

# Understanding Frontal Plane Correction in Hallux Valgus Repair



W. Bret Smith, DO, MS<sup>a,\*</sup>, Paul Dayton, DPM, MS<sup>b</sup>,  
Robert D. Santrock, MD<sup>c</sup>, Daniel J. Hatch, DPM<sup>d</sup>

## KEYWORDS

• Frontal plane • Hallux valgus • Bunion • Lapiplasty

## KEY POINTS

- Understanding the role that frontal/coronal rotation plays in the mechanics of the hallux-abducto-valgus (HAV) deformity and in the radiographic appearance is vital.
- As we begin to understand the more complex 3-dimensional deformity, it will likely push our understanding further.
- Although the initial concepts proposed are a radical challenge to current HAV dogma, classification systems such as this one will ultimately provide an improved understanding of the pathomechanics and pathogenesis of HAV.

## INTRODUCTION

The goal of correction of the hallux-abducto-valgus (HAV) deformity should be to position the first metatarsal and metatarsophalangeal (MTP) joint in a position as close to normal anatomy as possible. The current technique that is discussed attempts to correct the deformity at the center of rotational angulation (CORA) in all 3 planes (coronal/frontal, transverse, and sagittal), and is adjustable to the degree of correction in those planes. There are no limitations to this technique based on severity of the hallux valgus angle (HVA) or intermetatarsal angle (IMA). The presence (or absence) of hypermobility, or sagittal plane malalignment, is not a factor in the use of the triplanar correction technique, and it may be used in either condition. This technique is appropriate for all

---

All authors are paid consultants for Treace Medical Concepts, Inc.

<sup>a</sup> Orthopedics, University of South Carolina, Palmetto Health-USC Orthopedic Center, 104 Saluda Pointe Drive, Lexington, SC 29072, USA; <sup>b</sup> Department of Podiatric Medicine and Surgery, College of Podiatric Medicine and Surgery, Des Moines University, UnityPoint Clinic, Trinity Regional Medical Center, 3200 Grand Avenue, Des Moines, IA 50312, USA; <sup>c</sup> Department of Orthopaedics, West Virginia University, 1 Medical Center Drive, PO Box 9100, Morgantown, WV 26506-9600, USA; <sup>d</sup> Department of Podiatric Medicine and Surgery, North Colorado PMS Residency, 1600 23rd Avenue, Greeley, CO 80634, USA

\* Corresponding author.

E-mail address: [wbsmithdo@yahoo.com](mailto:wbsmithdo@yahoo.com)

Clin Podiatr Med Surg 35 (2018) 27–36  
<http://dx.doi.org/10.1016/j.cpm.2017.08.002>

[podiatric.theclinics.com](http://podiatric.theclinics.com)

0891-8422/18/© 2017 Elsevier Inc. All rights reserved.

ages as well. Both the adult and adolescent HAV deformities can be corrected via this approach.

The strength of this triplanar technique is the ability to reliably correct all 3 anatomic planes in hallux valgus deformities before committing to a permanent resection of bone. This includes correcting the coronal/frontal plane metatarsal rotation that is present in 87.3% of hallux valgus deformities when examined by weightbearing computed tomography scan.<sup>1</sup> However, the system is adjustable to correct all deformities, from zero rotation to maximum rotation.

This triplanar technique is contraindicated in the case of the unhealthy first MTP joint, or “degenerative bunion.” As with other previously described HAV corrective techniques, an arthritic first MTP joint should be addressed by a first MTP joint arthrodesis.

## TECHNIQUE

The patient’s operative extremity is marked and consent confirmed. For anesthesia, the authors’ preference is a regional extremity nerve block performed by the anesthesia team. Once the nerve block has been completed, the patient is taken to the operative suite. The patient is placed on a radiolucent operating room table. A tourniquet is applied to the operative limb, and the limb is prepped and draped in the usual fashion for the operative procedure. The leg is exsanguinated and the tourniquet inflated to the appropriate pressure.

