

Post-traumatic instability of the first metatarsophalangeal joint: a novel surgical technique of capsular reconstruction in a young kickboxer

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ABSTRACT

Aim To report a novel surgical technique of capsular reconstruction of post-traumatic instability of the first metatarsophalangeal joint (MTPJ).

Methods The clinical case is related to a 24-year-old male athlete whose clinical symptoms began with pain and spontaneous dislocation of the left first MTPJ during a kickboxing fight. He received conservative treatment (cryotherapy and rest) at first. Afterwards, he referred persistent hallux instability associated with moderate pain, despite normal anatomic alignment with no evidence of first ray deformity. Plain traditional x-rays of the left foot, magnetic resonance imaging (MRI), static and dynamic ultrasonography (US) and clinical tests were performed in order to diagnose capsular ligamentous structure lesions.

Results The plain x-rays showed *hallux abductus* angle of 3°. The MRI and US demonstrated a rupture of the lateral capsular ligamentous structures and detachment of the abductor tendon. The pull out medium-lateral of the capsule with the abductor suture was performed as a treatment for dynamic hallux varus deformity. At six-month follow up, the patient walked without lameness with complete active and passive range of motion and with a stable first MTPJ.

Conclusion The patient presented with the post traumatic instability of the first metatarsophalangeal joint treated with a novel surgical technique of capsular reconstruction. The patient returned to the full weight-bearing in only 2 months of rehab. To the best of our knowledge, the surgical correction proposed has not been previously described.

Key words: hallux varus, joint instability, metatarsophalangeal joint

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INTRODUCTION

Acquired hallux varus is an uncommon occurrence in foot pathology. The most common cause is iatrogenic following bunionectomy (1). Another less common etiology is trauma (1). The first metatarsal phalangeal joint (MTPJ) post-traumatic instability is a rare condition. Injury produces the rupture of the capsular-ligamentous structure of the joint (2). Hallux varus is studied as a triplane deformity consisting of medially deviated hallux in a varus rotation with the contraction of the interphalangeal joint (IPJ) (1). Trauma mechanism is typically in hyper plantarflexion-adduction of the hallux. Similar foot lesions in male boxers and professional and amateur dancers were described (2-3). Clinically, instability is complained as a sub-dislocation or dislocation of the hallux during active or passive range of motion (ROM), especially during dorsi-flexion (4).

Big toe and the first MTPJ are essential in load transfer while walking. Stability of the joint is guaranteed by the capsular-ligamentous complex; particularly, the abductor maintains alignment of the hallux, and it has a “lever” effect on the first metatarsal, it pushes the first metatarsal towards the second one acting in a parallel line with this bone and using the metatarsal head as a fulcrum. The hallux adductor balances the action of the abductor, with its two transverse and oblique ends (4).

Different techniques to reconstruct the joint stabilizers were described (1).

The aim of this study was to present a novel surgical technique to treat the first metatarsal phalangeal instability successfully managed in a young male kickboxer. To the best of our knowledge, the surgical correction proposed has not been previously described.

PATIENT AND METHODS

Patient and study design

A 24-year-old male athlete without other medical issues complained about pain and instability of the left hallux. The patient denied the use of drugs, smoking or alcohol. He referred foot injury in June 2020 during a kickboxing fight. His hallux was forced in flexion and adduction stuck on the ground. The patient reported medial hallux sub-

dislocation with pain, which spontaneously reduced within a few days. He went to the emergency department, where he received conservative treatment (cryotherapy and rest) at first. Afterwards, he referred persistent hallux instability associated with moderate pain, despite normal anatomic alignment with no evidence of first ray deformity.

Physical examination revealed a medial dislocation of the hallux during the switch in extension, both in passive and active ROM. The orthopaedic team planned further consultations and instrumental diagnostic investigations.

Methods

Vascular and neurologic examinations were performed and completed with a 10-cm visual analogue scale (VAS) (5), the short-form 36-item health survey (SF-36) (6), and the American Orthopedic Foot and Ankle Society ankle-hindfoot scale (AOFAS) (7). Imaging studies included a traditional X-ray (anteroposterior, lateral) in order to measure *hallux abductus* angle, MRI and static and dynamic ultrasonography (US) to investigate capsular ligamentous structure lesions. The latter was performed with the dynamic varus stress tests by a senior orthopaedic surgeon experienced in dynamic musculoskeletal ultrasound. The pull out medium-lateral of the capsule with the abductor suture was indicated as the treatment of choice for the dynamic hallux varus deformity. It was completed in September 2020.

