



Post-traumatic Hallux Varus: The Importance of Intraoperative Fluoroscopy Squeeze Test to Assess a Dynamic Instability of the First Metatarsal-Cuneiform Joint

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Abstract

Post-traumatic Hallux Varus is a rarely described event, this deformity mostly derives from complications of corrective surgery of the forefoot. However, when a patient comes to clinical observation with a forefoot trauma, it is necessary, for an adequate diagnosis and a correct therapeutic path, to consider all anatomical and biomechanical aspects. In these patients, the varus deformity of the first metatarsophalangeal joint (1st MTP) is typically linked to the lesion of the lateral capsuloligamentous complex: nevertheless, sometimes it can associate a dynamic reduction or even an inversion of the Inter-Metatarsal angle (IMA) during foot load, which occurs in case of instability of the 1st metatarsal-cuneiform joint (CMJ). This event can represent an insidious noxa that, if underestimated, can make distal surgical reconstruction vain, even when correctly executed. The authors suggest performing routinely an intraoperative forefoot squeeze test under fluoroscopy, to recreate the forces over the first metatarsus on monopodial stance, thus demonstrating a dynamic 1st CMJ instability and the eventual need for a 1st CMJ fusion.

Keywords: Forefoot; Hallux Varus; Lapidus; Trauma; Joint Instability; Cuneiform Metatarsal Joint

Introduction

Acquired hallux varus is the medial deviation of the great toe about the 1st metatarsal bone and represents, typically, a complication of corrective surgery of the forefoot, occurring from 2 to 14% of the corrective interventions of the hallux valgus [1-7]. It mainly occurs in distal procedures such as McBride's (where the pathogenesis relays to the excision of the peroneal sesamoid), or in case of extreme or failed metatarsal osteotomies or proximal arthrodesis of the first cuneiform-metatarsal joint [1]. However, hallux varus might also be related to other causes such as trauma, systemic inflammatory diseases (e.g., rheumatoid arthritis), neurological (e.g., Charcot-Marie-Tooth disease), severe burns, avascular necrosis of the metatarsal head, paralysis, and polymyositis: all of which, although rare, must be considered for an adequate diagnosis and a correct therapeutic path [2].

In case of traumatic outcomes, lesions of the lateral capsuloligamentous complex and lateral tendon complex of the Metatarsal-Phalangeal (MTP) [3,4] should be sought. There can also be instability of the first metatarsal-cuneiform joint (MTC), mostly

described in hallux valgus [11,12], with reversal of the intermetatarsal angle (IMA) [9], fixed or dynamic, which must be addressed because, if underestimated, can make distal surgical procedures vain, even if correctly performed.

To establish the presence of a 1st CMJ instability, a routinely executed intraoperative squeeze test under fluoroscopy is suggested: this test consists of compression of the forefoot at the level of the metatarsal heads, seen at fluoroscopy on anteroposterior view, aiming to reduce the first intermetatarsal angle (IMA) to demonstrate the presence of a first cuneiform-metatarsal joint instability.

The patient must be informed about the possibility of this condition, not always seen on plain radiographs, and the surgeon should consider it on the preoperative planning, so being ready to perform a 1st CMJ fusion.

Surgical technique

To establish the presence of a proximal dynamic instability by recreating the weight-bearing condition under fluoroscopy, we

propose the case of a 40-year-old professional yacht skipper. After a right forefoot trauma, the patient complained of walking pain and instability of the big toe with deformity in varus. Functional impairment during walking with weakness in the stance phase and inability at the toe-off walking phase [10] was also reported. The above-mentioned trauma took place about 10 years before the first examination and had never been treated before.

Physical examination showed a slight varus toe and flatfoot at the affected site in a bipodal stance. In the right monopodial stance and during walking, the deformity evolved to a full dislocation of the big toe medially, especially in the toe-off phase, with a painful and distinct “clock” sound and antalgic gait. A dynamic pes planus on midstance was also evident with 1st metatarsus dorsiflexion, not present contralaterally.