The initial incision is made over the dorsal aspect of the first tarsometatarsal (TMT) joint, just medial to the extensor hallucis longus tendon (Fig. 1: initial exposure). It is

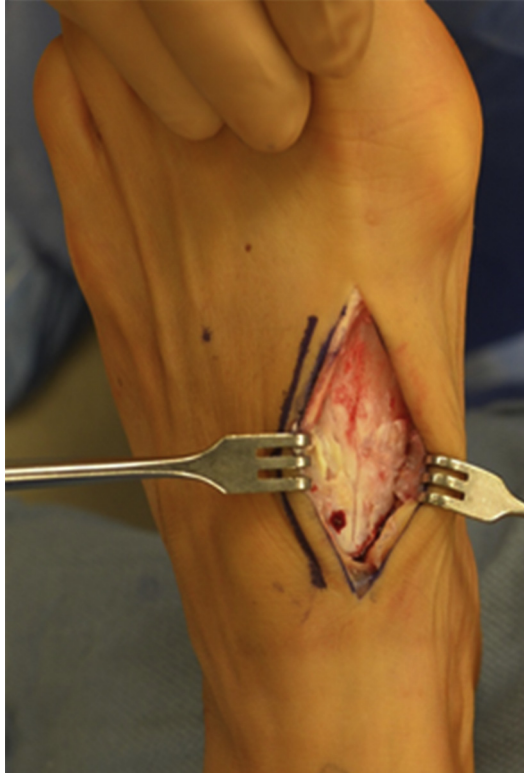


Fig. 1. Dorsal incision.

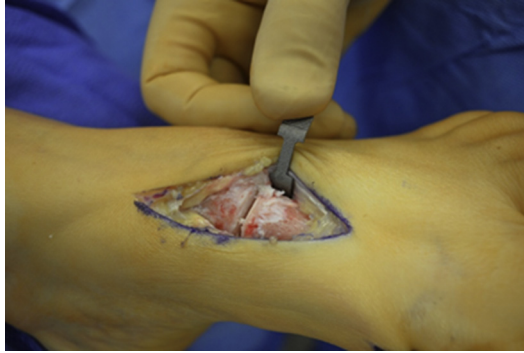
essential to keep the incision dorsal for this technique to allow the guidance system to work properly. The incision is developed until the dorsal aspect of the first TMT joint is exposed. At this time, the entire dorsal and medial aspects of the joint are subperiosteally dissected.

Next the joint is released to allow for rotation if a frontal plane deformity is noted preoperatively. The joint can be released plantarly using a combination of oscillating saw and osteotome (**Fig. 2**: joint release with osteotome only). A hemostat is then used to open a small space at the proximal aspect of the first and second metatarsal interspace. The fulcrum device (Lapiplasty Fulcrum; Treace Medical Concepts, Ponte Vedra Beach, FL) is then placed into the interspace of the proximal first and second metatarsals (**Fig. 3**: fulcrum placement).

At this time, the mobility of the first MTP joint needs to be evaluated. If it is found to be stiff or ankylosed, then a small webspace incision is made and the tight lateral



