

Delayed treatment of unstable proximal interphalangeal joint fracture-dislocations with a dynamic external fixator



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ABSTRACT

Background: Fracture-dislocations of the proximal interphalangeal joint (PIPJ) remain a challenging problem to treat. Although there are a number of papers describing the use of dynamic external fixators and force couples for treatment of unstable PIPJ fracture-dislocations acutely, the literature is scarce on delayed treatment of PIPJ fracture-dislocations, where malunion of the articular surface may theoretically compromise postoperative range of motion (ROM) at the PIPJ. The purpose of this study was to evaluate the effectiveness of dynamic distraction external fixation (DDEF) for the delayed treatment of PIPJ fracture-dislocations at least 3 weeks after the inciting injury.

Methods: Ten consecutive patients were treated with delayed DDEF between 2010 and 2013. Postoperative ROM at the PIPJ was measured. Disabilities of the Arm, Shoulder and Hand (DASH) score and Michigan Hand Outcomes Questionnaire were administered to all patients postoperatively.

Results: Mean time from injury to surgery was 27.5 days. The mean follow-up period was 23.7 months (range 10–36). The mean active ROM at the PIPJ on final postoperative follow-up was 83.9° (range 52–100). None of the patients experienced pin-tract infections. Mean DASH score was 3.7 ± 3.4 and mean Michigan Hand Outcomes Questionnaire score was 97.3 ± 3.0. All patients returned to work and resumed normal activities.

Conclusions: Delayed treatment of unstable PIPJ fracture-dislocations with a DDEF is effective in restoring function to the PIPJ. Nascent malunion of the PIPJ articular surface does not compromise postoperative outcomes and the joint surface undergoes remodeling over time to restore a smooth and functional articular surface.

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Introduction

The proximal interphalangeal joint (PIPJ) is one of the most commonly injured joints in hand. Unstable PIPJ fracture-dislocations and pilon fractures present a particularly difficult problem to treat, due to difficulty in reducing multiple displaced fracture fragments, compounded by the necessity for early joint motion to prevent stiffness. A variety of distraction systems have been described for immediate treatment of these injuries, with the aim of reducing fracture fragments with ligamentotaxis, while allowing simultaneous early joint motion [1–7]. The vast majority of

patients were treated immediately after the inciting injury. Early treatment, according to recommendations in the literature, is crucial, to reduce any subluxation and institute early mobilisation [7]. In addition, immobilisation for >3 weeks can result in permanent loss of motion [8].

Unfortunately, treatment may be delayed if the patient does not seek immediate medical attention. This problem is more common in rural areas, or where access to tertiary health care is not immediately available. As injury to the PIPJ may not necessarily cause much pain, particularly with immobilisation, patients may not seek medical treatment if it is not conveniently available. Under these circumstances, malunion at the articular surface of the PIPJ can theoretically impair outcomes with the requirement for a more invasive procedure, such as open reduction and internal fixation (ORIF) [9], volar plate arthroplasty [10], or hemi-hamate arthroplasty, which has been used with success in delayed treatment of patients with dorsal PIPJ fracture-dislocations and

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Table 1
Patient information.

Patients	Gender	Age (years)	Injured hand	Injured finger	Time from injury to surgery (days)	Follow-up (months)	Schenck grade	Type of fracture
1	F	57	Left	IV	43	22	IIIA	Palmar lip
2	F	79	Right	IV	21	26	IIIA	Palmar lip
3	F	37	Left	IV	21	20	IIIB	Pilon
4	M	64	Left	IV	23	30	IIIA	Palmar lip
5	M	46	Left	II	31	36	IIIB	Palmar lip
6	M	42	Left	IV	30	18	IIIB	Palmar lip
7	F	48	Right	V	23	33	IIIA	Palmar lip
8	F	24	Left	II	25	26	IIIA	Palmar lip
9	F	35	Right	III	27	16	IIIA	Palmar lip
10	F	62	Left	IV	31	10	IIIB	Pilon

fractures involving the palmar lip of the base of the middle phalanx [11,12]. Hemi-hamate arthroplasty is a procedure that can result in good outcomes. However, it cannot be used for fractures involving both the dorsal and palmar articular surfaces. In addition, there is a steep learning curve, and a high technical proficiency is required to contour the graft while maintaining an adequate-sized bone block for fixation that allows early motion at the PIPJ [11].

