



Hammertoes and Claw Toes: Primary and Revision

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Abbreviations

DIPJ	Distal interphalangeal joint
EDL	Extensor digitorum longus
FDL	Flexor digitorum longus
MTP	Metatarsophalangeal joint
PIPJ	Proximal interphalangeal joint

5.1 Introduction

Hammertoe and claw toe deformities are common problems treated by all foot and ankle surgeons. Hammertoes present with dorsiflexion at the MTP, plantarflexion at the proximal interphalangeal joint (PIPJ), and extension at the distal interphalangeal joint (DIPJ). Claw toes present with dorsiflexion at the MTP and plantarflexion at both the PIPJ and DIPJ. Hammertoes and claw toes are caused by an imbalance between the extrinsic and intrinsic pedal musculature that can further lead to instability of the less MTPs. Hallux valgus, equinus, and neuropathic disorders lead to increased forefoot loads that cause

biomechanical compensation of the digits and MTPs. Subsequent plantar forefoot pain or metatarsalgia can manifest from plantar plate tearing; attenuation or complete rupture can occur due to these deformities, further complicating treatment plans. Hammertoes can be associated with a pes planus foot type due to excessive flexor stabilization from the long flexors firing for a longer period which overpower the interosseous muscles and can lead to 4th and 5th toe adductovarus rotation. Claw toes are typically associated in patients' cavus foot type or neuromuscular disease with extensor overcompensation secondary to a weak posterior complex musculature in which the extensor gains advantage over the intrinsic lumbricals.

5.2 Case Example

A 50-year-old female with main complaints of a 2nd digital hammer toe with plantar forefoot-associated pain at the 2nd metatarsal head. She has a hammertoe deformity with concerns for a plantar plate tear. The patient has a reducible toe deformity, and a negative Lachman's test of the 2nd MTP without a hallux valgus or planus deformity. Plain film radiographs reveal a digit with elevation seen on the lateral view and a "gun barrel" sign on anteroposterior (AP) viewing. There is no angular deformity present, but there is a concomitant elongated 2nd metatarsal. The

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patient has exhausted nonoperative treatments including shoe gear change, custom orthotics, and physical therapy. Magnetic resonance imaging demonstrates no tear of the plantar plate and no neuroma present in the 3rd interspace.

5.3 Presentation/Diagnosis

Digital hammertoe and claw toe deformities can affect patients of all ages and level of activity. Patients will typically present with complaints of toe pain from either dorsal or distal calluses that form secondary to shear forces and repetition friction in shoe gear. Additionally, patient with neurological or spastic disorders may have difficulty wearing certain bracing or shoe gear due to the severe deformity. As previously noted, hammertoes and claw toes often present with other associated foot deformities including equinus contracture, metatarsalgia, and bunion deformity. Flexor stabilization is the most common type of mechanism that results in a hammertoe which can be evaluated and seen in patients as the flexor digitorum longus (FDL) muscle overpowers interosseous muscles. During a gait analysis, compensation of the FDL muscle attempting to supinate the foot can ultimately lead to this deformity. The least common mechanism is flexor substitution, a compensation likely due to a weak triceps surae muscle group. The FDL muscle tries to compensate for the weak triceps surae and as a result, overpowers the interossei muscles. This may be seen clinically with a chronic Achilles tendon tear or overlengthened Achilles tendon from a previous surgery. As noted prior, extensor substitution is seen in patients with a pes cavus foot type or neuromuscular disease which often results in claw toes. This deformity is seen during the swing phase of gait, and patients typically have some degree of equinus deformity.

All hammertoe and claw toe deformities generally follow a three-stage pathology from reducible to semirigid to a final rigid state. A thorough exam should include a history or family history of a neuromuscular disease, gait analysis, and complete lower extremity exam. Predislocation

syndrome or plantar plate injury should also be excluded, especially when a hallux valgus deformity is present. An intermetatarsal neuroma, inflamed bursa, or capsulitis must also be ruled out as a contributing factor in any globalized forefoot pathology.

Preoperative labs should be considered to evaluate nutritional status (prealbumin, albumin), diabetic control (if applicable), and electrolyte balance (basic metabolic panel).

Tobacco use should be discontinued prior to any surgical intervention as this can increase the risk of complications in foot and ankle surgery (Bettin [1]). Hammertoes and claw toe deformities can be treated by either arthroplasty or arthrodesis of the affected joints. For arthrodesis, your choice of equipment can vary based on adjunctive procedures and cosmesis. These choices are part of the preoperative planning stage, and one must have all needed instruments in the room.

5.3.1 Arthroplasty

Digital arthroplasty is the resection of the proximal phalanx head in isolation and can indicate semirigid or rigid hammertoes with no other associated varus/valgus angulation or contracture at the MTP. Arthroplasties of the DIPJ and PIPJ shorten the length of the digit and weaken the pull of the flexor complexes which reduce further hammering (Boberg [2]). Arthroplasties are less definitive than an arthrodesis and best for isolated digit deformities and can provide symptomatic relief. One common use for arthroplasty has been for the treatment of the adductovarus 5th digit deformity.

