

Case Report

A Novel Minimally Invasive Technique for Hallux Fracture-Dislocation Fixation Using Hypodermic Needles: An Effective Solution for Disaster and Catastrophic Settings

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Abstract

Hallux fractures, particularly those involving the proximal phalanx, can lead to significant functional impairments if not promptly managed. This report introduces a novel, minimally invasive technique for hallux fracture fixation using hypodermic needles. This technique is specifically designed for resource-limited settings such as disasters or emergencies. A 30-year-old female sustained an open proximal phalanx fracture of the left hallux with interphalangeal joint dislocation following a motor vehicle accident. Under local anesthesia in the emergency service settings, fracture reduction and stabilization were achieved using two hypodermic needles. A 21-gauge needle was inserted intramedullary through the medial aspect of the hallux to stabilize the fracture, while an 18-gauge needle was placed distally to secure alignment. Postoperative radiographs confirmed proper alignment, and the needles were removed after four weeks. The patient achieved pain-free ambulation with a full range of motion within six months, with no complications noted. This technique offers a cost-effective, rapid, and practical alternative to traditional methods, eliminating the need for fluoroscopy or specialized surgical tools. It is particularly valuable in emergency and resource-constrained environments, providing favorable clinical and radiological outcomes. This approach demonstrates significant potential for managing hallux fractures in challenging settings and warrants further validation in broader orthopedic practice.

Keywords: hallux fracture dislocation; hypodermic needle fixation; minimally invasive technique; emergency orthopedics; resource-limited settings



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1. Introduction

Fractures of the phalanges in the toes are frequently encountered in clinical practice [1]. Among these, fractures of the first toe (hallux) phalanges are reported as the most common type of toe fracture in the literature, with an incidence of 38–56% [2–4]. The hallux plays a vital role in maintaining balance, bearing weight, and facilitating pedal movements [3]. Traumatic injuries to the forefoot are mostly caused by axial loading of the foot in plantar flexion or crushing injuries. Specifically, hallux fractures are often the result of impalement of the toe into the ground or impact from a falling object [5]. These fractures can manifest as intra-articular fractures involving the interphalangeal joint or as extra-articular fractures

affecting the proximal or distal phalanges [5]. Axial trauma to the foot generally leads to fractures of the distal phalanx, while crushing injuries may involve either the distal or proximal phalanx [5].

Failure to provide timely and appropriate intervention for hallux fractures may result in joint range of motion impairments, early-onset osteoarthritis, and deformities of the hallux [6]. Techniques such as debridement of open fractures, fixation with Kirschner wires (K-wires) under fluoroscopic guidance, and achieving anatomical reduction are commonly performed in surgical settings. This case report introduces an innovative alternative technique utilizing hypodermic needles for fracture reduction in emergent settings. Notably, documentation of this technique in the scientific literature remains scarce. In a case series involving eight patients, Takamoto et al. implemented a reduction maneuver and internal fixation using hypodermic needles with a needle-in-needle pinning technique for open distal phalanx fractures of the hand fingers. Subsequent follow-up assessments revealed that all patients exhibited pain-free joint motion without necessitating additional surgical intervention [7]. Similarly, a comparative study conducted by Van Royen et al. evaluated the efficacy of K-wire fixation versus hypodermic needle fixation for phalanx fractures of the hand fingers [8]. Within this study, 24 distal phalanx fractures underwent fixation under fluoroscopic guidance in an operating room setting using K-wires, whereas 25 fractures were treated in an emergency room setting without fluoroscopic control utilizing hypodermic needles. The analysis revealed no statistically significant differences between the two cohorts in terms of fracture healing duration, union rates, delayed union incidence, or nonunion occurrence. However, a higher incidence of fixation loosening was observed in the hypodermic needle cohort. Importantly, neither treatment group exhibited post-procedural infections. Furthermore, hypodermic needle fixation was associated with reduced procedural costs [8].

Another study by Senesi et al. further corroborated these findings by comparing K-wire and hypodermic needle fixation in patients with distal phalanx fractures. Among the 60 patients enrolled, 32 underwent fixation via hypodermic needles, whereas 28 received K-wire fixation. Notably, the hypodermic needle cohort demonstrated expedited fracture healing times and superior distal interphalangeal joint range of motion at six-month follow-up. Additionally, Visual Analog Scale (VAS) pain scores were significantly lower in the hypodermic needle group, reinforcing its potential clinical benefits [9].

This case report underscores a novel and pragmatic approach to the management of open fracture-dislocation of the proximal phalanx of the hallux, employing hypodermic needles to achieve anatomical reduction and fracture stabilization in the absence of fluoroscopic guidance. This technique offers a minimally invasive, expeditious, and efficacious alternative, particularly in resource-constrained emergency scenarios. The hypodermic needle methodology emerges as a viable, cost-effective intervention, meriting further investigation and potential integration into clinical practice.

2. Case Report

Informed consent was obtained from the patient for the publication of this case report. A 30-year-old female patient was admitted to the emergency department following a motor vehicle accident in which her left foot was trapped beneath a motorized vehicle. Clinic and radiographic evaluation revealed an open fracture of the proximal phalanx of the left hallux with 1 cm long skin cut, extending into the interphalangeal joint, accompanied by joint dislocation (Figure 1).



