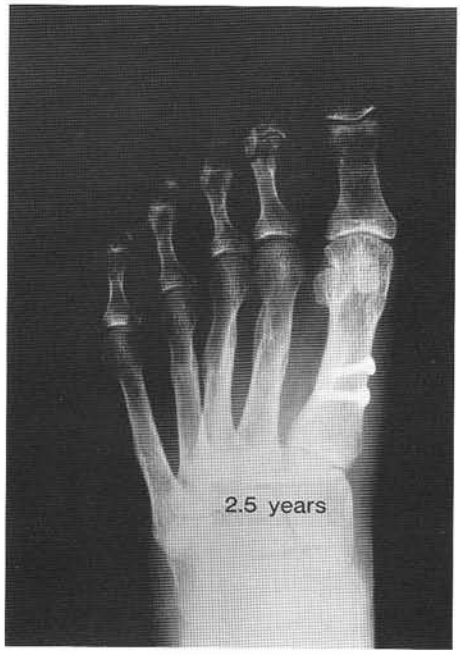

Figure 2C. View at 2.5 years postoperative.

Figure 3A. Recurrent hallux abducto valgus with previous excessive resection of the metatarsal head.

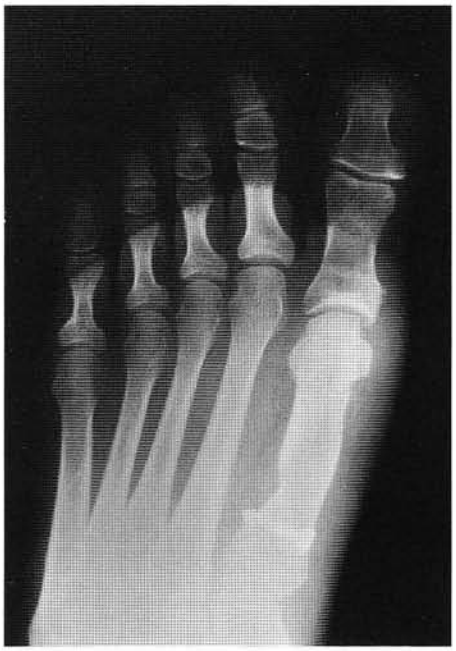

Figure 3B. Effective correction may at times be achieved with a base wedge osteotomy in similar instances.

In patients with other iatrogenic forefoot deformities, repair of a concomitant hallux abducto valgus may be part of the overall correction. A closing base wedge osteotomy will provide maximum correction and the best overall improvement in forefoot function.

Sagittal Plane Aberrations of the First Metatarsal

Hallux abducto valgus with first metatarsal equinus or elevatus may also be readily and effectively addressed with closing base wedge osteotomy. Sagittal plane alterations can be effected by altering the axis of the osteotomy. Further correction may be achieved by sacrificing the hinge of the osteotomy if necessary. First, the required amount of intermetatarsal correction is achieved and then the osteotomy is continued through, sacrificing the cortical hinge. This will allow the surgeon to rotate the distal metatarsal in the sagittal plane until the desired location is found. Two points of fixation will be required to ensure adequate stability and rigidity.

One might question why a proximal procedure would be required for this purpose when a distal metaphyseal osteotomy can also plantarflex or dorsiflex the distal apsect of the ray. It is the author's opinion that when significant sagittal plane correction is made at the first metatarsal head, then there is a greater chance for aberrations in sagittal plane function of the hallux. While significant plantarflexion of the first ray may result in a weak or nonpurchasing hallux, there is a greater likelihood that this will occur when the correction is achieved distally. The more distal the procedure, the more abrupt the change in the vector forces of the extensor and flexor tendons, and the more pronounced the changes in muscle dynamics.

CONCLUSION

The author has proposed specific and relative indications for the base wedge osteotomy. Other authors have recently confirmed the efficacy of the procedure. While distal osteotomies tend to remain the primary means of correcting hallux abducto valgus deformity, the closing base wedge procedure should not be relegated to the past.

BIBLIOGRAPHY

Banks AS, Hsu YS, Mariash S, Zirm R: Juvenile hallux abducto valgus association with metatarsus adductus. *J Am Podiatr Assoc* 84:219-224, 1994.

Banks AS, Cargill RS, Carter S, Ruch JA: Shortening of the first metatarsal following base wedge osteotomy. Submitted for publication.

Cain TD, Boyd D: Defining the Limits of the Austin Bunionectomy. In DiNapoli RD, ed. *Reconstructive Surgery of the Foot and Leg, Update 1990,* Tucker, GA: Podiatry Institute Publishing Co; 1990: 128-134.

Cain TD: Distal Metaphyseal Osteotomies in Hallux Abducto Valgus Surgery. In McGlamry ED, Banks AS, Downey MS, eds. *Comprehensive Textbook of Foot Surgery,* 2nd ed. Baltimore, Md: Williams and Wilkins; 1992: 493-503.

