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Digital lengthening with external fixation for shortening and misalignment after hallux valgus surgery

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Summary

Shortening and misalignment can be complications of corrective techniques used for hallux valgus when overaggressive bone resection is performed, thus resulting in a toe that lacks stability and function. This can cause functional and cosmetic concerns for the patient. We present a case of a patient with first shortened proximal phalanx and persistent extension of the first metatarsophalangeal joint corrected by gradual bone digital lengthening with external fixation. This lengthening procedure was safe and stable, and restored length and function of the toe.

Key words: hallux extensus, hallux valgus, digital lengthening, external fixation

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Conflict of interest
The Authors declare no conflict of interest

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Introduction

Shortening and misalignment of the first ray of the foot can represent serious complications in previous hallux valgus surgery. These sequelae are often very complex to treat and, if not properly corrected, can further aggravate leading to more severe complications.

From a biomechanical point of view, this shortening of the first ray, which can affect the proximal phalanx, first metatarsal, or both, causes critical alterations in the biomechanics of the foot with loss of weightbearing function resulting in overloading of the adjacent metatarsals and subsequent metatarsalgia ("transfer metatarsalgia") [1].

Shortening of first ray is more frequently caused by failure of surgical techniques that excessively resect the base of the proximal phalanx (such as Keller-type arthroplasty, Regnaud arthroplasty) or by failures of distal diaphyseal and metaphyseal osteotomies of the first metatarsal (such as Chevron osteotomy) caused by technical errors or avascular necrosis of first metatarsal head. Furthermore, other possible causes may be related to trauma, infections, or failed joint implant [1-3].

The main objectives in these cases are to normalize the length of first ray and digital formula, restore weightbearing function reducing metatarsal pain, allow normal gait and improve the aesthetic appearance of the forefoot to facilitate the use of common footwear.

Traditionally, first metatarsophalangeal joint (MTPJ) arthrodesis is the preferred surgical option indicated to resolve pain and prevent further shortening, often associated with shortening osteotomies of lesser metatarsals.

A number of techniques for first MTPJ arthrodesis with restoration of toe length, as a salvage procedure in failures secondary to surgical correction of hallux valgus, have been reported in the literature, mainly after interpositional bone block graft in a one-stage procedure or after previous distraction osteogenesis with external fixation, with good results [1,3].

While the use of external fixation in the treatment of phalangeal pathologies of the hand has been well documented since 1979, when Matev published his successful results in the extension of fingers through distraction osteogenesis, it is not the same in digital lengthening of the foot. In fact, except for small case series or case report regarding one-stage digital lengthening with bone graft or two-stage lengthening with distraction osteogenesis and subsequent bone graft for correction of flail toe or floppy toe [4,5], external fixation is not mentioned.

Herein, we present the case of a patient with first shortened proximal phalanx and persistent extension of the first metatarsophalangeal joint that resulted from failure of the technique used for hallux valgus corrected by gradual bone digital lengthening with external fixation. To our knowledge, this procedure has never been previously described in the literature.

Case report

A 23-year-old woman who had undergone previous surgery to correct the right hallux valgus presented one year later to the orthopedic outpatient clinic (Fig. 1). Following the arthroplasty procedure on the first metatarsophalangeal joint, the patient reported a walking pain of the first and second metatarsal heads. She also reported the impossibility of using closed shoes even with a small heel. On physical examination, she had a shortening of the first toe with concomitant dorsal flexion ("cock up deformity") and signs of skin reaction affecting the medial scar. She had normal vascular and neurological status. On clinical examination in bipodalic support, the patient was unable to put her first toe on the ground and the propulsive phase of the step was also painful and insufficient. Radiographically, shortening of the first phalanx with bone sclerosis at its base and a