Figure 1. Initial anteroposterior (A) and oblique (B) radiographs of the left foot showing a proximal phalanx fracture with dislocation of the interphalangeal joint of the hallux.

Initial management included debridement of the open fracture with sterile saline solution. The patient received appropriate antibiotic therapy and tetanus prophylaxis. The interphalangeal joint dislocation was reduced using manual maneuvers. Subsequently, a minimally invasive, cost-effective technique was implemented under local anesthesia using hypodermic needles:

A 21-gauge hypodermic needle was introduced through the medial aspect of the hallux at the distal fracture line of the proximal phalanx, intersecting the interphalangeal joint region. The needle was directed perpendicularly to the bone shaft, targeting the lateral cortex. It was positioned as not to penetrate the contralateral cortex, allowing intramedullary positioning to support fracture reduction and prevent inferior displacement of the oblique fracture.

An 18-gauge hypodermic needle was inserted through the distal tip of the hallux. It traversed the lateral edge of the proximal phalanx and extended toward the interphalangeal joint. The needle insertions were done blind without fluoroscopy by feeling the bone in the emergency department.

After needle placement and proper irrigation and debridement, the layers were sutured anatomically, and a short-leg splint in neutral position was applied. Control radiographs confirmed proper anatomical alignment of the fracture (Figure 2). The patient was discharged and scheduled for weekly follow-ups after prescription of amoxicillin clavulanic acid 1 g twice a day. The hypodermic needles were removed during the fourth week in the outpatient clinic and passive range of motion exercises and weight bearing were begun gradually. After 6 weeks, radiographs showed fracture union (Figure 3), and the patient resumed normal walking and weight bearing with no pain. Control radiographs were also obtained in the third month showing fracture healing (Figure 4). At the 6-month follow-up, the patient exhibited a full, pain-free range of motion, could perform all daily

activities without limitations, and radiographs demonstrated complete healing with no complications (Figure 5).



Figure 2. Post-procedure anteroposterior (A), oblique (B), and lateral (C) radiographs of the left hallux following hypodermic needle fixation. The images show proper anatomical alignment achieved through the novel minimally invasive technique utilizing hypodermic needles for fracture stabilization and reduction.



Figure 3. Anteroposterior (A), oblique (B), and lateral (C) radiographs taken at the 1.5-month follow-up. Fracture union with callus formation is evident.



Figure 4. Anteroposterior (A), oblique (B), and lateral (C) follow-up radiographs at the 3-month follow-up.



Figure 5. Anteroposterior (A), oblique (B), and lateral (C) radiographs at the 6-month follow-up showing complete fracture healing and normal bone structure with the proper alignment.

3. Discussion

Fractures of the proximal phalanx of the hallux often require surgical intervention compared to fractures of other toes [3,10]. These fractures can occur with or without intra-articular extension, and early, appropriate treatment is essential [3]. Failure to address hallux fractures promptly can result in valgus deformities, loss of joint range of motion, and early arthrosis of the interphalangeal joint [3,11,12].

Clinical indicators such as acute subungual hematoma, eponychium bleeding, or nail bed laceration should raise suspicion of an open fracture [13,14]. For nondisplaced or minimally displaced fractures, closed reduction and conservative management are typically sufficient [13]. However, surgical intervention is indicated for intra-articular fractures with more than 2 mm displacement, unstable fractures, malrotations, or open fractures [3]. Studies have demonstrated that surgically treated hallux fractures achieve superior outcomes in terms of pain relief, range of motion, and deformity prevention [3,15,16].

Available surgical options for displaced fractures include mini-plate fixation, closed or open reduction with K-wires, and intramedullary lag screw fixation [3,13,14]. In our case, an alternative technique utilizing hypodermic needles was employed for the emergency reduction of open fractures, diverging from conventional methods. This technique remains rarely documented in existing literature. In our study, hypodermic needle fixation was applied to an open proximal phalanx fracture of the first toe, yielding outcomes consistent with previously reported cases.

This method represents an innovative and viable alternative to commonly utilized fixation techniques, demonstrating comparable clinical results. It holds particular significance for the treatment of both open and closed fractures of the fingers and toes, especially in settings where sterile operating room conditions cannot be ensured or where limited resources impose constraints. Moreover, this technique proves to be especially valuable in emergency scenarios, such as natural disasters, earthquakes, and conflict zones, where immediate intervention is required. The ability to achieve fracture reduction rapidly without imaging requirements further enhances its practicality, cost-effectiveness, and uniqueness as a treatment option.

4. Conclusions

This case highlights a novel, minimally invasive, rapidly applicable, and cost-effective technique using hypodermic needles for the reduction and fixation of toe fractures. While there are limited studies in the literature on similar approaches, this technique offers a practical alternative to traditional surgical methods. It eliminates the need for fluoroscopy and specialized equipment, making it particularly suitable for emergency or resource-limited

settings, where sterile operating environments and specialized equipment may not be available. This report demonstrates that hypodermic needle fixation is a unique, effective, and sufficient method for managing toe fractures, providing a reliable option for both emergency and outpatient care.

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