



30 Hallux valgus

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30.1 Introduction

Hallux valgus describes a forefoot condition in which the 1st metatarsal is medially deviated and the hallux is laterally deviated creating a medial prominence at the 1st metatarsophalangeal (MTP) joint that can be painful, especially with footwear. The lay term *bunion*, derived from the Latin word for turnip, *bunio*, can describe the protruding medial eminence that is characteristic of hallux valgus, but may also describe 1st MTP enlargement caused by osteoarthritis, bursal inflammation, ganglion formation, or gouty arthropathy. Hallux valgus can be associated with posterior tibial tendon rupture, neuromuscular disorders and inflammatory arthropathies.

With varying evidence in the literature, pes planus, 1st ray hypermobility, footwear, occupation, heredity, Achilles contracture, and ligamentous laxity have all been implicated as causes for hallux valgus deformity. A recent prospective study by Coughlin and Jones evaluated 103 patients with 122 feet treated for moderate to severe deformity.⁵ They found that:

- 83% of patients had a family history of hallux valgus
- 71% of feet with hallux valgus deformity had an increased 1st metatarsal length — 2.4 mm longer when compared with the 2nd metatarsal
- 71% of feet had an oval or curved MTP joint surface
- 32% of feet had moderate to severe metatarsus adductus
- 34% of patients implicated shoe wear or occupation as causative factors in the development of their bunions
- 23% of feet had plantar gapping at the 1st metatarsocuneiform (MTC) joint
- 13% of feet had increased 1st ray mobility as defined by 9 mm or more of motion determined by Klaue's device



Factors that were not significantly increased in hallux valgus patients included pes planus (15%) and Achilles contracture (11%).⁵

30.2 Anatomy

Appropriate treatment of hallux valgus requires a clear understanding of the anatomy of the entire first ray. The MTP joint is stabilized by ligamentous, tendinous and bony structures. The joint capsule is augmented medially and laterally by the collateral and sesamoid ligaments. Dorsally, the extensor hallucis longus (EHL) tendon is stabilized medially and laterally by the extensor hood ligament. Plantar to this extensor hood is the extensor hallucis brevis tendon, which inserts on the dorsal lip of the proximal phalanx.

Plantar to the first MTP, the joint capsule is augmented by the lateral and medial tendons of the flexor hallucis brevis (FHB). These tendons insert broadly onto the sesamoids proximally. Distally the sesamoido-phalangeal ligaments serves as the extension of these tendons from the sesamoid to the base of the proximal phalanx. The flexor hallucis longus (FHL) tendon runs between the sesamoids, bounded by a firm sheath, and proceeds distally to the base of the proximal phalanx.

The abductor hallucis (AbH) tendon plantaromedially is contiguous with the MTP capsule and inserts onto the medial sesamoid and medial plantar base of the proximal phalanx. The adductor hallucis (AdH) tendon is plantarlateral and inserts on to the lateral sesamoid, the lateral capsule and the lateral aspect of the proximal phalanx. This leaves areas of relative weakness dorsomedially and dorsolaterally, where only the hood ligament augments the joint capsule.

The bony shape of the distal metatarsal lends some stability to the joint as well. Flat and chevron-shaped MTP joints are inherently more resistant to lateral subluxation of the proximal phalanx, while rounded joints are associated with hallux valgus.

In addition, the sesamoid complex is stabilized mediolaterally by a bony ridge or crista between the two FHB tendons in which the sesamoids are embedded. This crista is typically eroded in more advanced stages of hallux valgus deformity as the entire sesamoid complex migrates laterally.

The 1st MTC joint is stabilized by its capsule, ligaments, and adjacent 2nd metatarsal. Allowing for sagittal and coronal motion and rotation, the orientation of this joint influences the degree of metatarsus primus varus, as well as joint stability.

30.3 Biomechanics

The 1st MTP joint plays an important role in weight bearing. The plantar aponeurosis, by its attachment to the base of proximal phalanx, helps to raise the arch and depress the 1st metatarsal, allowing it to accept weight.

30.4 Clinical Presentation

In a series reported by Coughlin et al,⁴ 70% to 75% of patients reported a chief complaint of pain over the medial eminence.