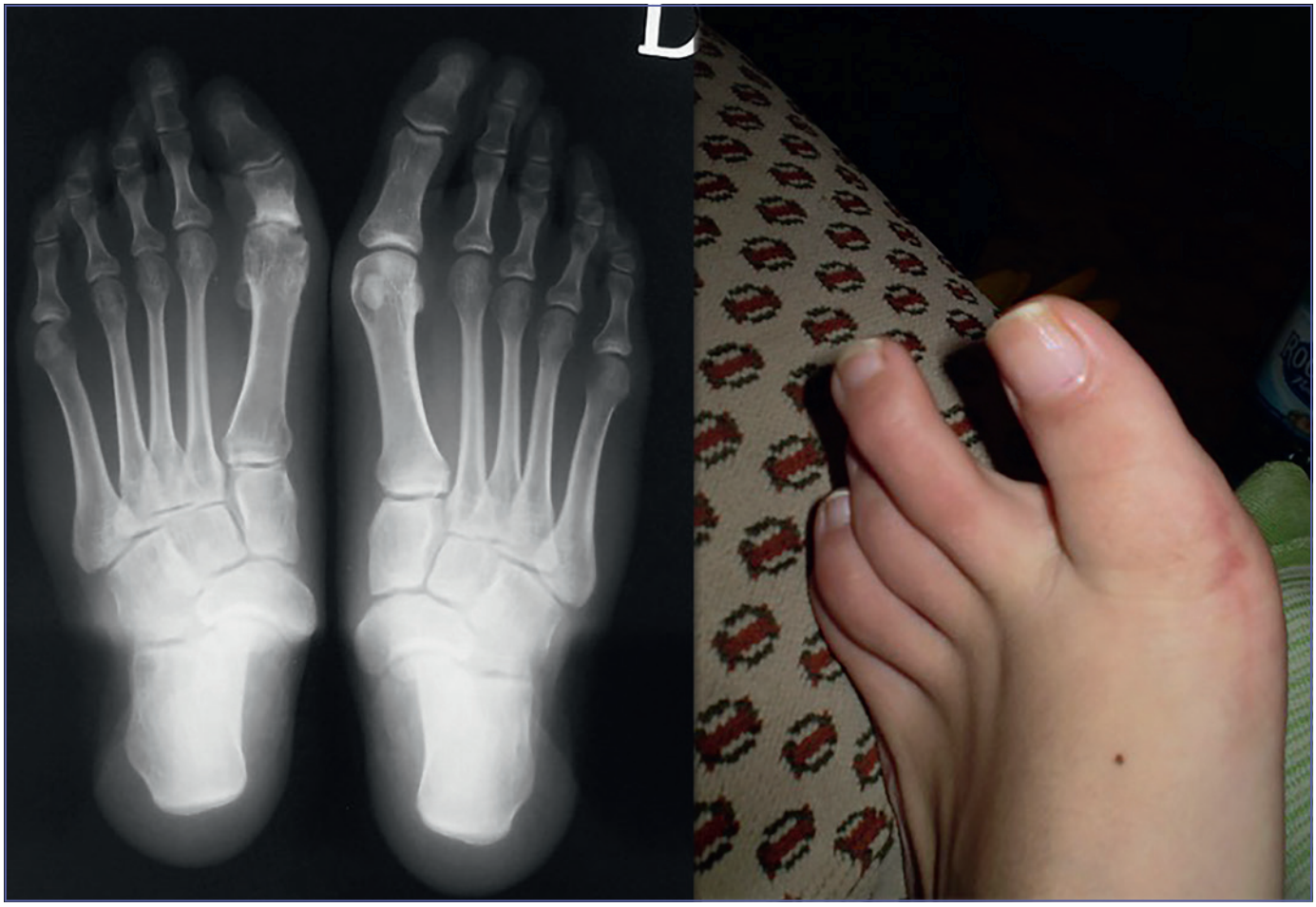

Figure 1. Radiograph and clinical photograph of the foot at initial presentation 1 year after post hallux valgus surgery. Note the severe shortening of the first phalanx with concomitant dorsal flexion of the first toe.

clear reduction of metatarsophalangeal joint space with signs of suffering at the head of the first metatarsal bone was evident. There was also an interphalangeal valgus.

As this is not a brachymetatarsia, in the presence of a good metatarsal formula, we decided to treat the first phalanx which presented shortened and had dorsal flexion. For this reason, in consideration of the young age of the patient and in order to preserve the first metatarsophalangeal joint motion, we performed gradual lengthening of proximal phalanx with external fixation, in addition to soft tissue elongation of the extensor tendon.