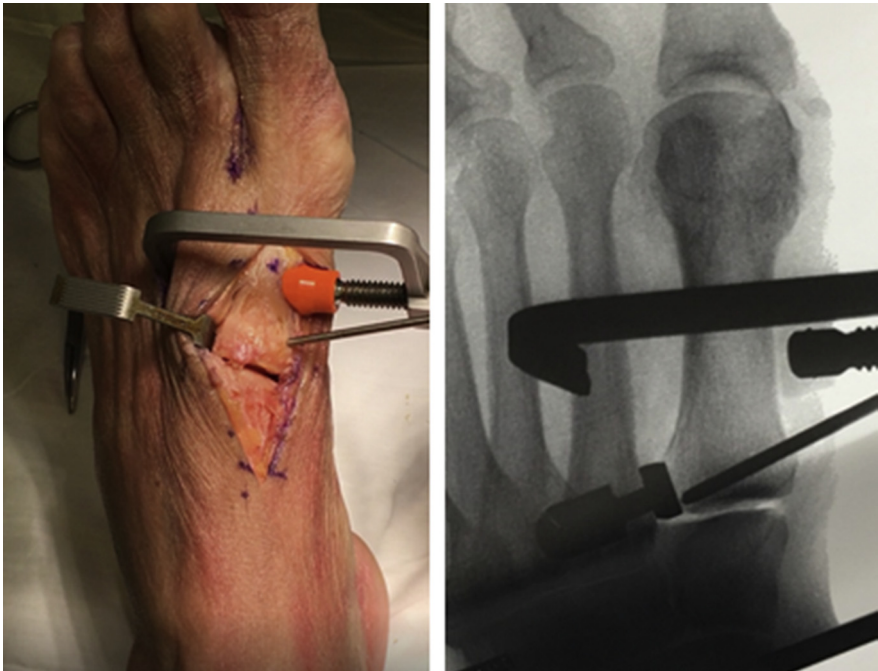
**Fig. 2.** TMT release (showing both the saw and osteotome options).



**Fig. 3.** Fulcrum.

structures are gradually released until the joint is mobilized. It is important to note that you should avoid opening the medial capsule of the first MTP joint at this time because destabilizing the medial structures will not allow the system to correct all 3 planes of the deformity properly.

Once the fulcrum has been placed, a positioner device (Lapiplasty Positioner; Treace Medical Concepts) is ready to be applied. A small stab incision is made over the second metatarsal approximately 1.5 to 2.0 cm distal from the first TMT joint. The positioner is then applied distal to the fulcrum and the joint (**Fig. 4**: positioner placement). The medial aspect of the positioner should be applied to the plantar



**Fig. 4.** Positioner (to assist with reduction).

medial ridge on the first metatarsal. The lateral portion of the positioner is placed over the lateral cortex of the second metatarsal.

At this time, the correction of the HAV deformity can be corrected in all 3 planes. Once the correction has been dialed-in to a satisfactory position, it can be confirmed on fluoroscopy. A Kirschner wire can be used to temporarily stabilize the corrected position with a pin placed through a cannulation in the positioner.

A joint seeker (Lapiplasty Joint Seeker; Treace Medical Concepts) is then introduced dorsally in the first TMT joint. This provides a placement guide for the cutting guide (Lapiplasty Cut Guide; Treace Medical Concepts), as well as ensuring that the cuts are made correctly in the sagittal plane to prevent dorsiflexion of the first ray. The cutting guide is then placed and temporarily fixed in place (Fig. 5: cutting guide placement). It is recommended at this point to take an image with the c-arm to confirm the alignment of the cutting guide. Once the position has been confirmed, a final pin can be introduced to secure the cutting jig in position. The joint seeker is then removed and the cuts on the base of the metatarsal and cuneiform can be completed.

The cut bone is then removed, usually with a combination of osteotome and rongeur. Once all of the cut bone has been removed, the joint is prepared for arthrodesis. A drill bit is used to fenestrate the joint surfaces. At this time, the pin placed through the positioner will need to be removed.

Once the temporary holding pin in the positioner has been removed, the joint is axially compressed and held in the corrected position of choice and precompressed with the terminally threaded olive wire (Fig. 6: compression olive wire). A second threaded olive can be placed as well, based on surgeon preference. It is

