Reducing Complications Associated With Surgical Correction of Forefoot Deformities

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Complications of surgical correction of forefoot deformities can be reduced through the use of proper technique during the correction and through proper immobilization and protection following the procedure. Manfred Thomas, MD, Hessingpark-Clinic, Augsburg, Germany, discussed potential complications associated with hallux valgus (HV) surgery. The goal of HV surgery is to restore normal weight-bearing mechanism and gain and functional range of motion and to correct deformities. However, there are potential complications that can occur following HV surgery, involving soft tissue, bone, and hardware. Soft tissue complications include impaired wound healing, infection, nerve damage, arthrofibrosis, transsection of flexor hallucis longus, complex regional pain syndrome, and recurrence of HV. Bone- and hardware-associated complications include hardware failure, malunion resulting in pseudoarthrosis, over or undercorrection, failure in length ratio, and head necrosis.

There are several methods for HV surgery, and some studies have sought to determine if there are different rates of complications among them. In a multicenter study [Lagaay PM et al. *J Foot Ankle Surg.* 2008] of >600 patients, the rate of revision surgery was similar among Chevron-Austin osteotomy (5.56%), Lapidus arthrodesis (8.82%), and closing base wedge osteotomy (8.19%).

A study [Hammel E et al. *Rev Chir Orthop Reparatrice Appar Mot.* 2007] of 475 feet that underwent first metatarsal scarf osteotomy and first phalanx osteotomy found that the most common complication was first metatarsophalangeal (MTP) joint stiffness, which improved over time; at 6 weeks, the rate was 41.7% and at 4 months, 5.7%. In addition, delayed wound healing occurred in 5.7%, secondary dislocation in 1%, complex regional pain syndrome in 1.3%, and infection in <1%. A meta-analysis of >62 studies [Schuh R et al. *Int Orthop.* 2013] found that the overall complication rate of angular correction of the proximal first metatarsal osteotomies was 18.7%, with the most common complications being hallux varus (4.3%), recurrence (3.5%), and dorsiflexion malunion (2.5%).

Preliminary results of a study with >1200 patients evaluated the complication rates of 6 methods. For Chevron-Austin osteotomy, hallux varus occurred in 0.5% of patients, head necrosis in 0.7%, and reoperation in 0.9%. A common complication of scarf osteotomy was hallux varus, which occurred in 1.9% of patients. Hardware failure was common in proximal metatarsal osteotomy (6.1%) and proximal plus distal metatarsal osteotomy (3.3%); delayed wound healing (2%), head necrosis (1.2%), hallux varus (2.4%), and reoperation (2.9%) occurred in patients who underwent the latter. Hardware failure, delayed wound healing, hallux varus, and reoperation also occurred with the tarsometatarsal fusion method at rates of 2.1%, 1.2%, 1.2%, and 1.2%, respectively.

Ryuzo Okuda, MD, Shimizu Hospital, Kyoto, Japan, outlined strategies to manage and prevent the complications associated with HV surgery. A common cause of HV recurrence is undercorrection of the HV angle or the intermetatarsal angle. To prevent this, one study [Okuda R et al. *J Orthop Sci.* 2011] found that correction of the HV and intermetatarsal angles resulted in ≤15° and <10°, respectively, which reduced the risk of recurrence over a mean follow-up period of 33 months. In addition, Prof Okuda noted that the distal metatarsal articular angle is important. Excessive resection of the medial eminence during the Chevron-Austin approach or excessive rotation of the distal fragment in the horizontal plane during the proximal osteotomy approach can lead to undercorrection.

Recurrence may also be a result of local anatomic features. The development of HV is associated with a round-shaped lateral edge of the first metatarsal head (round type), which is caused by a pronation position instead of the normal neutral position. In one study [Okuda R et al. *J Bone Joint Surg Am.* 2007], 78.3% of patients with HV had the round type of the first metatarsal head, whereas 18.3% with HV had an intermediate type and 3.3% had an angular type. Furthermore, recurrence is associated with the round type, with recurrence rates of 58% with round type versus 9.8% without it. Another anatomic variant is the position of the sesamoids such that patients with the medial sesamoid positioned at grade V to VII, according to the system described by Hardy and Clapham, were more likely to have HV [Okuda R et al. *J Bone Joint Surg Am.* 2009]. Patients with an incomplete reduction of the sesamoids were more likely to develop recurrence when compared with patients who did not have displacement (OR, 10.0; 95% CI, 2.75 to 36.33). Importantly, if pronation of the first metatarsal is not

corrected, it can cause displacement of the sesamoids regardless of sesamoid reduction.