5.3.2 Arthrodesis

Arthrodesis of either the PIPJ or DIPJ represents a more definitive procedure with longer lasting results. Whether a bony union or a fibrous stable union, it offers more stability and less chance of recurrence. Additionally, eliminating the deforming force of the digit may prevent further issues at the MTPJ level such as plantar plate injury or

metatarsalgia. It is effective in both extensor- and flexor-based deformities and preferred when multiple digits need to be stabilized in the forefoot (Boberg).

5.3.3 Flexor Tendon Transfer

A seldom used procedure in modern surgical practice, it can afford added stabilization without the need for internal fixation of the digit. Transferring power of the flexor dorsally creates a straight lever arm at the MTP.

5.3.4 Flexor Tenotomy

A flexor tenotomy is best utilized for flexible flexion deformities at either the DIPJ or PIPJ level. If a claw toe deformity is present, the FDL should be released at the DIPJ; if a hammertoe is present, releasing both long and short flexors at the PIPJ will reduce the deformity.

5.3.5 Extensor Tenotomy

This technique is used for moderate to severe extension deformities of the lesser digits. The release is generally completed proximal to the MTPJ to reduce the contracture prior to the joint level. It can provide relief for flexible hammertoe or in conjunction with other digital surgical correction.

5.3.6 A Note on Local Skin Plasty

Z, V–Y, or rotational skin plasty techniques can be used both in the primary setting or revision if concerns for skin contracture are present when treating a multilevel deformity. Most commonly, a “derotational arthroplasty” can be used on adductovarus 5th digit deformities using an elliptical incision in a distal, medial to proximal lateral direction. Subsequent pinning of the digit can be done for added stabilization but has been described without this addition successfully.

5.3.7 A Note on Plantar Plate Pathology

Multiplanar digital deformities or plantar plate treatments will not be addressed here. Treatment options and discussion can be found in Chap. 6.

5.4 Imaging

X-rays AP and lateral plain film radiographs can be used to assess evident contractures by noting a “gun barrel” sign which is associated with a hammertoe deformity as the viewer is seeing the medullary canal of the proximal phalanx. This is similar in claw toe deformities as one can look down the central axis of the distal phalanx. A lateral view is helpful in evaluating the elevation of the digit which may indicate plantar plate insufficiency or associated pathologies.

MRI A magnetic resonance imaging series of the forefoot can be useful to evaluate the plantar plate as well as rule out any soft tissue pathology or interdigital neuromas that may be also present. Additionally, this form of advanced imagining can help detect other osseous pathology including cartilage defects or the presence of the avascular necrosis of the 2nd metatarsal head (most common).

Noninvasive vascular studies Noninvasive arterial studies may be warranted based on patient comorbidities including diabetes mellitus, peripheral vascular disease, history of vasculopathies, or distal peripheral neuropathy. Surgical intervention on digits in immunocompromised or fragile hosts for ulcer prevention may require this full work-up for the healing assessment.

5.4.1 Operating Room Setup

The patient is brought into the operative room theatre and placed on the operating table. General anesthesia is then performed via LMA or general intubation. A thigh tourniquet should be applied to the operative extremity. A sequential compression device is placed on the nonoperative extremity. All

appropriate equipment should be present. An ipsilateral hip “bump” can be valuable as many patients are externally rotated in the lower extremity. Typically, an ortho minor or small procedure tray has all the equipment needed for the procedure. A No. 15 blade is used to incise the skin in an elliptical or liner fashion over the proximal head allowing access to proximal phalanx for resection, and a curette and rongeur are used to resect the cartilage off the base of the middle phalanx.

5.4.2 Equipment

Hammertoes

1. A 0.062” K-wire is used in a retrograde fashion through the end of the digit to fixate the PIPJ fusion.
2. Hammer toe implant of the surgeon’s choice.

Claw toes

1. 2.5 mm or 3.0 mm fully threaded cannulated screw for intramedullary fixation of the surgeon’s choice. It has been the experience at our institution that this helps to prevent recurrence seen in some patients with claw toe deformities, especially when the etiology is neurogenic in nature.

tal saw is then used to remove the head of the proximal phalanx or middle phalanx. If only performing an arthroplasty, the procedure will end here with layer closure and application of sterile dressing.

If performing an arthrodesis, a rongeur and curette is used to resect the cartilage on the respective bases. The fixation for hammertoes includes a 0.062” K-wire that is placed in a retrograde fashion through the digit distally and then inserting the wire into the proximal phalanx. Prior to advancing the K-wire into the associated metatarsal, the digit is generally positioned in a slightly plantarflexed position. If using an implant device, implantation should occur after the area is flushed with good retraction. Various implant systems exist and may contain 2 or 1 component implants that require slightly different compression techniques based on the technology. Appropriate planning and practice should be considered prior to use (Figs. 5.1 and 5.2).

