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Distraction Plating for Intra-articular Proximal Phalanx Base Fractures on Middle Finger Reconstruction: A Case Report

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ABSTRACT

Phalanx fractures are among the most frequently encountered hand injuries, with fractures at the base of the proximal phalanx presenting unique management challenges due to their diverse presentations. We present a case of a 47-year-old male with a complex fracture at the base of the proximal phalanx following a motorcycle accident. Radiology revealed severe comminution with apex volar angulation. Treatment involved open reduction and internal fixation with a miniplate using the distraction plating method; the hardware was removed at six weeks. Physical therapy was then initiated, and after one year, the patient achieved an excellent range of motion post-operatively (metacarpophalangeal joint of 45 – 90°, proximal interphalangeal joint and distal interphalangeal joint were 0 – 90°) comparable to pre-injury function. Radiographs showed union of the fracture and proper alignment. The successful application of distraction plating in complex comminuted distal radius fractures inspires further research and application in other challenging fractures. Distraction plating can effectively maintain proper fracture alignment while minimising strain on surrounding soft tissues. This supports bone healing and allows good radiological and functional outcomes. The favourable outcome in this case supports the use of distraction plating in situations where traditional fixation methods, such as Kirschner wire fixation, may be insufficient. Distraction plating may be an alternative to Kirschner wire fixation to maintain the proper alignment and avoid the risk of pin-track infections, and allow an early return to daily activities. The successful application of distraction plating in complex comminuted distal radius fractures has inspired further research and its application in other challenging fractures. Distraction plating can effectively maintain proper fracture alignment while minimising strain on surrounding soft tissues, thereby supporting bone healing and enabling favourable radiological and functional outcomes. Distraction plating may serve as a viable alternative to Kirschner wire fixation by maintaining proper alignment, reducing the risk of pin-track infections, and allowing an earlier return to daily activities.

Keywords:
intra-articular fracture, proximal phalanx fractures, distraction plating method, hand trauma

INTRODUCTION

Phalanx fractures are among the most common hand injuries, comprising 23% of upper extremity fractures diagnosed in emergency departments[1]. Fractures at the base of the proximal phalanx present unique challenges compared to other fractures due to their diverse presentation, ranging from small avulsion fractures of collateral ligaments to complex, multi-fragment comminuted fractures.

The lumbricals flex the proximal fragment, while the central slip extends the distal fragment, creating a shortened, extended phalanx. This imbalance disrupts the extensor mechanism, causing proximal interphalangeal (PIP) joint extensor lag proportional to bone shortening and potentially leading to fixed flexion contractures that impair hand function. When therapy fails to restore adequate motion, surgery is required to reestablish the proper length-tension balance[2]. Untreated fractures can lead to malunion, often resulting in dorsal angulation caused by unopposed soft tissue forces.

Proximal third phalanx fractures pose additional challenges as the lateral bands envelop the bone, causing hardware friction and range of motion (ROM) restriction. Temporary fixation with K-wires can address these issues[3]. However,

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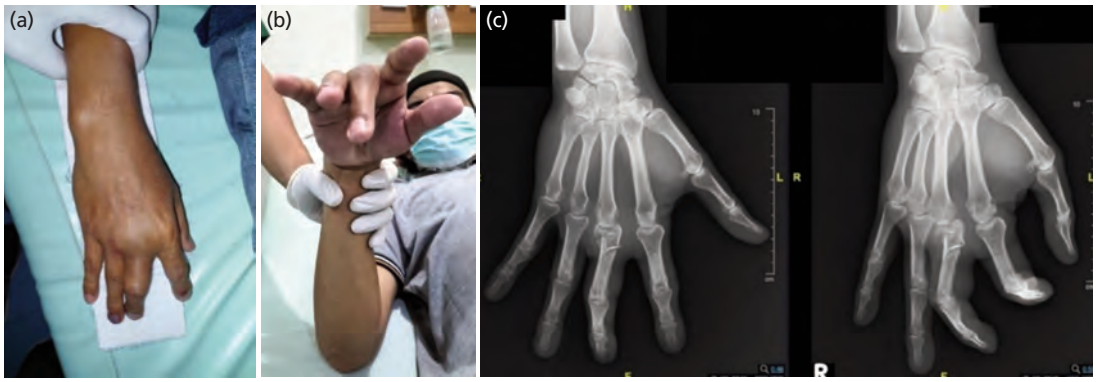

Fig. 1: (a) Patient's initial hand examination showing evidence of swelling and malalignment of the third digit. (b) The cascade examination showed malrotation of the third digit. (c) Pre-operative hand radiograph, anteroposterior and oblique view.

