Gradual Digital Lengthening with Autologous Bone Graft and External Fixation for Correction of Flail Toe in a Patient with Raynaud's Disease

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Iatrogenic flail toe is a complication of hammertoe surgery that occurs when an overaggressive resection of the proximal phalanx occurs. This can cause both functional and cosmetic concerns for the patient. We present a case report of the correction of a flail second toe in a patient with Raynaud's disease. The correction was achieved by means of gradual soft tissue lengthening with external fixation and an interposition autologous bone graft digital arthrodesis. After 5 months, this 2-stage procedure lengthened, stabilized, and restored the function of the toe. Level of Clinical Evidence: 4 (The Journal of Foot & Ankle Surgery 48(4):488–494, 2009)

Key Words: external fixation, ischemia, phalanx, vasoconstriction, vasospastic

Hammertoe correction is one of the most common procedures performed by foot and ankle surgeons. The various procedures used to correct hammertoe have relatively low complication rates. Complications that do occur include recurrence, infection, wound dehiscence, persistent swelling, vascular embarrassment, pseudarthrosis, nonunion, malunion, and destabilization of the digit.

Digital surgery can be complicated by Raynaud's disease, which is defined as episodic vasoconstriction of small, mainly digital, arteries of the extremities upon exposure to cold, prolonged vibration, or emotional stress not associated with other diseases such as the connective tissue disorders (1–3). Between vasospastic attacks, digital blood flow can be normal but often is reduced, especially when trophic changes are present (2). The affect of acute lengthening of digital arteries on patients with Raynaud's disease is unknown and theoretically risky.

Floating toe syndrome and flail toe are two different forms of digital instability. It is important to differentiate between these conditions, because they have different causes and thus different treatments. Floating toe syndrome was originally described by McGlamry (4) and is defined as a condition in which one or more toes fail to purchase the weight-bearing surface in stance or during walking (4). It occurs because of failure of the flexor mechanism to function effectively (4). Potential causes of floating toe include dislocated or disrupted flexor plate, elevated metatarsals, loss of internal osseous cubic content of the foot, scarring around the metatarsophalangeal joint (MTPJ), and the presence of a short metatarsal (5). Treatment solutions vary in accordance with the specific cause of the deformity in question. Flail toe, however, is defined as a digit that lacks stability and structural integrity. The cause of flail toe has been described as either excessive digital bone resection or overlengthening of the extensor and flexor tendons (6, 7). The involved toe is floppy and short and usually lacks motor control. It may or may not come into contact with the floor in the stance phase of gait (Figs 1 and 2).

The patient with flail toe often complains of pain from shoe irritation and cosmetic concerns. The distal end of the toe can catch on shoes or socks, and the toe can bend back on itself. Flail toe, we feel, has received only limited attention in the literature. Procedures used to treat flail toe generally attempt to lengthen and stabilize the toe. This can be accomplished through syndactylization to an adjacent toe (8, 9), implant arthroplasty (10), free autologous bone graft arthrodesis of the proximal interphalangeal joint (6, 7), or transposition of an osteocutaneous flap from the hallux to the second toe (11, 12). Amputation of the involved toe is also considered a treatment option in patients with unremitting pain (13), when other interventions have either failed to stabilize the symptomatic digit, and when other potentially corrective procedures are contraindicated. For instance, surgical syndactylization does

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Financial Disclosure: None reported.

Conflict of Interest: None reported.

1067-2516/09/4804-0015$36.00/0
doi:10.1053/j.jfas.2009.02.011

FIGURE 1 Clinical photograph of the patient's right foot at initial presentation after an overaggressive arthroplasty. Note that the second toe is deformed in the transverse plane and protrudes only slightly farther than the fifth.

not address the cosmetically short toe and usually does not provide complete stabilization of the digit. Moreover, implant arthroplasty can be difficult to perform in cases of flail toe due to the lack of bone substance, inadequate soft tissue coverage, and inability to provide adequate stability (7).

Mladick (14) described a technique in which a Z-lengthening of the skin and extensor tendons was performed, and a small piece of iliac bone graft was used to replace the defect created by complete excision of the proximal phalanges of a patient's fifth toes. Three years after that operation, it was reported that the patient walked without problems. In 1992, Mahan (6) described the use of autologous calcaneal bone to perform an interpositional arthrodesis of the proximal interphalangeal joint. The technique consisted of the following: 1) débridement of digital bone to create a flat surface, 2) determination of the graft size needed to restore the desired length and stability, 3) procurement of the bone graft from the superior aspect of the body of the ipsilateral calcaneus, 4) interposition of the graft between the digital bone ends, and 5) fixation with a retrograde Kirschner wire

FIGURE 2 Second toe is flail and has limited function.

(K-wire). In that report, the patient underwent bilateral second toe lengthening procedures and was pleased with the cosmetic and functional results. Later, Mahan et al (7) conducted a review of 22 such procedures in 13 patients and reported an overall success rate of 82%. They reported that complications had arisen in 3 patients, including 1 patient who experienced complete resorption of the graft and 2 who required additional surgical procedures for nonunion and malunion of the toes.

Interestingly, Koshima et al (11) described a technique for correction of a flail second toe that developed after resection of osteomyelitis. The technique that they described involved a hemi pulp osteocutaneous island flap procured from the lateral one third of the distal phalanx of the hallux to reconstruct the adjacent second toe. As such, the flap was supplied by the lateral plantar neurovascular bundle of the hallux and was fixated with a pin. According to the authors, the main advantage of this particular technique is the transfer of blood supply with the bone and soft tissue. The major disadvantages, however, are technical difficulty, alteration of the normal appearance and structure of the hallux, and the fact that the procedure is only applicable to reconstruction of the second toe because of the limited mobility of the island flap.

In this report, we present a 2-stage approach to reconstruction of a flail toe by means of gradual soft tissue lengthening with the use of external fixation, followed by digital arthrodesis with the use of an autologous interpositional bone graft. To our knowledge, this particular combination of procedures has not been previously described for the reconstruction of a symptomatic flail toe.

Case Report

A 34-year-old white female presented with a chief complaint of a short, deformed, and painful right second