Injury, Int. J. Care Injured 47 (2016) 377–382

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Pressing fixation of mallet finger fractures with the end of a K-wire (a new fixation technique for mallet fractures)☆

Wenlong Zhang [a], Xu Zhang [b], Gang Zhao [a,*], Shunhong Gao [a], Zhiliang Yu [a]

[a] Department of Hand Surgery, Second Hospital of Tangshan, Hebei, People's Republic of China
[b] Department of Hand Surgery, Second Hospital of Qinhuangdao, Hebei, People's Republic of China

ARTICLE INFO

Article history:
Accepted 19 September 2015

Keywords:
Bony mallet finger
K-wire
Fragment
Pressing fixation
Surgical treatment

ABSTRACT

Aim: The aim of this study was to describe and evaluate a surgical technique for the treatment of mallet finger fractures using a K-wire stabilization of the distal interphalangeal (DIP) joint and another K-wire pressing the bone fragment.
Methods: Between June 2007 and March 2014, 41 patients (28 men, 13 women) with isolated closed mallet finger fracture were treated using two K-wires. In the cohort, the mean joint surface involvement was 44.3% (range: 28–62%). With a mean period of 23.6 months, patient follow-up lasted 13–34 months. The fingers were evaluated for loss of extension and flexion of the (DIP) joints. The results were graded using Crawford's criteria.
Results: Union of all fractures took place at an average of 5.5 weeks after the surgical procedure. Average extension lag was 4°, and active flexion 71°. According to the Crawford rating scale, 35 fingers were excellent, four were good, one was fair, and one was poor.
Conclusions: Pressing fixation of the bone fragment with the end of a K-wire was a useful technique in the treatment of mallet finger fractures.
Type of study/level of evidence: Therapeutic IV.

Introduction

In general, mallet finger fracture is a work or sport-related injury, which is an avulsion of the extensor tendon from the base of the distal phalanx with a bony fragment [1]. If untreated, the distal phalanx may gradually assume a fixed flexed position, and the proximal phalangeal joints may gradually hyperextend [2]. Various treatments have been proposed, but the optimal treatment choice is controversial.

Conservative treatment of mallet finger fracture has been extensively reported, such as continuous rigid aluminium splinting, prefabricated splints, plaster casting, and custom-made orthosis [3–6]. However, nonsurgical treatment provides less than satisfactory results in those cases in which there is a fracture avulsion of more than one-fourth of the base of the distal phalanx [1]. Various surgical techniques have been described including open reduction and K-wire fixation, pin fixation alone, tension band wire, and pull-out steel wires [7]. According to the type of surgery, major complications are pin migrations, loss of reduction, and avascular necrosis of the fragment [8].

The aim of this study is to describe a surgical technique for pressing fixation of the dorsal fragment with the end of a K-wire after stabilization of the distal interphalangeal joint (DIP) joint with another K-wire and evaluate the efficacy of the use of this technique.

Materials and methods

Between June 2007 and March 2014, 41 patients with mallet finger fractures were treated in our hospitals. The series comprised 28 men and 13 women with an average age of 37 years (range: 17–53 years). The injury occurred in the right hand in 29 patients and in the left hand in 14. The ring finger was the most commonly injured digit (17 cases), followed by the little finger (14 cases), long (seven cases), and index (three cases). The injuries occurred during sports ($n = 21$), working ($n = 12$), daily activities ($n = 5$), and fighting ($n = 3$). The mean time between the injury and operation was 4.5 days (range: 1–22 days).

☆ No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

* Corresponding author at: Department of Hand Surgery, Second Hospital of Tangshan, Hebei 063000, People's Republic of China. Tel.: +86 03152058010.
E-mail address: zhaog9998@126.com (G. Zhao).

http://dx.doi.org/10.1016/j.injury.2015.09.018
0020–1383/

Preoperative radiographs were obtained in all cases. On the lateral view, the articular surface of the fragment was measured as a percentage of the entire joint surface. The average articular surface of the fragment was measured at 44.3% (range: 28–62%) of the joint surface, and mean fragment displacement was measured at 3.6 mm (range: 2–5 mm) (Figs. 1–3). On the lateral view, 19 injured fingers had DIP joint subluxation.