Additionally, or alternatively, patients can present with forefoot pain due to a variety of associated problems:

- Painful calluses
- Inter-digital neuromas
- Lesser toe deformities
- Painful corns

30.5 Pathogenesis

Although there are many stabilizing structure crossing the MTP joint, there are no tendons attaching to the distal metatarsal to prevent medial deviation. Therefore, normal alignment of the 1st MTP is a product of a delicate balance of abducting and adducting forces.

In a hallux valgus deformity with a congruent MTP joint, this balance is stable. with the prominent medial eminence causing irritation with shoe wear and a resultant bursitis or neuralgia or overlying tissue breakdown. With an incongruent MTP, this balance is lost and the proximal phalanx progressively moves laterally, pushing the distal metatarsal medially. The dorsomedial capsule attenuates, allowing the distal metatarsal to move more medially as the AbH tendon slides under the metatarsal head. This subluxation of the AbH pulls the hallux into pronation.

The common tendon of AdH tendon and the transverse metatarsal ligament apply a constant lateral force to the sesamoid complex and, over time, the crista erodes and allows lateral subluxation of the sesamoids with respect to the metatarsal head. At the level of the MTP joint, the FHL tendon moves laterally with the sesamoid complex and accentuates the deformity. As the deformity progresses, the extensor hallucis contracts, causing both extension and lateral deviation.

As the 1st MTP joint becomes less stable, less weight is supported by the first ray and the force is transferred laterally within the forefoot, causing transfer lesions of synovitis and/or instability in the 2nd or even 3rd MTP and MTC joints. In addition, the lateral drift of the hallux crowds the 2nd and 3rd toes, causing or aggravating hammertoe, clawtoe deformities, overlapping toes, or a windswept appearance of these digits.

30.6 Classification (Staging)

Hallux valgus deformity is classified by the degree of deformity as assessed by weight-bearing AP radiographs

- **Mild deformity** is defined by an intermetatarsal angle (IMA) of less than 13° and a hallux valgus angle (HVA) of less than 30°.
- **Moderate deformity** is defined by an IMA greater than 13° but an HVA of less than 40°.
- **Severe deformity** is characterized by an IMA of greater than 20° and an HVA greater than 40°.

However, the severity and natural history of the deformity and therefore the treatment plan is also influenced by the stability of the 1st MTC joint and the congruency of the 1st MTP joint.



30.7 Physical Examination

The patient's foot is observed while walking, standing, and sitting. While weight-bearing, the hallux and lesser toe positions, hindfoot alignment, and arch morphology are also observed. Range of motion of the ankle with the knee flexed and extended, the subtalar joint and transverse tarsal joint are assessed. The 1st MTC joint is evaluated for hypermobility and crepitus. The degree of hallux valgus deformity is assessed with and without weight-bearing.

The 1st MTP joint is assessed for reducibility of deformity, range of motion, crepitus, and pain with motion. The hallux should be reduced to a corrected position and put through a range of motion in the sagittal plane to assess joint congruity. A joint that is concentric and spherical will typically reduce better and have a greater range of motion than one that is squared or not concentric.

The lesser MTP joints are evaluated for synovitis, range of motion, and stability. The skin is carefully examined for plantar callosities suggestive of transfer lesions, bursitis, and erosions. A careful neurovascular examination is conducted to assess vascular status and the presence of interdigital neuralgias.

30.8 Imaging

A weight-bearing foot series should be obtained to assess forefoot alignment, including the presence of lesser toe deformity, and evaluated for degenerative changes at the IP, MTP, and MTC joints. A weight-bearing AP radiograph assess:

- HVA
- IMA
- Distal metatarsal articular angle (DMAA)
- Hallux valgus interphalangeal (HVIP) angle
- MTP joint congruency
- Sesamoid position
- Degree of metatarsus adductus

This evaluation allows for classification and preoperative planning.

The lateral radiograph should be assessed for plantar gapping at the 1st MTC joint and dorsal translation of the 1st MT relative to the cuneiform indicative of instability.

30.9 Conservative Treatment

Hallux valgus in most patients can be treated with conservative management; however, by the time patients come to a specialist, most have tried and exhausted many of these measures.

- Roomier foot wear with soft leather uppers and/or a wider toebox can supply relief from impingement on the medial eminence and lesser toe prominences.
- Shoes can be further modified by an orthotist, stretching regions where the shoe causes irritation.
- Some patients experience relief from specific hallux valgus night splints, pads, toe spacers, and/or posts.