5.5 Operative Technique

For both hammertoes and claw toes, the surgical technique is similar but can vary based on incisional placement and the materials used for fixation.

A 2–3 cm curvilinear incision is made dorsally over the MTP. Dissection is carried down to the extensor tendon, and a Z-lengthening can then be performed. A capsulotomy of the MTP is performed releasing the associated extensor contracture. Next a full thickness elliptical incision is then made dorsally over the PIPJ or DIPJ of the digit. Alternatively, a linear incision is made over the PIPJ or DIPJ, and the extensor tendon is reflected off the bone. (This may be best when preparing both joints to reduce dissection time.) The entire ellipse of skin with the associated extensor tendon is removed. A sagit-



Fig. 5.1 A 52-year-old neuropathic male with flexion contractures at the level of both the DIPJ and PIPJ treated with intramedullary fixation for dual arthrodesis. The patient is now 8 months post-op in normal shoe gear without complications. (Photo credit: G. Berlet MD)

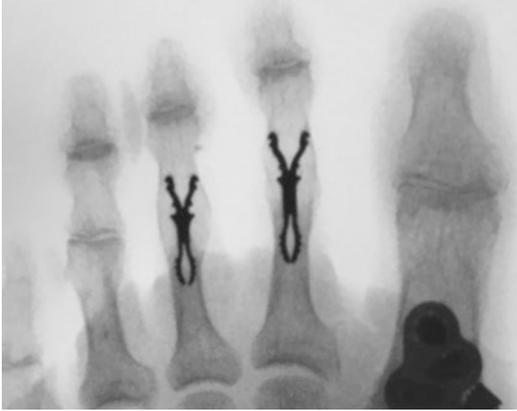


Fig. 5.2 A 60-year-old male s/p 2nd and 3rd digital PIPJ fusions approximately 7 years ago with good osseous union and stability



Fig. 5.4 A 42-year-old female with 2nd PIPJ fusion via an intramedullary screw not crossing the DIPJ. Concomitant metatarsal osteotomy and a modified Lapidus were also performed



Fig. 5.3 A 73-year-old male 2 weeks status post from a modified Lapidus bunionectomy with a 2nd digit PIPJ fusion, 2nd metatarsal Weil osteotomy, and direct plantar plate repair. (Photo credit: T. Philbin DO)

The fixation for claw toes consists of a 2.5 mm or 3.0 mm cannulated screw placed in a retrograde fashion. The guide wire for this screw type

is thinner and is not placed into the metatarsal to breakage. Intraoperative fluoroscopy is used in both AP and lateral viewing to determine optimal placement of the guide wire prior to measuring and pre-drilling. Finally the screw is inserted with good compression across both joints. The digits are instead splinted in a plantarflexed position using sterile 4 × 4 dressings. Closure consists of either 2-0 or 3-0 Vicryl for the deep layers and a 3-0 Monocryl running subcuticular technique or a 3-0 nylon in an interrupted horizontal technique. The tourniquet is let down prior to bandage application to assess for capillary refill. Patients are then placed in a well-padded posterior Jones splint postoperatively (Figs. 5.3 and 5.4).

5.6 Postoperative Protocol

1. All patients are placed into a posterior splint immediately postoperatively. They are seen 5–7 days after surgery, and the incision(s) are checked, and a new sterile dressing is applied.

2. If no other procedures were performed that require the patient to remain non-weight-bearing, then patients are placed into a pneumatic cam walking boot and are advised that they can bear weight as tolerated in the boot. They are required to wear the boot until the K-wires are removed and/or fusion is seen radiographically which is typically 4–6 weeks. At that time, if K-wires were placed, they are pulled, and patients can begin weight-bearing in a regular shoe as tolerated.
3. Radiographs are obtained at the first postoperative visit and at 4 and 8 weeks, 6 months, and 1 year.

Additional Callout/Pearls and Pitfalls for Resident/Fellow Readers

- Use a thigh tourniquet to prevent artificial buckling of the digits as when using an ankle tourniquet.
- When using a 0.062" K-wire for fixation, create a pilot hole down the center in the proximal phalanx prior to driving the wire in antegrade fashion out the distal phalanx. This allows more accurate

placement of the wire in the center aspect of the proximal phalanx when driving the wire back in a retrograde direction from the distal aspect of the digit.

- When correcting multiple digits, perform all the incisions and dissection at the same time. This allows for an assembly line type joint resection which is more efficient and reduces the surgical time.
- For claw toe correction, a 2.5 mm fully threaded cannulated screw is used in lieu of a 0.062" K-wire. This has been shown to decrease the rate of recurrence.

References

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2. Boberg J, Willis JL. Digital deformities: etiology, procedural selection and arthroplasty (Chap. 13). In: Banks AS, Downey MS, Martin DE, editors. *McGlamry's forefoot surgery*. Philadelphia: Wolters Kluwer Health; 2015.