There are three treatment goals: (1) to restore a congruent and stable joint throughout the arc of motion without “hinging,” (2) to achieve early motion, and (3) to reduce the articular surface. Unfortunately, not all three goals are achievable, particularly in severe pilon fractures involving the entire articular surface with a central depressed articular fragment. In these cases, the aim would be to achieve goals 1 and 2, and allow the patient to regain useful function.

The largest series to date examining the use of a distraction device for management of unstable PIPJ fracture-dislocations was published by Khan and Fahmy [7], with 81 PIPJ fracture-dislocations. In their series, only four patients were treated after 21 days, two with pilon fractures, one with a palmar lip fracture, and one with a unicondylar fracture. The mean follow-up period was 8.3 months.

In view of the lack of evidence regarding the delayed application of dynamic distraction external fixation (DDEF), the aim of this study was to review the results of delayed DDEF performed at least 21 days after the initial injury for the treatment of unstable fracture-dislocations and pilon fractures of the PIPJ.

Materials and methods

Institutional review board (IRB) approval was obtained by the Human Ethics Committee of our institution, according to ethical guidelines of the Helsinki Declaration. Written informed consent was obtained from individual participants. Charts were reviewed for patient demographics and outcomes data. Consecutive patients underwent DDEF at a single tertiary hand surgery centre between 2010 and 2013.

Inclusion criteria

The Schenck classification [13], which describes both the percentage of the fractured joint surface and the degree of dorsal dislocation, was used to classify fractures preoperatively. Fracture grade (percentage of articular surface): type 1 (<10%), type II (11–20%), type III (21–40%), and type IV (>40%). Dorsal dislocation grade: grade A (<25%), grade B (25–50%), grade C (>50%), and grade D (total). Patients meeting criteria for surgery were at least Schenck IIIA, and other patients were treated conservatively with extension block splinting. For palmar lip fractures, congruent reduction of the PIPJ could not be obtained with a dorsal blocking splint in 30° of flexion. All patients had at least 10 months of follow-up and were mentally competent.

Patients and methods

Between 2010 and 2013, 10 patients (seven female, three male) underwent DDEF for the delayed treatment of unstable fracture-dislocations of the PIPJ or pilon fractures. The mean age at the time of surgery was 48 years (range 24–79). The mean follow-up period was 23.7 months (range 10–36). The injury was located most commonly in the ring finger ($n = 6$), followed by the index finger ($n = 2$), middle finger ($n = 1$), and little finger ($n = 1$). A total of seven patients injured their nondominant hand. The fractures in six patients were classified as Schenck IIIA and those in the remaining four patients were classified as IIIB. There were eight palmar lip fractures and two pilon fractures. The mean time from injury to surgery was 27.5 days (range 21–43). Patient information is provided in Table 1. All patients were given local anaesthesia and were fitted with the pins and rubber band system (Figs. 1–2). Active mobilisation of all finger joints was initiated for 2 days postoperatively. After 4 weeks, the Kirschner wires (K-wires) were removed and the patients returned to full activity.

Disabilities of the arm, shoulder and hand (DASH) score and Michigan Hand Outcomes Questionnaire [14] were administered to all patients at final follow-up. A functional scoring system as described by Ishida and Ikuta [9] (Table 2) was used to evaluate objective outcomes at final follow-up.

Surgical technique

Patients were treated while awake, with local anaesthesia. Surgical technique is depicted in Figs. 1 and 2. A 0.045-inch K-wire was placed transversely through the centre of the head of the proximal phalanx under fluoroscopic control. The wire was bent on both sides of the finger at a 90° angle towards the digit and directed distally towards the fingertip. The end of the K-wire reached ~5 cm distal to the fingertip and was formed into a hook shape. A second 0.035-in. K-wire was inserted parallel to the first wire into the proximal aspect middle phalanx at the diaphyseal–metaphyseal junction, and the ends were similarly shaped into a hook. We did not use a third K-wire inserted at the base of the dorsally displaced middle phalanx, as described by Ruland et al. [3]. Rubber bands were applied between the hooks of the wires on both sides of the finger. Intraoperative X-rays were obtained at this point to evaluate the distraction at the joint space and to confirm that

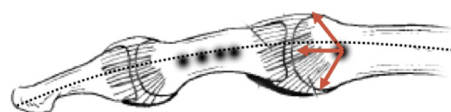


Fig. 1. Schematic of surgical technique. A 0.045-in. K-wire was placed transversely through the centre of the head of the proximal phalanx. A second 0.035-in. K-wire was inserted parallel to the first into the proximal aspect of the middle phalanx.

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