- Custom orthotics may help by correcting associating conditions such as pes planus, flexible flatfoot deformity, and ligamentous laxity.

Although orthotics cannot improve the deformity, they may provide some short term relief and delay the need for surgery.¹⁴

30.10 Operative Treatment

The goals of hallux valgus surgery are not only to correct the valgus angulation and pronation of the 1st MTP, but also to narrow the forefoot by resecting the medial eminence and/or correcting the IMA. Other surgical goals are to re-establish

- Normal weight-bearing status of the 1st ray
- Congruency of the MTP joint
- Congruency and relationship of the metatarsal head-sesamoid joint

Just as there is a varying spectrum of pathology, there are various surgical techniques to address this pathology. The simplest pathology is a ***congruent joint with mild or moderate deformity***, which can be treated with a medial eminence resection, proximal phalangeal osteotomy, distal soft tissue reconstruction (DSTR), or any combination of the three. A medial eminence resection, or Silver procedure, is generally used in conjunction with other procedures and involves a sagittal saw cut in line with the medial border of the metatarsal, starting just medial to the sagittal sulcus. This procedure does not correct abnormalities of HVA or IMA and is prone to recurrence when used in isolation; overresection of the medial eminence can lead to hallux varus.

Hallux interphalangeus, as characterized by a high HVIP angle, can be addressed with an Akin osteotomy, a closing medial wedge proximal phalangeal osteotomy. Usually fixed with a single Kirschner wire or screw, the Akin may be all that is needed in a mild deformity with a congruent 1st MTP. More often, the Akin is used adjunctively when there is a component of interphalangeus.

A DSTR or modified McBride procedure involves a lateral release as well as a medial capsulorrhaphy after the medial eminence has been resected. The extent of lateral release depends on whether the deformity is reducible. A full lateral release involves release of the metatarsal-sesamoid ligament and insertion of the adductor hallucis on the fibular sesamoid, transverse metatarsal ligament, and, finally, the lateral capsule. After the medial eminence has been resected, blunt dissection is carried out superficial to the medial capsule down to the sesamoid to avoid damaging the medial plantar hallucal nerve, and a dorsally based wedge of capsule is excised. It is important to realize that traditionally the McBride included a lateral sesamoidectomy, which increased the risk of hallux varus. The capsular repair is conducted with 2-0 nonresorbable suture during a layered closure.

Mild deformity with an incongruent joint can be addressed with a distal metatarsal osteotomy such as a Chevron osteotomy combined with a DSTR and medial eminence resection. A distally oriented V-shaped osteotomy, the distal portion of the metatarsal is translated laterally up to 50% of the width of the bone to narrow the forefoot. Described with no fixation or with screws or Kirschner wires for fixation, the Chevron is a fairly stable osteotomy that can be used in isolation or in combination with the Akin when there is a component of interphalangeus.



When the DMAA is high, a biplanar osteotomy should be considered. The biplanar Chevron involves taking a laterally based wedge at one or both of the limbs of the osteotomy to allow both lateral translation and internal rotation of the distal piece to reduce the DMAA.¹⁰ Combining a Chevron osteotomy with a lateral release improves the amount of obtainable correction; however, with the distal metatarsal blood flow already decreased approximately 45% by the medial capsular release, the lateral release further decreases the vascularity of the distal metatarsal⁸. Although some studies describe radiographic changes in the metatarsal head following this surgery, no studies describe symptomatic avascular necrosis^{9,12}.

Moderate hallux valgus requires a more proximal metatarsal osteotomy to correct the IMA at the actual apex of deformity. These proximal osteotomies are used in combination with a DSTR. The scarf osteotomy is a midshaft z-cut osteotomy described by Charles Gudas in 1984 that allows lateral translation of the distal metatarsal and with some modification of the cuts can allow biplanar correction.⁷ Although this is a stable and versatile osteotomy, there is a high rate of complication, with one series reporting 35% troughing (dorsal migration with potential for supination of pronation malunion and functional unloading of the first ray) in addition to 30% rotational malunion and 25% recurrence.¹

Other proximal osteotomies used for moderate to severe hallux valgus include the proximal crescentic, proximal chevron, proximal opening wedge, lateral closing wedge, and oblique osteotomies.

