

HALLUX EXTENSUS

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Hallux extensus deformity describes a dorsal displacement or subluxation of the hallux at the metatarsophalangeal joint. Historically this condition has been termed a floating toe, ski jump toe, cocked hallux and hitchhiker's toe. The underlying cause is any condition that gives the extensor tendons an advantage over the flexor tendons. This sagittal plane deformity can be an annoying and potential disabling problem characterized by persistent extension of the first metatarsophalangeal joint. Hallux extensus can be accompanied by adaptive plantarflexion deformity at the hallux interphalangeal joint, (hallux malleus). Chronic sesamoiditis can also result from increased retrograde plantar pressure. Adaptive degenerative changes including arthrosis is long-term sequelae.

Various causes of hallux extensus have been previously attributed to primarily neurologic causes, specifically, idiopathic pes cavus, neuromuscular imbalance following a cerebrovascular accident, post neuromuscular disease as in Charcot Marie Tooth disease, sciatic or peroneal palsy with "drop foot," prolonged cast immobilization, injury to the plantar plate/sesamoid apparatus, dorsal capsular adhesions, and EHL contracture following surgery.¹

Hallux extensus can alternatively be caused by any surgical procedure for hallux valgus that excessively plantarflexes or shortens the first metatarsal (Figures 1A, 1B). This structural change favors the extensor tendons such that they may overpower the plantar structures and enhance dorsiflexory excursion. This may actually be desired in some hallux limitus surgery. However, a postoperative, nonpurchasing hallux may very well represent a postoperative complication known as iatrogenic hallux extensus (Figures 2A, 2B).

A cocked-up toe following a Keller arthroplasty is another example of a postoperative hallux malleus.



Figure 1A.

Refinements in technique for hallux valgus surgery over the last 25 years have included precise biplanar and triplanar first metatarsal osteotomies that when performed correctly will address deformities in multiple planes. However poor technical execution or lack of understanding of the spatial orientation of the resulting first metatarsal position may result in an unacceptable postoperative result. It is the author's opinion that due to a lack of conceptual understanding first metatarsal osteotomies that are excessively plantarflexed and shortened are causing a rising number of both postoperative hallux extensus as well as sub-second metatarsal head syndrome (Figure 3).

SURGICAL IMPLICATIONS

The use of an axis guide to create a shortening and plantarflexory distal metaphyseal osteotomy has become widely employed in the surgical treatment for hallux valgus. The orientation for this osteotomy is primarily used in cases of a relatively long first metatarsal compared to the second metatarsal and based on the premise that



Figure 1B.



Figure 2A.

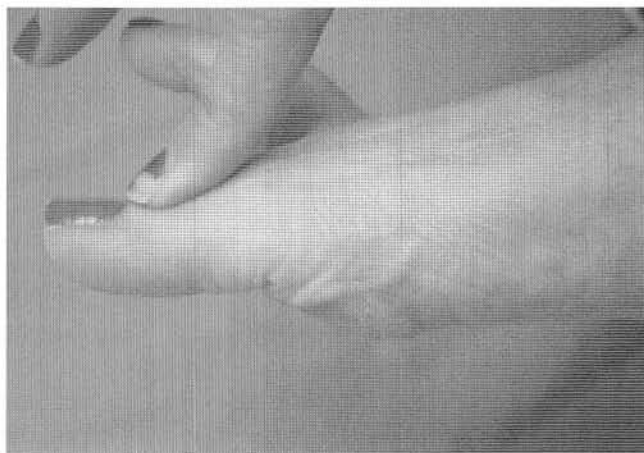


Figure 2B.



Figure 3.

plantarflexion of the capital fragment will compensate for the sacrificed metatarsal length. It is generally agreed that first metatarsal protrusion is associated with a high incidence of hallux valgus.² The plantar flexion component serves to compensate for the loss of length and ensure a relatively normal weightbearing parabola while decompressing the joint.

However, when a shortening and plantarflexory osteotomy is performed on a metatarsal that is already shorter than the second metatarsal complications can and

do occur. Approximately 1-2 mm of additional shortening occur from the surgical osteotomy alone. Impaction of the medial cortex can account for an additional loss of 2-3 mm. The osteotomy is quite unstable and may be difficult to fixate in the preferred position.