The use of orthoses did not solve the problem, also considering that the patient’s profession often involved barefoot walking on boats. The clinical and radiographic picture showed a two joints impairment: A) the 1st metatarsophalangeal distally, with a lesion of lateral sesamoid-metatarsal ligament and capsule, and B) instability of the 1st cuneiform-metatarsal joint (CMTJ), with “dynamic” closure of the IMA when loaded, resulting in 1st metatarsophalangeal dislocation during monopodial stance and walking. The radiographic standing examination showed the deformity in varus of the big toe, associated with the inversion of the intermetatarsal angle (IMA), with overlapping of the head of the 1st MT on the second (Figure 1). The patient was then offered a combined surgical treatment, consisting of arthrodesis of the 1st CMTJ and soft tissue capsuloplasty of the 1st MTPJ, with retention of the lateral capsulo-ligamentous complex and, eventually, reinsertion of the adductor tendon of the big toe. Proper informed consent was obtained.

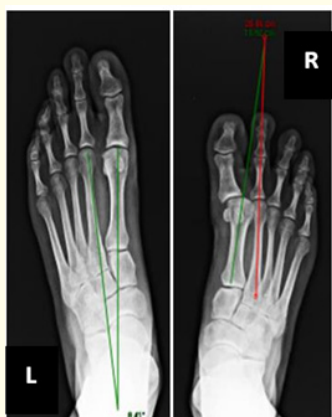


Figure 1: Preprocedural squeeze test shows on right foot 1° MTF subluxation, 1° MT adduction with overlapping on 2nd metatarsus, negative IMA, and 1st Metatarsal dorsiflexion due to 1st MTCJ instability.

The procedure was performed on a day surgery basis. The anesthesia chosen for the procedure was the ankle block type, executed by the first author using 25 mL of 1% Marcaine and 10 ml of 7.5% Ropivacaine. Before the skin incision, an Esmarch bandage was used for exsanguination and to perform the squeeze test under fluoroscopic imaging, then left at the ankle as a tourniquet. The instability of the 1st CMTJ was confirmed, as the squeeze test of the metatarsal heads was accomplished, with adduction of the 1st MT and so showing a consequent 1st MTPJ dislocation. A Lapidus procedure, with 2 screws arthrodesis of the 1st CMTJ was then performed, obtaining a fixed IMA of about 9°. The distal procedure then followed, with capsuloplasty, plication of lateral collateral ligament, and tensioning of adductor tendon, all with long-time absorbable sutures. The transverse intermetatarsal ligament showed no apparent lesions, so no further soft tissue procedures were necessary. After skin closure, dynamic tests were then performed both clinically and under fluoroscopy, showing CMTJ and 1st MTPJ stability, and no varus deformity recurrence (Figure 2): this excluded the need for further stabilization with k-wires.

At the end of the surgery, after a soft bandage, a postoperative



Figure 2: Monopodial weight bearing: Hallux Varus with clinical evidence of 1st CMTJ instability Postoperative fluoroscopy. Full postop ROM of MTPJ.

shoe was applied, the patient was then dismissed. Postoperative indications consisted in 4 weeks of non-weight bearing walking, followed by 2 weeks of protected partial load and subsequent tolerance full load on the right foot. Rehabilitation began at 30 days, aimed at full 1st MTFJ range of motion, proprioception exercises, and walking training: anyway, immediately after the suture removal at two weeks, active and passive hallux mobilization was encouraged. Clinical and X-ray follow-up was performed at 1, 2, 3, 6 months after the procedure. The last clinical evaluation has been done 4 years postoperatively.

Results

The purpose in the treatment of this patient was not only to obtain an esthetic forefoot but also to have a functional foot, which can both wear the shoe and allow walking barefoot in the absence of pain and with valid support on the 1st metatarsal and good plantar grip during the push-off phase.