- The **proximal crescentic osteotomy** is conducted with a crescentic blade and is technically demanding. Although some length is lost with the curf of the blade, the congruent osteotomy can be used to rotate the 1st ray to the desired IMA. There is a significant risk of dorsiflexion malunion of the 1st ray, although the addition of two Kirschner wires provides more stability.
- The **proximal chevron osteotomy** involves lateral translation as well as a medial opening wedge to correct the IMA. The osteotomy has a distally directed apex and stable surface area that allows faster healing time and resists the dorsal migration seen with proximal crescentic osteotomies⁶.
- The **proximal opening wedge osteotomy** has become more popular as fixation hardware has improved. As this osteotomy at least maintains length and some literature describes lengthening of the 1st metatarsal,¹¹ this method should be considered in cases of 2nd MTP overload and moderate to severe hallux valgus or in cases of previous osteotomy and 1st metatarsal shortening. The low-profile wedge plate provides a consistent and stable construct; however, it is the experience of the principle author (LCS) that using more than a 5-mm wedge can lead to stiffness and overload of the 1st MTP. It is also important to evaluate the DMAA and consider a distal closing wedge osteotomy if correction of the IMA produces an incongruous joint.
- The **lateral closing wedge osteotomy** is conducted through a dorsal incision and is technically demanding. Although a long-term study by Trnka et al reported 85% good to excellent functional results, the incidence of hallux varus (27%), dorsal malunion (25%), metatarsal shortening (average 5 mm), and resultant transfer metatarsalgia (25%) makes this a less desirable option than other proximal osteotomies.¹⁵
- **Oblique osteotomies**, including the Mau and Ludloff, provide correction of the IMA and a broad surface area for healing and stability. In a biomechanical study of six different osteotomies, the Mau osteotomy was the most stable and significantly more stable than the Ludloff osteotomy;¹⁶ however, the axis of rotation is more distal in the Mau than the Ludloff, thus providing less correction for the degree of rotation.



All of these proximal osteotomies require medial eminence resection (the bone of which can be used at the osteotomy site) and medial capsular plication; excessive lateral release is associated with hallux varus¹³ and therefore care should be taken in assessing and modifying the soft tissue balance.

Severe hallux valgus can be treated with proximal metatarsal osteotomies, but sometimes requires fusion of the 1st MTP joint or a modified Lapidus procedure. Fusion of the 1st MTP is especially considered in cases of failed hallux valgus surgery, advanced arthrosis of the 1st MTP, neuromuscular disorders, and rheumatoid arthritis. Fusion of the MTP converts the deforming force of the adductor hallucis into a dynamic stabilizer, thereby narrowing the IMA. In a study by Coughlin et al with a minimum of 2 year follow-up, patients reported a high degree of satisfaction and ability to wear conventional footwear, although there was a 14% nonunion rate.⁴

A modified Lapidus procedure is a fusion of the 1st TMC joint with a lateral and plantar based proximal wedge to allow narrowing of the IMA. This should be considered in patients with 1st TMC hypermobility, instability, or arthrosis or in those who have a previous failed hallux valgus surgery, but only if there is adequate range of motion of the 1st MTP exists. A Lapidus can also be a good option for treating the adolescent bunion if the epiphyses are closed.

After medial eminence resection and release of the adductor hallucis, the 1st TMC joint is exposed, denuded of cartilage, and the subchondral bone is perforated. With this aggressive preparation of the joint surface, it is not necessary to resect an actual wedge of bone to obtain correction of the IMA. If incomplete correction of the IMA persists, it is most likely due to incomplete debridement of the joint.²

A prospective cohort study of 91 patients treated with a modified Lapidus procedure for moderate to severe hallux valgus revealed a very stable correction of the HVA when fusion occurred, However, 8% of patients had a nonunion that required revision and 9% require removal of symptomatic hardware. Although a modified Lapidus procedure is a good salvage procedure, it is contraindicated when there is excessive 1st metatarsal shortening from a previous procedure (> 2 cm) and patients who smoke should be cautioned about an increased risk of nonunion.³

Regardless of the degree of deformity severity or the operative intervention chosen, a frank discussion of the risks and benefits of surgery must be undertaken. It is also important to emphasize the amount of time it takes for full recovery. Although rehabilitation varies from patient to patient, on average patients take up to 1 year to be fully recovered. When patients have this expectation set before surgery, the postoperative experience is more likely to match their experience.

30.11 References

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