Preoperative antibiotic prophylaxis with intravenous cefazoline 2 gm was given. Under peripheral anesthesia and with ankle strap, the patient was placed in a supine position. We first performed osteotomy of the base of first proximal phalanx, positioned two screws in the distal phalangeal portion and two screws at the level of the metatarsal diaphysis and then assembled them with the body of the mini external fixator Citieffe®. To avoid a misalignment and a first toe angulation, a possible complication in cases of metatarsal lengthening, we placed a Kirschner wire on the medial side with the function of "track". Finally, we performed a Z-tenotomy of the extensor of the first toe, correcting the dorsal flexion (Fig. 2).

At the end of the surgery, as usual, we performed anesthetic infiltration for better tolerability of post-operative pain. The patient was discharged the following day with permission to walk with a special shoe (talus shoe). After about 7 days, the distraction of about 0.50 mm per day (0.25 mm twice a day) began until the desired length was reached. This had been determined postoperatively step-by-step according to radiographs up to a total of 7 mm of length. The obtained elongation was verified by comparing the pre- and post-operative radiographs taking as reference the length of the second metatarsal bone. The fixator was subsequently left in place for about 2 months and removed in the outpatient clinic after radiographically consolidation was obtained (Figs. 3-4).

Since unplanned interphalangeal valgus deformity remained, surgical correction was performed with a medial closing wedge