After patient discussion about treatment options, risks and potential complications, as well as the postoperative management, the patient signed an informed consent. A written informed consent for the publication of their clinical details and/or clinical images was also obtained.

Surgical treatment

The patient was taken to the operating room and placed in a supine position. The surgical procedure was performed with troncular anaesthesia and using a pneumatic thigh tourniquet. The leg was sterilized up to the knee. Skin incision was made in line with the first interdigital space, just lateral to the first MTPJ. A dissection was performed down to the lateral structures of the joint. An inveterate lesion of the lateral capsule showing hypertrophic and fibrotic was reported. The detachment of the abductor tendon was identified (Figure 1). Varus

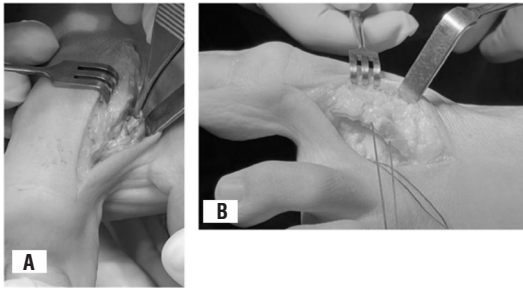


Figure 1. Surgical technique. A) Frontal view of detachment of abductor tendon; B) lateral view of detachment of abductor tendon (Policlinico Bari, September 2020)

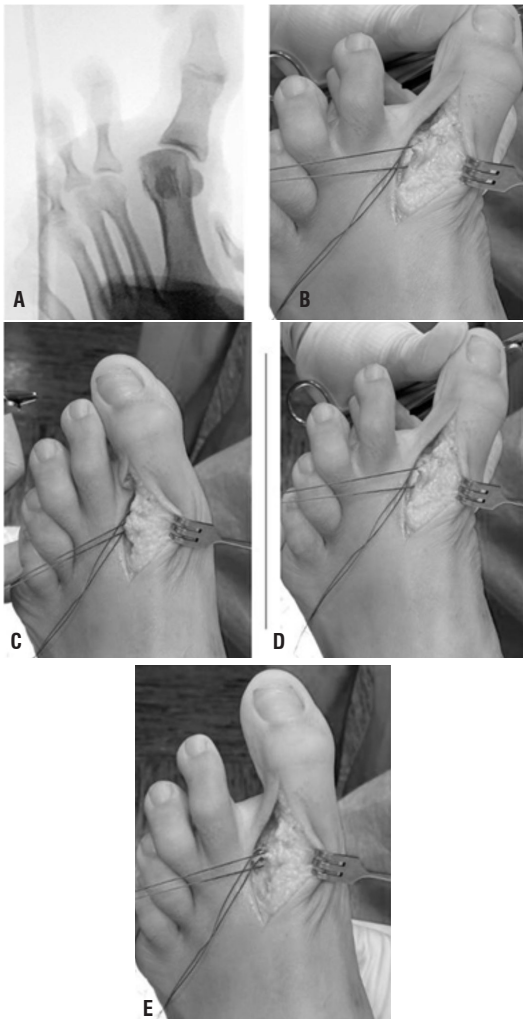


Figure 2. Intra-operative stress test and preparation of the lateral capsule. A) Varus stress test instability repeated under fluoroscopy; B) lateral capsule prepared with Vicryl 2.0 suture; C) tensioning of the system; D) varus stress test of the lateral capsule; E) valgus stress test of the lateral capsule (Policlinico Bari, September 2020)

stress test was repeated under fluoroscopy (Figure 2). Lateral capsule was prepared with Vicryl 2.0 suture (Ethicon Inc., Ohio, USA), and the tensioning of the system was tested (Figure 2). A pull out was made with a slotted Kirshner (K) wire, from

the metatarsal head following lateral-to-medial direction. The wire was locked with a button over the skin (Figure 3). Stability was checked with the varus-valgus stress tests under fluoroscopy - no instability found. Abductor tendon was re-inserted on the base of the proximal phalanx. Capsule was further tensioned with another Vicryl 2.0 suture. Then, C-arm images were performed once more: the hallux stability in varus stress test was confirmed. Hallux was splinted in syndactyly with the second toe and the patient had non-weight-bearing postoperative care regimen for 3 weeks. Skin sutures were removed 15 days postoperatively.