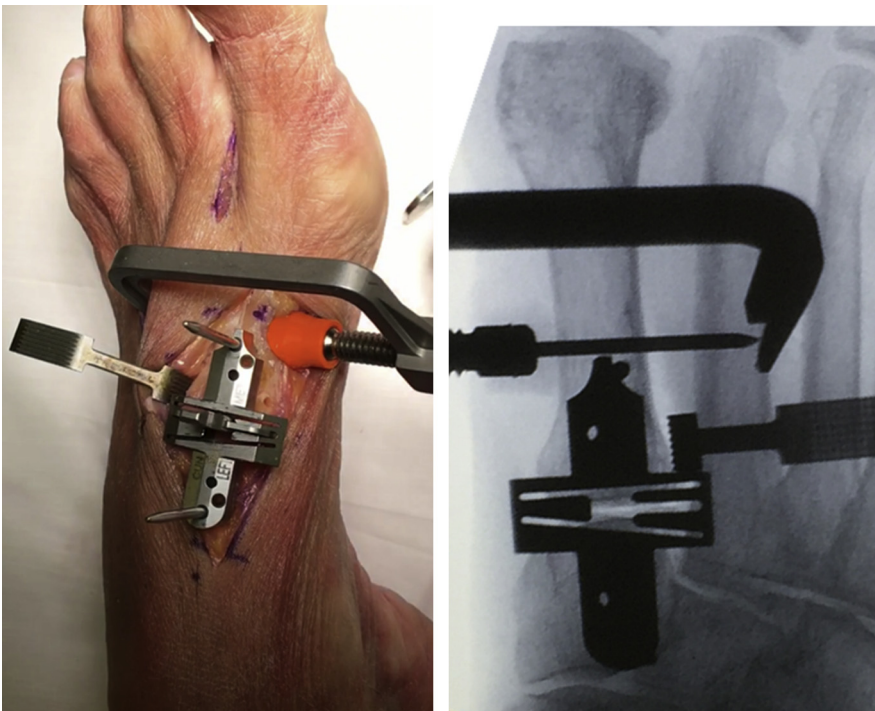


Fig. 5. Cut guide.



**Fig. 6.** Olive compression wires holding correction.

recommended at this time to remove or release the positioner and check the correction with fluoroscopy.

If the position is satisfactory, then final fixation can be applied. The current technique uses a biplanar mini-plate construct (Control 360 System; Treace Medical Concepts) that offers stability and allows for physiologic micromotion to promote healing, as described by Perren.<sup>2</sup>

The initial plate is applied straight dorsal across the first TMT joint. Once the plate is positioned, it is temporarily held in position with plate tacks. With the plate held in position, the other open holes are drilled in preparation for screw placement. The drill guides are then removed and the locking screws placed. At this time, the plate tacks can be removed and drill guides and the final 2 locking screws are applied to the plate construct.

At this time, a choice of either a second straight plate can be applied medially across the first TMT joint 90° to the dorsal plate, or a specially designed anatomic plantar-medial-based plate (Plantar Python Plate; Treace Medical Concepts) can be applied. As with the dorsal plate, the second plate is helped with 2 plate tacks and then secured in sequence with the 4 locked screws (Fig. 7: plate constructs).

Once the biplanar plate construct has been applied, the surgeon does have the option of adding a screw from the first to the second metatarsal if there is suspicion of intercuneiform instability or if there is a need for additional stabilization of the construct.

Once the first TMT joint has been stabilized, the surgeon can direct his or her attention to the first MTP joint. If needed, a medial-based incision is used to access the joint. Usually, it is noted that there is significant capsular thickening that may require