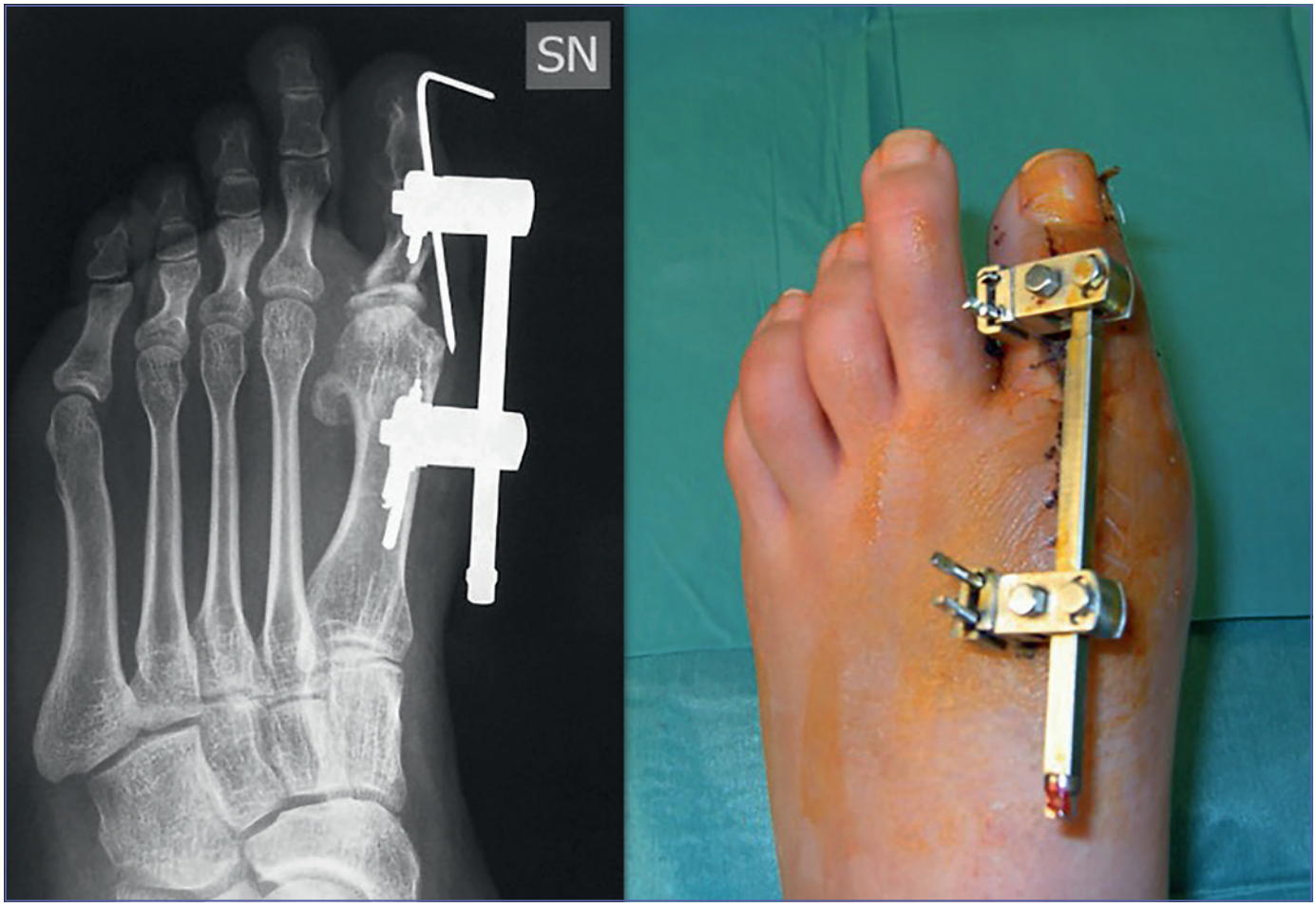

Figure 2. Radiograph and clinical photograph showing the mini external fixator in place that was used to correct shortening and misalignment of the first toe.

Figure 3. Anteroposterior view radiograph after removal of mini external fixation showing elongation obtained.

osteotomy of the proximal phalanx stabilized with metallic staple. At the end of the treatment, the forefoot had a good digital morphology with a correct plantigrade support without signs of limping (Fig. 5). Clinically the patient reported the absence of pain during the propulsive phase of the step. She had no limitations in daily activities, also allowing her to use shoes with heels. By comparing the radiographic images after about one year, it was possible to confirm, in addition to the good correction of shortening and misalignment, recovery of the vitality of the metatarsal head. There were no post-operative complications. Occasionally, there was serous drainage from pin tracts that were cleaned every 2-3 days without any evident signs of infection that would require antibiotic therapy. Pain during treatment was managed, when present, with oral anti-inflammatory therapy.

Discussion

Shortening and misalignment of the first ray can represent serious complications of hallux valgus surgery whose treatment is often complex. This shortening causes alterations in the biomechanics of the forefoot with clinical consequences. In case of excessive shortening of the proximal phalanx, the metatarsal, or both, there is a more or less accentuated instability of the first metatarsophalangea and functional insufficiency of the big toe, in particular, during the step. In these cases, the load is transferred laterally with frequent occurrence of overload alterations of the adjacent metatarsal bones and consequent

Figure 4. Clinical photographs of the foot.

Figure 5. Radiograph and clinical presentation at the end of the treatment. Good digital formula and alignment were obtained.