Michael J. Coughlin, MD, Saint Alphonsus Regional Medical Center, Boise, Idaho, USA, discussed treatment of lesser toe deformities. Dr Coughlin noted that, in his practice, osteotomy was frequently not sufficient to correct the MTP joint. Plantar plate tears were commonly present in patients with hammer toes [Cooper MT, Coughlin MJ. *Foot Ankle Int.* 2011]; therefore, Dr Coughlin recommended that the MTP and the proximal interphalangeal joint be treated. Prior approaches did not treat the underlying plantar plate tear, and newer strategies still require improvement.

The use of a single Kirschner wire (K-wire) to fuse the toe is not effective. One study [Coughlin MJ et al. *Foot Ankle Int.* 2000] found that 15 of 17 patients were dissatisfied because of malalignment over a follow-up period of 5 years. As a result, Dr Coughlin noted that single K-wires must be removed early, around 3 to 5 weeks postoperation. Alternatively, 2 K-wires should be used, which can help maintain correct alignment and decrease rotation, although removal still occurred around 4 weeks postoperation. Other options include the use of screws, which can be difficult to break if reoperation is required, but one prospective study found no recurrence of deformities [Catena F et al. *Foot Ankle Int.* 2014]. Dr Coughlin discussed another type of implant with a fibrous union, which, as thin metal, is easier to cut and remove if needed. A K-wire can still be used in addition to the fibrous union: it has rotational stability, and it does not violate the distal interphalangeal joint.

For the surgical treatment of mallet toes, 2 K-wires can achieve overall good satisfaction; however, early removal of the wires and recurrence remain an issue. Instead, screw implants may offer a better alternative.

Caio A. Nery, MD, Escola Paulista de Medicina, São Paulo, Brazil, discussed complications and solutions to MTP joint instability. The MTP joint is stabilized by multiple muscles and ligaments; however, the plantar plate is particularly important. A clinical staging system for MTP joint instability has been developed, which is valuable for determining the best course of management for these patients (Table 1) [Coughlin MJ et al. *Phys Sportsmed.* 2011]. In addition, an anatomic grading system, which is associated with the clinical staging system, has improved knowledge of the underlying pathology of MTP joint instability [Nery C et al. *Foot Ankle Int.* 2012].

Treatment of clinical/anatomic grade II to III MTP joint instability involves the direct repair of the plantar plate plus the Weil osteotomy and capsular or collateral reefing [Nery C et al. *Foot Ankle Int.* 2014]. Following treatment, the foot should remain in taping and bandages for 6 weeks, followed by postoperative walking shoes for an additional 6 weeks, then a rehabilitation program to regain range of motion. To evaluate this method, Dr Nery and colleagues evaluated patients with lesser MTP joint instability for a mean follow-up time of 2 years 9 months. Among treated feet, grade III was the most common plantar plate lesion, and the second toe was the most frequently affected. The complication rate was 12% of 136 operated joints. Complications included misdiagnosis, residual plantar forefoot pain, transfer metatarsalgia, intrinsic muscle weakness, MTP joint stiffness, and dorsal contracture.

A recent study [Nery C et al. *J Surg Orthop Adv.* 2014] found common signs among patients with plantar plate ruptures that may better identify those with this underlying issue: toe supination, varus valgus toe deviation, loss of ground touch, crossover toe, MTP drawer test, toe elevation, and loss of toe purchase.

In conclusion, there are several potential complications associated with the surgical correction of HV, MTP joint instability, and lesser toe deformities. However, newer techniques, when carefully performed, can reduce these complications, as can proper positioning and protection of the foot after the procedure.

Table 1. Clinical Staging System for MTP Joint Instability

Grade	Alignment	Physical Examination
0	MTP joint alignment; prodromal phase with pain but no deformity	MTP joint pain; thickening or swelling of the MTP joint; reduced toe purchase; negative drawer
1	Mild malalignment at MTP joint; widening of web space, medial deviation	MTP joint pain; swelling of MTP joint; loss of toe purchase; mild positive drawer (< 50% subluxable)
2	Moderate malalignment; medial, lateral, dorsal, or dorsomedial deformity; hyperextension of toe	MTP joint pain; reduced swelling; no toe purchase; moderate positive drawer (> 50% subluxable)
3	Severe malalignment; dorsal or dorsomedial deformity; second toe can overlap the hallux; may have flexible hammertoe	Joint and toe pain; little swelling; no toe purchase; very positive drawer (dislocatable MTP joint); flexible hammertoe
4	Dorsomedial or dorsal dislocation; severe deformity with dislocation; fixed hammertoe	Joint and toe pain; little or no swelling; no toe purchase; dislocated MTP joint; fixed hammertoe

MTP, metatarsophalangeal.

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