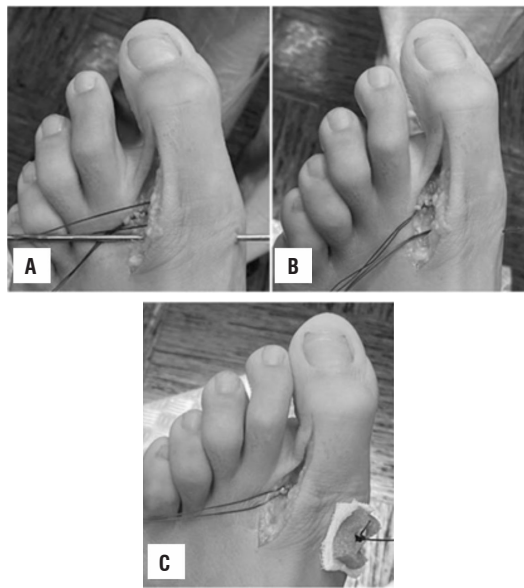


Figure 3. Pull-out technique. A) Slotted K-wire was passed through the base of the first metatarsal; B) the Vicryl suture was inserted medially; C) the button was used to fix the pull out (Policlinico Bari, September 2020)

RESULTS

Before surgery, vascular and neurologic examinations were unremarkable. The clinical scores were: VAS 6.5, SF-36 physical and mental components 31 and 33 respectively, and AOFAS scored 35. Palpatory pain was mainly localized on the lateral side of the first MTPJ. Traditional X-ray (Figure 4) showed correct alignment of the first MTPJ. The *hallux abductus* angle was 3°. Magnetic resonance imaging (Figure 4) and static and dynamic ultrasonography detected a rupture of the lateral capsular ligamentous structures and a detachment of the abductor tendon (Figure 4).

Three weeks after the surgery, splint was removed but syndactyly was maintained. Weight-bearing was indicated with talus shoes. Flexion and