The patients recruited for this study met the following standards: (1) joint unstable during active flexion appearing subluxation of the DIP joint; (2) size of the fracture fragment involving one-fourth or more of the joint surface; and (3) complete occurrence of ossification involving the base of the distal phalanx. The exclusion criteria were as follows: (1) if the fracture was comminuted; (2) if the size of the avulsed dorsal fragment involved less than one-fourth of the joint surface; (3) if the fragment was present with no displacement; and (4) if the injury was a tendinous mallet finger injury.

The data of the postoperative results were collected from office visits or home follow-up visits. This study was approved by the institutional review boards of the participating hospitals. Health Insurance Portability and Accountability Act consents were obtained from each patient. In addition, all patients gave their consent for purposes of this study before surgery.

Surgical technique

Surgery was performed under local anaesthesia with finger tourniquet control. An H-shaped incision was made over the dorsal aspect of the DIP joint. The fracture was then exposed clearly.

Using a 0.039- or 0.047-inch-diameter K-wire from the tip of the distal phalanx and across the DIP joint to the middle phalanx in a retrograde manner, the DIP joint of the injured finger was stabilized in slight hyperextension. The end of this K-wire was left out of the skin (2–3 mm). The fragment was reduced by rotating and placing it into the trough. In the lateral plane, an oblique line was marked which formed an angle of about 30° with the longitudinal axis of the middle phalanx. The entry point was located at the distal one-third of the middle phalanx (Fig. 4). Another 0.039-inch-diameter K-wire was inserted from the entry point towards the base of the middle phalanx at an angle of 30° and passed through the dorsal and volar cortex, respectively. The end of this K-wire was bent at an angle of 90–120° at the level of 5 mm distal to the entry point (Fig. 5). The excessive wire was then cut off leaving a 3-mm-long hook. The hook was rotated 180° to press the dorsum of the fragment (Fig. 6). The pressure at the end of the hook should be moderate so as to provide better control and reduction of the dorsal fragment. X-ray photographs were then taken to confirm the achievement of complete reduction. Finally, the wound was closed (Figs. 7–12).

Fig. 2. The mode pattern of the mallet finger fracture.

During the procedure, the oblique K-wire was drilled onto the middle phalanx at the distal one-third and passed through the dorsal and volar cortex at an angle of 30°. Thus, the fragment was buttoned and pressed into the reduced position. Based on visual estimation, the K-wire was passed through the middle phalanx at an angle of 30°. The fragment being buttoned and pressed would be difficult if the angle was <30°. If the angle was too large, the presenting distance between the end of the K-wire and the fragment would be longer. The hook would then be obvious under the skin. According to our experience, the end of the K-wire hook should press the centre of the fragment. If the hook pressed the far end or near end of the fragment, it would shift or even overturn under the tension.

Postoperative management

A small splint over the metacarpophalangeal joint was used for 2 weeks followed by a finger plaster cast applied directly over the DIP joint that allowed active motion of the proximal interphalangeal and metacarpophalangeal joints. The suture line was removed 2 weeks after the surgery. On radiographic examination, the cortices of the fragment appeared to be joined confirming the

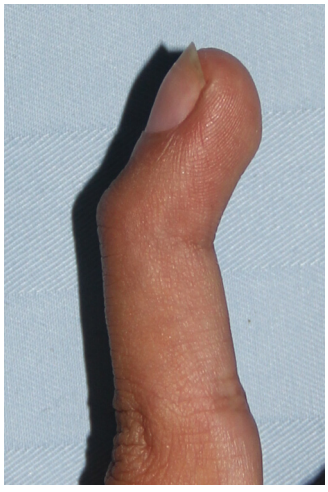

Fig. 1. The mallet finger deformity.

Fig. 3. The actinogram of the mallet finger fracture.