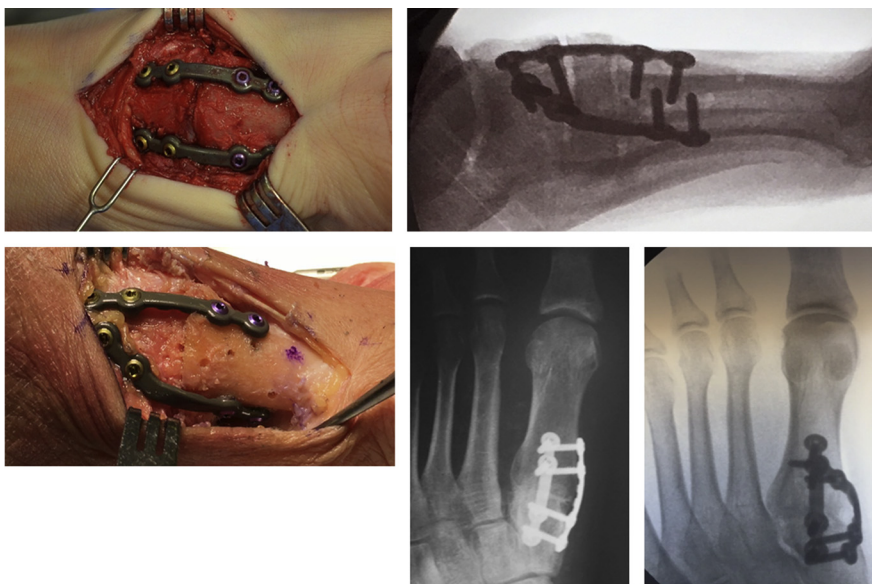


Fig. 7. Plates (demonstrating both biplanar and plantar options).



Fig. 8. Note the sesamoid position from rotated to corrected.

thinning. It is also not uncommon to find a dorsal ridge on the first metatarsal head that also may require removal.

Once any additional procedures have been completed, the wounds are copiously irrigated and closed in the standard fashion. The patient is placed into a sterile dressing and either a stiffened postoperative shoe or low walking boot, based on preference.

Several examples are given that represent cases using the triplanar correction technique described in this article (Figs. 8 and 9).

## DISCUSSION

It is readily evident that the first metatarsal in a bunion is not intrinsically deformed, but it and the hallux are deviated from their normal anatomic alignment.<sup>3,4</sup> When a single osteotomy procedure or, in some cases, more than one osteotomy in the first metatarsal is chosen, new deformities in the metatarsal are created and, at the same time, the original deviation of the metatarsal is not being corrected.<sup>5-7</sup> This practice of creating a surgical deformity of the metatarsal, rather than restoring the normal anatomic alignment, may be one of the reasons for poor outcomes and recurrence.



Fig. 9. Note both the derotated metatarsal and realigned sesamoids.



<b>Class</b>	<b>Anatomic Findings</b>	<b>MTP Joint Status</b>	<b>Treatment Recommendation</b>
1	Increased HVA and IMA <i>No first metatarsal pronation evident on AP and sesamoid axial radiograph</i> Sesamoids may be subluxed	No clinical or radiographic evidence of DJD	Transverse plane corrective procedure +/- Distal soft tissue procedures
2A	Increased HVA and IMA <i>First metatarsal pronation evident on AP and sesamoid axial radiograph</i> No sesamoid subluxation on axial	No clinical or radiographic evidence of DJD	Triplane correction with first metatarsal supination/inversion
2B	Increased HVA and IMA <i>First metatarsal pronation evident on AP and sesamoid axial radiograph</i> With sesamoid subluxation on axial	No clinical or radiographic evidence of DJD	Triplane correction with first metatarsal supination/inversion + Distal soft tissue procedures
3	Increased HVA and IMA >15° MTA	No clinical or radiographic evidence of DJD	Metatarsal 2 and 3 transverse plane correction Followed by first metatarsal correction per class 1 and 2 recommendations
4	Increased HVA and IMA +/- First metatarsal pronation	<i>Clinical and/or radiographic evidence of DJD</i>	First MTP arthrodesis

*Abbreviations:* AP, anteroposterior; DJD, degenerative joint disease; HAV, hallux-abducto-valgus; HVA, hallux valgus angle; IMA, intermetatarsal angle; MTA, metatarsus adductus; MTP, metatarsophalangeal.

Recent studies have shown anatomic recurrence rates of up to 78% depending on the procedure studied and, in some cases, the method of measurement used.<sup>8-14</sup> The question at hand is whether these outcomes are due to poor execution of the procedures or to a failure in basic anatomic definition and presurgical classification of the deformities.