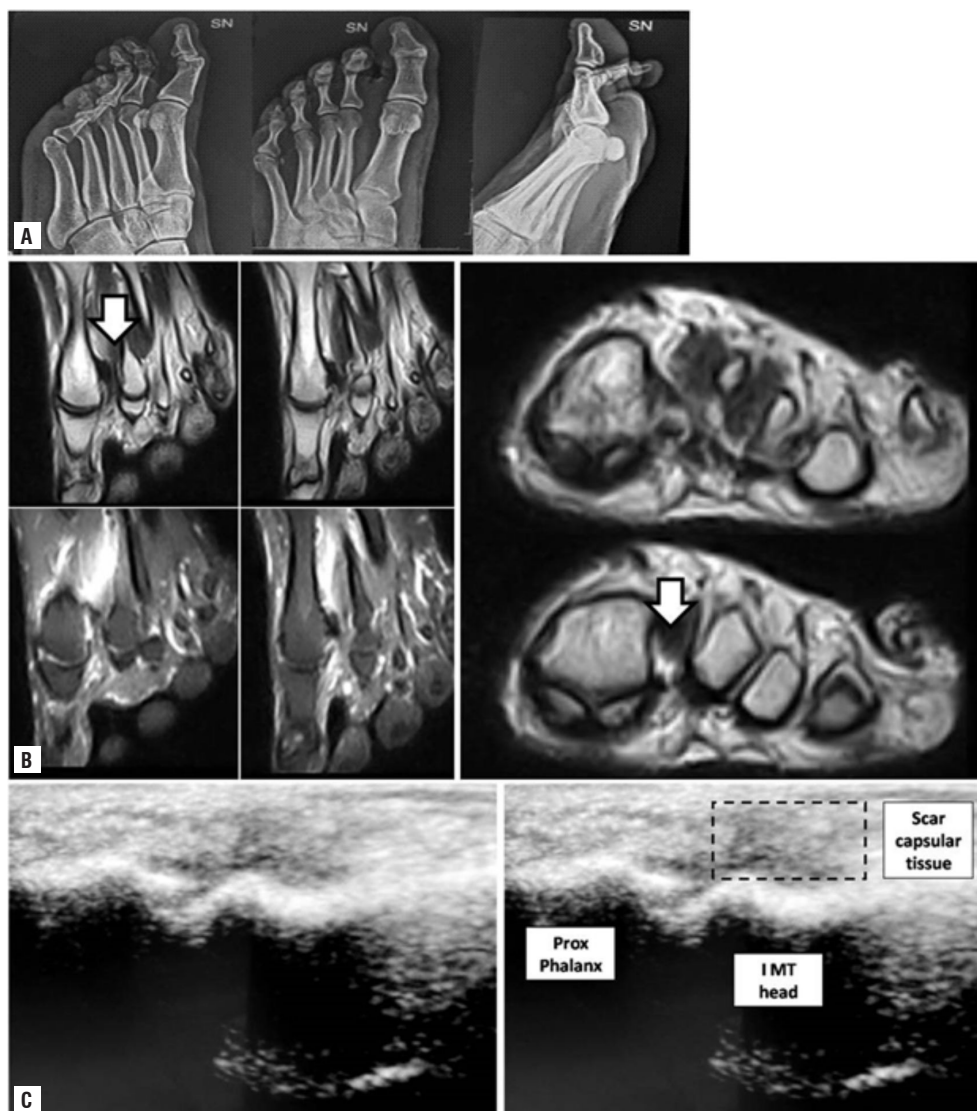


Figure 4. Pre-operative lesion. A) Traditional X-ray showed correct alignment of the first MTPJ with the *hallux abductus* angle 3°; B) magnetic resonance imaging of the abductor tendon detachment; C) ultrasonography of the lateral capsular ligamentous structures rupture (Policlinico Bari, August 2020)

extension were completed and granted in syndactyly. The VAS was 3, SF-36 measured 45 and 43, AOFAS scored 65.

After 2 months, the button was removed and full weight-bearing was gradually started. The clinical scores improved again with ROM complete.

After another 30 days, the syndactyly and the talus shoes were removed. The patient walked freely. It was advisable to abstain from sporting activity for another 30 days. The patient returned to check after six months, he walked without lameness. The surgical scar was normochromic and normotrophic. No residual anatomical deviation maintained (Figure 5). Complete active

and passive ROM with mild pain at maximum degrees of the interphalangeal joint was possible. The joint appeared stable. The patient referred he resumed cautiously running and regularly walking on toes. Hallux elastic taping and syndactyly with the second toe while playing sports was recommended. After six months, the visual analogue scale pain score improved from a pre-operative score of 6.5 to 2; the short-form 36-item health survey physical component and mental component scores improved from 31 and 33, to 55 and 52 points, respectively; the American Orthopedic Foot and Ankle Society score increased from 35 to 81 points.



Figure 5. Clinical image of the 6-month follow-up. **A)** The surgical scar clinically normochromic and normotrophic; **B)** no residual hallux anatomical deviation; **C)** walking on toes in lateral view; **D)** walking on toes in anterior view (Policlinico Bari, March 2021)

DISCUSSION

First metatarsophalangeal instability can be considered as a consequence of non-adequate management and treatment of initial injury. Few cases were described in literature, and a guideline of treatment and rehabilitation is not available yet (1-3).

Mullis and Miller described the adductor hallucis tendon reattachment via drill holes in the proximal phalanx and suturing the tendon on itself. This provided adequate reduction of the varus; however, weight-bearing was gradually resumed in the 7th postoperative week and full return to activity was achieved 4 months postoperatively (4). Labovitz and Kaczander presented a case involving a traumatic avulsion of the *abductor hallucis* tendon leading to hallux varus. A T-shaped capsulotomy was performed laterally, a wedge of capsule excised, and the proximal and distal aspects were tagged with suture (1). Ryan et al. described a traumatic hallux varus: patient initially injured his foot during a wrestling contest; he reported lateral collateral ligament of the 1st MTPJ lesion (8). Soft tissue anchor, as in supraspinatus tendon repair (9), alone was used to stabilize the joint in the transverse plane and augment the lateral capsule and collateral ligament (8). Residual pain and instability likely due to osteoarthritis are a fearful complication to be avoided (10-11).

Lui TH reported a case of traumatic hallux varus due to avulsion fracture of the lateral side of the proximal phalanx base hitting from a door (12).

Lateral instability of the first metatarsophalangeal joint was believed to be due to adductor hallucis function disruption. Surgical treatment consisted in minimally invasive extensor hallucis brevis (EHB) tenodesis using a tendon graft. The hallux varus deformity was then corrected by tensioning of the graft and the first metatarsal was transfixed with a 1.6mm K-wire as in transverse midshaft metacarpal fractures technique (13). The graft was sutured to the abductor hallucis under tension. The medial capsule was stripped from the bone with a small periosteal elevator. The K-wire was removed, and the patient walked weight-bearing with wooden base sandal 4 weeks after the operation. The patient could resume normal shoe gear 2 months after the operation (12).

In conclusion, the post traumatic instability of the first metatarsophalangeal joint is a rare condition. Our surgical correction has never been described before. The procedure included the pull out of the lateral capsule guaranteed the restoration of joint stability with a short-term surgery. Moreover, the treatment was simple and replicable. It was important to identify the intraoperative lesion and adequately prepare the capsule for the pull out. The patient returned to the full weight-bearing in only 2 months of rehab.

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TRANSPARENCY DECLARATION

Competing interests: None to declare.

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