Christenson C, Jones RO, Basque M, Mollohan E: Comparison of oblique closing base wedge osteotomies of the first metatarsal: stripping versus nonstripping of the periosteum. *J Foot Surg* 30:107-113, 1991.

Curda GA, Sorto LA: The McBride bunionectomy with closing abductory wedge osteotomy. A postoperative review. *J Am Pod Assoc* 71:349- 355, 1981.

Denton J, Kuwada GT: Retrospective study of closing wedge osteotomy complications at the base of the first metatarsal with bone screw fixation. *J Foot Surg* 22:314-319, 1983.

Fagan JP: Metatarsus adductus. In DeValentine SJ, ed. *Foot and Ankle Disorders in Children* New York, NY: Churchill Livingstone; 1992: 175-192.

Griffiths TA, Palladino SJ: Metatarsus adductus and selected radiographic measurements of the first ray in normal feet. *J Am Podiatr Med Assoc* 82:616-622, 1992.

Haendel C, Lindholm JA: First metatarsal wedge osteotomies. A retrospective study. *J Am Pod Assoc* 72:550-556, 1982.

Jeremin PJ, DeVincentis A, Goller W: Closing base wedge osteotomy: an evaluation of twenty-four cases. *J Foot Surg* 21:316-323, 1982.

Kalish SK, Gold RS: Modifications of the Austin Hallux Valgus Repair (Kalish osteotomy). In Ruch JA, Vickers NS, eds. *Reconstructive Surgery of the Foot and Leg, Update '92,* Tucker, Ga: Podiatry Institute Publishing; 1992:237-243.

La Reaux RL, Lee BR: Metatarsus adductus and hallux abducto valgus: their correlation. *J Foot Surg* 26:304-308, 1987.

Lynch FR: Juvenile Hallux Abducto Valgus. In McGlamry ED, Banks AS, Downey MS, eds. *Comprehensive Textbook of Foot Surgery,* 2nd ed., Baltimore, Md: Williams and Wilkins; 1992:566-577.

McCormick DW, Blount WP: Metatarsus adductus "skewfoot". *JAMA* 141:449-453, 1949.

Neese DJ, Zelichowski JE, Patton GW: Mau osteotomy: An alternative procedure to the closing abductory base wedge osteotomy. *J Foot Surg* 28:352-362, 1989.

Nigro JS, Greger GM, Catanzariti AR: Closing base wedge osteotomy. *J Foot Surg* 30:494-505, 1991.

Ruch JA: First Metatarsal Osteotomies in the Treatment of Hallux Abducto Valgus. Rigid Internal Fixation Techniques - Results and Complications. In McGlamry ED, ed. *Doctors Hospital Podiatric Education and Research Institute Seminar Manual,* Tucker, GA: The Podiatry Institute Publishing; 1982: 89-99.

Ruch JA, Banks AS: Proximal Osteotomies of the First Metatarsal in the Correction of Hallux Abducto Valgus. In McGlamry ED, ed. *Comprehensive Textbook of Foot Surgery,* Baltimore, Md: Williams and Wilkins; 1987: 195-211.

Ruch JA: Base Wedge Osteotomies of the First Metatarsal. In McGlamry ED, Banks AS, Downey MS, eds. *Comprehensive Textbook of Foot Surgery* 2nd ed., Baltimore, Md: Williams and Wilkins; 1992: 504-522.

Schuberth JM, Reilly CH, Gudas CJ: The closing wedge osteotomy. A critical analysis of first metatarsal elevation. *J Am Pod Assoc* 74:13-24, 1984.

Seiberg M, Felson S, Colson JP, Barth AH, Green RM, Green DR: Closing base wedge versus Austin bunionectomies for metatarsus primus adductus. *J Am Podiatr Med Assoc* 84:548-563, 1994.

Trepal MJ: Hallux valgus and metatarsus adductus: The surgical dilemma. *Clin Podiatr Med Surg,* 6:103-113, 1989.

Vogler HW, Smith ME: Osteotomy of the First Metatarsal Shaft in Hallux Abducto Valgus Surgery. In McGlamry ED, Banks AS, Downey MS eds. *Comprehensive Textbook of Foot Surgery,* 2nd ed., Baltimore, Md: Williams and Wilkins; 1992: 523-532.

Yu GV, DiNapoli DR: "Surgical management of hallux abducto valgus with concomitant metatarsus adductus", in *Reconstructive Surgery of the Foot and Leg, Update '89,* McGlamry ED, ed., Podiatry Institute Publishing, Tucker, GA, 1989.

Yu GV, Landers PA, Lo KG, Shook JE: Juvenile and Adolescent Hallux Abducto Valgus Deformity. In DeValentine SJ, ed. *Foot and Ankle Disorders in Children* New York, NY: Churchill Livingstone; 1992: 369-405.

Zlotoff H: Shortening of the first metatarsal following osteotomy and its clinical significance. *J Am Pod Assoc* 67:412-426, 1977.