Fig. 2: Image of the hand, taken one-year post-operative, demonstrates favourable outcomes, showing optimal reduction and restoration of the patient's range of motion (ROM) to pre-injury levels.

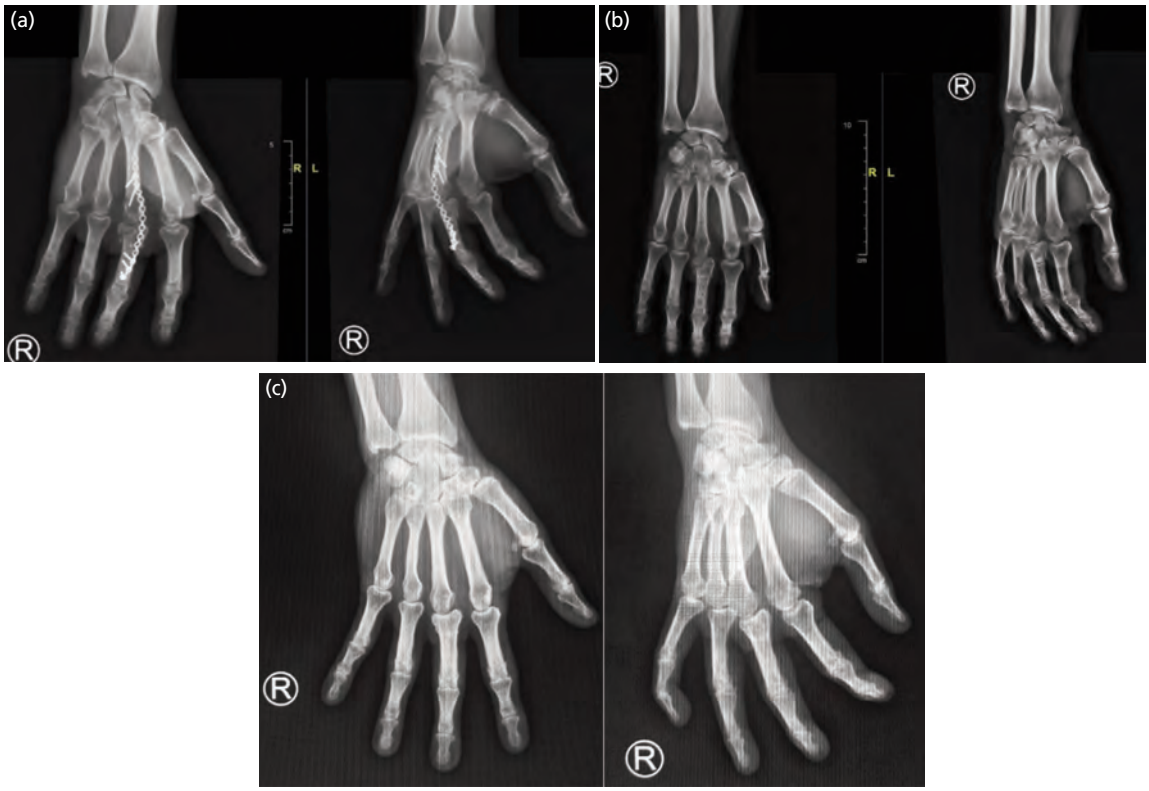

Fig. 3: (a) A comparison of six weeks post-operative, (b) immediate post-removal of implant, and (c) one-year post-removal of implant radiographs. Radiographic image of the hand, taken one-year post-operative, showing absence or minimal visible deformity, with the bone returning to its original anatomical shape.

aligning small intra-articular fragments precisely remains difficult. Reports on ORIF with distraction plating for these fractures are limited but demonstrate promising outcomes at one-year follow-ups.

CASE REPORT

A 47-year-old male fell from his motorcycle, injuring his right hand on the handlebars. He reported an inability to move his hand due to pain. Examination revealed swelling, deformity at the metacarpophalangeal (MCP) joint level, and no ROM throughout the third digit (Fig. 1). Flexion and extension of the interphalangeal joint (IP) were intact. The phalanx was tender on palpation, and the neurovascular function was normal. Patient was diagnosed with a complete articular fracture aligning with AO 78.1.1.1C as classified by Orthopaedic Trauma Association and the AO Foundation.

Due to the acute presentation, comminution, risk of avascular necrosis of the base, and malunion, ORIF with a miniplate was performed. Open reduction with external fixation and pin fixation were avoided due to the significant force required to maintain reduction in the acute setting.