For these reasons, it is felt that an improved algorithm should be used when assessing the HAV deformity. This algorithm uses components of all 3 planes of the deformity to drive decision making when approaching bunion correction (**Table 1**).

## SUMMARY

We believe that the current paradigm for evaluation of HAV deformity is incomplete. Because it is now understood that recurrence rates with bunion procedures based on traditional algorithms are higher than previously thought and have been linked to uncorrected frontal/coronal plane rotation, it is essential to increase the depth of understanding of this complex 3-dimensional deformity. We propose rethinking the current paradigm for evaluation and management to include all 3 planes of the deformity. Triplane correction of the first metatarsal position ensures the surgeon the flexibility to completely correct the HAV deformity. Understanding the role that frontal/coronal

rotation plays in the mechanics of the HAV deformity and in the radiographic appearance is vital. As we begin to understand the more complex 3-dimensional deformity, it will likely push our understanding further. Although the initial concepts proposed are a radical challenge to current HAV dogma, classification systems such as this one will ultimately provide an improved understanding of the pathomechanics and pathogenesis of HAV.

## REFERENCES

1. King DM, Toolan BC. Associated deformities and hypermobility in hallux valgus: an investigation with weightbearing radiographs. *Foot Ankle Int* 2004;25(4):251–5.
2. Perren SM. Evolution of the internal fixation of long bone fractures. *J Bone Joint Surg Br* 2002;84:1093–110.
3. Grode SE, McCarthy DJ. The anatomical implications of hallux abducto valgus: a cryomicrotomy study. *J Am Podiatry Assoc* 1980;70(11):539–51.
4. Thordarson DB, Krewer P. Medial eminence thickness with and without hallux valgus. *Foot Ankle Int* 2002;23(1):48–50.
5. Tanaka Y, Takakura Y, Kumai T, et al. Radiographic analysis of hallux valgus. *J Bone Joint Surg Am* 1995;77A(2):205–13.
6. Tanaka Y, Takakura Y, Sugimoto K, et al. Precise anatomic configuration changes in the first ray of the hallux valgus foot. *Foot Ankle Int* 2000;21(8):651–6.
7. Paley D. Radiographic assessment of lower limb deformities. In: Paley D, editor. *Principles of deformity correction*. Heidelberg, Germany: Springer; 2002. p. 31–6.
8. Bock P, Kluger R, Kristen K-H, et al. The scarf osteotomy with minimally invasive lateral release for treatment of hallux valgus deformity. *J Bone Joint Surg Am* 2015;97(15):1238–45.
9. Iyer S, Demetracopoulos CA, Sofka CM, et al. High rate of recurrence following proximal medial opening wedge osteotomy for correction of moderate hallux valgus. *Foot Ankle Int* 2015;36(7):756–63.
10. Chong A, Nazarian N, Chandrananth J, et al. Surgery for the correction of hallux valgus: minimum five-year results with a validated patient-reported outcome tool and regression analysis. *Bone Joint J* 2015;97-B(2):208–14.
11. Agrawal Y, Bajaj SK, Flowers MJ. Scarf–Akin osteotomy for hallux valgus in juvenile and adolescent patients. *J Pediatr Orthop B* 2015;24(6):535–40.
12. Edmonds EW, Ek D, Bomar JD, et al. Preliminary radiographic outcomes of surgical correction in juvenile hallux valgus: single proximal, single distal versus double osteotomies. *J Pediatr Orthop* 2015;35(3):307–13.
13. Jeuken RM, Schotanus MGM, Kort NP, et al. Long-term follow-up of a randomized controlled trial comparing scarf to chevron osteotomy in hallux valgus correction. *Foot Ankle Int* 2016;37(7):687–95.
14. Shibuya N, Thorud JC, Martin LR, et al. Evaluation of hallux valgus correction with versus without akin proximal phalanx osteotomy. *J Foot Ankle Surg* 2016;55(5):910–4.