At the first follow-up, no pain or discomfort was reported. At 3 months after surgery, the patient had no pain at 1st MPJ and defor-

mity under monopodial (stance and walking), with a complete and non-painful toe-off phase (figure 4-5). Weight-bearing radiographic examination at 6 months showed the complete fusion of the 1st TCM and, from a clinical point of view, the complete functionality of the foot was obtained (figure 3-B).

Clinical findings at 5 years follow up showed persistent stability, full ROM, and function (figure 3-C).



Figure 3: Surgical steps: Lapidus + distal soft tissue procedures. Postoperative fluoroscopy. Full postop ROM of MTPJ.



Figure 4: The 3 months follow-up: weight bearing xRays show persistence of anatomical IMA and no recurrence of deformity.



Figure 5: The 6 months F.U. x-rays demonstrate complete 1st CMTJ fusion.



Figure 6: Functional evaluation at 6 months F.U.



Figure 7: 4 years F.U., full active ROM, the scar is barely visible.

Discussion

Post-traumatic hallux varus, in absence of metatarsal fractures, generally expresses itself at the level of the MTF joint, due to lesion of the lateral capsuloligamentous complex and the adductor tendon [3-6,8]. However, in some cases it is possible to see an associated instability of the 1st cuneiform-metatarsal joint which, with weight-bearing, determines adduction and dorsiflexion of the 1st metatarsus, resulting in an inversion of the IMA [7]. The concomitant lesion of the lateral capsuloligamentous complex further increases the deformity [1,7,8]. In such a case we have a dynamic lesion, in which the sole correction at the level of the metatarsophalangeal joint, could not guarantee a lasting functional result. The decision-making algorithm, which arises from clinical examination and instrumental investigations, still uses more traditional radiology than second-level examinations [5,6].

In these patients, when the instability of the cuneiform-metatarsal is suspected, in addition to the standard radiographic examinations, intraoperative dynamic fluoroscopic evaluation, with a squeeze test of the metatarsal heads, reproduces the lesion, thus allowing to recreation the inversion of the intermetatarsal angle that occurs during walking, so allowing to establish the most appropriate type of treatment.

When a CMTJ instability is confirmed, we see the IMA inversion and the subsequent 1st MTPJ dislocation, thus guiding the surgeon to the arthrodesis of the 1st cuneiform-metatarsal, to maintain a correct intermetatarsal angle under load, and obtain more effective distal surgical procedures.

Conclusions

In the presence of a varus big toe, usually, the surgeon's attention can initially be aimed at the 1st MTPJ component of the pathology, with the risk of neglecting the characteristics of the foot as a whole: given the distribution of the lines of forces and the biomechanics of the foot, it is, therefore, advisable to always evaluate the stability of the Lisfranc joint, and especially around the 1st CMTPJ.

When the genesis of the hallux varus, as well as iatrogenic, sees post-traumatic, rheumatological, or neurological origin, the characteristics of the deformity can be evaluated by a clinical and technical examination that involves recreating, in fluoroscopic vision, the stresses to which the foot is subjected during weight-bearing and walking.

When planning a surgical correction of forefoot deformity, a

surgeon should always think of a concomitant first CMJ instability, so inform the patient and be ready to fix it. In the operative theatre, dynamic fluoroscopy with forefoot squeeze test recreates the pathogenetic noxa, demonstrating the presence of an intermetatarsal angle (IMA) reduction or inversion. This simple and effective test makes it possible to direct the surgical gesture also to a proximal stabilization, e.g., to a 1st CMJ fusion, which will permit the restoration of anatomical and biomechanical forefoot characteristics and save the efficacy of the distal surgical steps, with a full functional recovery in the absence of pain.

In the acquired non-iatrogenic hallux varus, the research and recognition of dynamic instability of the first cuneiform-metatarsal joint allow to place a correct operative indication and minimize distal procedures that could, if not associated with proximal surgical steps, would not be long-term decisive.

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