A slight curved dorsal incision on the dorsal side was made. Subperiosteal dissection was not performed to preserve vascularity to the proximal phalanx. Following closed reduction, a 2.0mm 15-hole miniplate [Osteomed, Dallas, USA] was applied, along with two 2.0 x 10mm and three 2.0 x 14mm locking screws under fluoroscopy.

After two weeks, the sutures were removed. A volar splint was maintained for six weeks. After 6 weeks, the plate was removed, and intra-operative ROM assessments showed DIP (0 – 10°), PIP (0 – 20°), and MCP (25 – 30°). The patient was referred to a rehabilitation program involving thrice-weekly exercises, including active/passive ROM, full finger extensions, making a fist, and squeezing a soft ball.

The patient had regular monthly to bimonthly outpatient follow-ups. At one year, he reported high satisfaction with his functional recovery. ROM at the third MCP joint was 45 – 90°, and ROM at the PIP and DIP joints was 0 – 90°. Follow-up radiographs showed a satisfactory result with minimal signs of previous fracture (Figs. 2 and 3). Comparative early post-operative and post follow-up radiographs are as seen in Fig. 3. The Patient's written consent was received before the writing of this case report.

DISCUSSION

Proximal phalanx base fractures can occur in different segments, each having varying degrees of complexity. Proximal phalanx fractures at the intra-articular region pose

a significant challenge due to potential impact on the joint junction, and increased risk of stiffness, malalignment, and chronic pain[4]. Achieving optimal treatment outcomes is crucial for restoring hand dexterity. The primary goal for such fractures is to restore articular congruity, maintain joint mobility, which is critical for hand function[3].

External fixation using plates and lag screws, although effective for unstable fractures, necessitates opening the joint capsule, thereby compromising vascularity and increasing the risk of pin-tract infection, neurovascular injury, and patient discomfort due to bulky external hardware. This method is generally reserved for fractures that are less likely to heal with internal fixation[3]. Kirschner wire fixation is suitable for comminuted fractures with a larger single fragment, particularly in the proximal third, where the extensor tendon covers the region, and may cause adhesions with permanent plates. Risks include pin-site infections, joint stiffness, and tendon adhesions. In this case, K-wire fixation is inadequate to maintain anatomic reduction, given the presence of multiple fragments and/or soft tissue injury[1].

Distraction plating has recently gained popularity as an alternative to manage complex intra-articular proximal phalanx base fractures, prioritising maintenance of reduction and avoidance of exposed wires. In this case, distraction plating was chosen as a more stable fixation method for small multi-fragmented fractures and following the patient's wish to avoid exposed wires and post-operative motion restrictions. Additionally, previous studies on hand fractures have found that distraction plating provides a rigid construct while avoiding potential complications, such as pin-tract infection, pin loosening, and soft tissue tethering. Even though previous studies have found insignificant differences between the outcomes of conventional approaches and plating, K-wires may be associated with higher rates of malunion and require longer downtime, which may progress into joint stiffness, an unwanted aftermath, considering the fracture site.

Distraction plating maintains proper fracture alignment while minimising strain on surrounding soft tissues, promoting bone healing with good radiological and functional outcomes[5]. This technique, often applied in complex comminuted distal radius fractures, can maintain alignment, promote bone healing, and avoid disrupting articular content. Furthermore, plate fixation, including distraction plating, allows earlier mobilisation and restoration of finger range of motion in comparison to other conventional approaches. However, its placement across joints can restrict movement and lead to joint stiffness, while hardware may cause extensor tendon adhesions. In this case, the surgeon minimised extensor dissection by working from the radial aspect, avoiding tendon adhesions. Despite six weeks of fixation and subsequent removal, the patient regained excellent ROM and pre-injury functional status, likely due to compliance with rehabilitation. The patient did undergo a structured rehabilitation program that focuses on both active and passive ROM. Previous studies have found that early and consistent rehabilitation is essential in maximising functional outcomes and minimising stiffness after phalangeal fractures. Additionally, the outcomes in this study are consistent with previous reports demonstrating the efficacy of distraction plating in complex phalangeal fractures, with most patients regaining high levels of function and satisfaction.

To our knowledge, only a limited number of case reports have documented distraction plating for intra-articular proximal phalanx fractures with complete functional recovery over one year, making this case a unique and valuable addition to the literature.

This case also highlights the advantages of distraction plating over traditional external fixators. Further research is warranted to evaluate outcomes, refine techniques, optimise fixation duration and patient-specific considerations, and establish guidelines to enhance outcomes for these challenging fractures.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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