If the conditions are right an excessively shortened, plantarflexed first ray may cause forefoot dysfunction which may include hallux extensus, sub-second metatarsal head syndrome, lesser metatarsal stress fractures or a contracted adducted second toe, (lesser toes).

Cain and Boyd³ used trigonometric calculations to define the limits of the biplaner translation of the capital fragment using the Austin osteotomy. They postulated those patients with hallux abducto valgus who present with coexisting functional metatarsus primus elevatus and functional hallux limitus would benefit from an osteotomy that both shortens and plantarflexes the capital fragment. The net effect is increased dorsal excursion of the joint caused by eliminating the functional metatarsus elevatus and relaxation of the transarticular soft tissues. The defined limit of plantarflexory displacement was found to be (>7mm) when the axis guide was placed at 45 degrees.

The art of hallux valgus surgery entails why, when and how much manipulation of the reconstructed position of the first metatarsal head should be performed in order maintain a congruous joint with a near full range of motion. Surgeons have a great deal of variability in three planes to position the first metatarsal head. The question is how much shortening and plantarflexion, if any, should be performed on any bunion to ensure adequate function of the entire forefoot.

The following parameters should all be considered to help in the preoperative evaluation:

1. Overall foot architecture: high arch, low arch, neutral, rigid, semi-rigid, semi-flexible, flexible
2. Forefoot to rearfoot relationship: varus, valgus
3. Presence of equinus, ankle, subtalar motion
4. First ray hypermobility: talonavicular, naviculocuneiform, metatarsocuneiform joints⁴
5. First metatarsophalangeal joint motion
6. Skin lesions: sub-two tyloma, porokeratoma, spin callous, plantar lesion patterns
7. Radiographic findings: radiographic angles, metatarsal parabola, first metatarsus elevatus

GUIDELINES

The preoperative evaluation is key to the “fine tuning” that every hallux valgus deformity requires. No two bunion deformities are identical. There is no one universal procedure for hallux valgus correction. No absolute guidelines could ever exist however several observations may hold true the vast majority of the time.

1. A first metatarsal that is longer than a second metatarsal can be shortened so that it is shorter than the second metatarsal with some plantarflexion to compensate for the loss of length
2. Minimal shortening and plantarflexion should be performed on a rigid or semi-rigid cavus foot.
3. Shortening occurs via the osteotomy and with impaction
4. A minimal amount of shortening, if any, should be performed on a first metatarsal that is shorter than the second metatarsal.
5. A significant metatarsus primus elevatus can be addressed with maximum plantarflexion and minimal shortening.
6. A sub-second metatarsal head syndrome/lesion will necessitate a significant plantarflexory osteotomy with minimal shortening.
7. Concomitant hallux limitus warrants a modest shortening and plantarflexory osteotomy.
8. An overly shortened and plantarflexed first metatarsal can lead to hallux extensus and/or a sub-second metatarsal head syndrome.

TREATMENT

Subtle hallux extensus may present with increased dorsiflexion and decreased plantarflexion occurring at the first metatarsophalangeal joint. This is not usually problematic if the hallux is purchasing and there is no sesamoiditis. Younger athletic patients may express a lack of first metatarsophalangeal joint propulsiveness. Aggressive physical therapy is indicated. Conservative treatment consists of accommodative orthotics with properly placed cutouts or pockets. Extra-depth footwear with a deep toe box is recommended for moderate cases. Surgical treatment consists primarily of soft tissue releases, extensor hood releases and capsulotomies for dorsal contractures. An Extensor hallucis longus tendon lengthening is employed for a contracted tendon. Significant osseous over correction is treated with a corrective reverse Austin or an asymmetric “V” distal metaphyseal osteotomy.⁵ Severe cases warrant a dorsiflexory wedge osteotomy that may shorten the metatarsal even more or a sagittal plane corrective osteotomy. Painful, limited joint function with arthrosis mandates arthrodesis in a neutral position.

SUMMARY

Hallux extensus can occur from any change in the structure of the first metatarsal that favors the extensor Tendons so they can overpower the plantar structures. One of the main causes of iatrogenic hallux extensus is excessive shortening and plantarflexion of the capital fragment in hallux valgus surgery. Intentionally shortening and plantarflexing a first metatarsal, which is already short, may cause a hallux extensus and a sub-second metatarsal syndrome. Further research that utilizes pre and postoperative weightbearing pedographs is promising.

REFERENCES

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