metatarsalgia ("transfer metatarsalgia") [1]. In addition, in these situations, the hallux may not be able to make contact with the ground at any stage of the step, remaining permanently posed in dorsal flexion (hallux extensus also called "cockup toe").
MTPJ arthrodesis is recommended in these cases as a salvage procedure to stabilize the ray, improving weightbearing function and alignment of the first ray, even though it fuses the joint [1-3].
However, in the present of marked shortening of the hallux with bone loss or avascular necrosis, in situ hallux MTPJ arthrodesis fails to restore satisfactory length and would aggravate the insufficiency of the first ray and transfer metatarsalgia. In order to obtain vital bone for suitable fusion, it can produce greater shortening and thereby worsening the biomechanical and clinical problems.
To avoid this, various methods of arthrodesis with lengthening of the first ray after interposition of bone grafts in one-stage procedures or after previous distraction with external fixator have been described with good results in the literature [1-3]. With normalization of the length, a first stable ray is obtained which can improve the normal transfer of the load and relieve metatarsalgia.
While confirming the indication for MTPJ arthrodesis in all cases of failure of hallux valgus corrective procedures, in our specific case, in consideration of preserving the first metatarsophalangeal joint motion in a young patient, we decided to treat the phalanx proximal that was both dorsal flexed and shortened. Therefore, in addition to elongation of the extensor tendon, we associated lengthening of the proximal phalanx with external fixation.
In particular, as far as we know, there are no reports in the literature that describe distraction osteogenesis with external fixator for correction of the shortening of the proximal phalanx and malalignment, as complications of the surgical treatment of hallux valgus. Although metatarsal elongation with external fixation and/or bone grafts is well described in the literature, we have not however found digital lengthening except for limited cases or case reports,concerning one-stage digital lengthening with bone graft or two-stage lengthening with distraction osteogenesis followed by bone graft in case of flail toe and floppy toe [4,5].
The reason for the use of bone grafts is linked to the shorter duration of treatment and easy post-operative recovery. However, their use is associated with an increased risk of non-union, malunion abd bone resorption, as well as morbidity of the donor site in case of autograft use [1,5]. Elongation by distraction osteogenesis with an external fixator has the advantage of being gradual and controlled compared to the use of bone grafting in one-stage procedures, where the sudden stretching can lead to soft tissue tension with ischaemic complications or skin necrosis [4,5]. It should be noted that these are often procedures on tissues that have already undergone multiple operations (revision surgery) with poor tissue quality that increases the risk of complications. The use of the external fixator, however, is not without complications. Among these, it is necessary to consider the longer treatment period, the risk of superficial infections through the pin tracts, the axial deviations of the first metatarsophalangeal joint and joint stiffness [3,4].
In our case, the gradual lengthening procedure described allowed for recovery of a good digital formula, with a correct plantigrade support and the resolution of metatarsalgia, also allowing the use of shoes with heels. We did not observe post-operative infectious or neurovascular complications. However, due to a residual interphalangeal valgus, further correction surgery was required. To avoid misalignment and angulation of the first toe, a possible complication in cases of metatarsal lengthening, during positioning of the external fixator it can be useful to place a Kirschner wire on the medial side with the function of "track".
Accurate patient selection and compliance are essential to obtain good results. In addition, serial radiographs are necessary to prevent possible complications.
An interesting observation was recovery of the vitality of the metatarsal head on radiographic images after one year. Following corrective hallux valgus surgery, it is in fact possible to observe metatarsal head necrosis, probably related to excessive exposure and devascularization of the distal end of the metatarsal with damage to the nutritional arteries. Probably, revascularization is related, in addition to correct walking with essentially shear forces, to the distraction carried out by the external fixator.
In conclusion, the use of an external fixator in treatment of foot phalangeal pathologies has its rationale. In the present case, gradual bone digital lengthening with external fixation of proximal phalanx is a reliable procedure that is safe and sta-

ble, and restored length and function of the toe after failure of previous hallux valgus surgery. Compliance of the patient and early treatment of complications are fundamental to obtain good results.

References

1 Malhotra K, Nunn T, Qamar F, et al. Interposition bone block arthrodesis for revision hallux metatarsophalangeal joint surgery: a case series. Foot Ankle Int 2015;36:556-64. https://doi.org/10.1177/1071100714563536

2 Baumhauer JF, Di Giovanni BF. Salvage of first metatarsophalangeal joint arthroplasty complications. Foot Ankle Clin 2003;8:37-48, viii. https://doi.org/10.1016/s1083-7515(02)00129-8

3 Núñez-Samper M, Viladot R, Ponce SJ, et al. Serious sequellae of the hallux valgus surgery: More options for its surgical treatment. Rev Esp Cir Ortop Traumatol 2016;60:234-42. https://doi.org/10.1016/j.recot.2016.04.002

4 Lamm BM, Ades JK. Gradual digital lengthening with autologous bone graft and external fixation for correction of flail toe in a patient with Raynaud's disease. J Foot Ankle Surg 2009;48:488-94. https://doi.org/10.1053/j.jfas.2009.02.011

5 Myerson MS, Filippi J. Interphalangeal joint lengthening arthrodesis for the treatment of the flail toe. Foot Ankle Int 2010;31:851-6. https://doi.org/10.3113/FAI.2010.0851