

Effectiveness of clinical estimation of bone union in hand fractures: a preliminary report

Andrzej Żyluk

Pomeranian Medical University in Szczecin, Department of General and Hand Surgery, Unii Lubelskiej 1, 71-252 Szczecin, Poland

ORCID: 0000-0002-8299-4525

✉ azyluk@hotmail.com

ABSTRACT

An assessment of the healing of bone fractures is mainly based on X-ray confirmation of some characteristic features of fracture consolidation. This paper presents a new method of estimation of bone union of hand fractures based on examination of pain resulting from pressure of the fracture site. It was assumed that bone is united if at 2–3 weeks the fracture site is painless. The pain at the fracture site was examined in 12 patients with fractures of phalanges and metacarpals of specified configuration; an assessment was performed at the beginning of the treatment and after 2, 3, and finally at 4 weeks. All patients were treated by functional method, without any immobilization. At baseline, the mean level of pain in numeric rating scale was 6.4 and in subsequent assessments a significant reduction in pain

was observed, down to 0.6 at 4 weeks. Radiological assessment at 4 weeks showed a lack of consolidation of the fracture in 8 patients and at 8 weeks in 4. Despite this, all patients demonstrated normal function of the hand and all returned to normal daily activity and to work. The results of this study demonstrate that clinical assessment of phalangeal or metacarpal fracture healing based on the lack of pain in reaction to applying pressure on the fracture site is a better and more reliable method than radiological estimation which shows bone union significantly later. The proposed clinical assessment allows patients a significantly earlier normal use of the affected hand.

Keywords: phalangeal fracture; metacarpal fracture; functional treatment; outcome assessment.

INTRODUCTION

An assessment of healing of bone fractures is mainly based on X-ray confirmation of some characteristic features of fracture consolidation, such as invisible or hardly visible fracture line (clearly visible before), a trabecular pattern over a fracture line, and periosteal thickening at both sides of the fracture. When these features are clearly visible in X-ray imaging, it confirms that the bone fracture united. However, in some situations, these signs are vague and weakly expressed, and then the estimation of bone union is interpreted as “uncertain” or “marked” bony union. If, after an adequate period of immobilization, or post-operatively, the fracture line is still visible, it means that the fracture did not unite and it is called “nonunion”. This interpretation of the radiological picture is characteristic of long bones healing, i.e. humeral or antebrachial bones. However, this is different in hand fractures because their healing is governed by slightly different rules. Finger and metacarpal fractures, both shafts and metaphyseal parts, unite well and nonunion occurs very rarely. It may occur in a substantial displacement of fracture, when bone fragments are separated one from another or there is an interposition of soft tissue (i.e. muscles) between bone fragments. In hand bones, the time of healing is also significantly shorter than in other (larger) bones and lasts approx. 3–4 weeks [1, 2].

OUTLINE OF THE IDEA OF THE CLINICAL ASSESSMENT OF BONE UNION

Healing time for finger fractures shown by X-ray imaging is often longer than the actual clinical healing. Fractures are frequently quite solidly healed 2–3 weeks after injury, in spite of a lack of clear signs of healing in an X-ray image. There is a simple clinical test confirming finger or metacarpal fracture healing, performed with the thumb and index finger of the examining person: when a firm pressure over a finger fracture 2–3 weeks following injury causes no pain, or only slight pain, it means that fracture is likely to be healed and immobilization (if it has been used) can be safely removed. The absence of fracture line tenderness implies good clinical healing (bone union) [3, 4]. It is also valid for fractures treated by percutaneous fixation with K-wires: no pain in reaction to firm pressure on the fracture suggests that K-wires can be safely removed even 3 weeks after surgery. However, additional injuries such as nerve lacerations or skin wounds in the fractured digit, which cause additional pain or numbness at the fracture site, disturb this situation, and then, clinical healing is no longer a valid measure of bone union.

The objective of this study was an assessment of the effectiveness of clinical estimation of bone union in hand fractures of specified configuration which met the criteria of inclusion for functional treatment, without any immobilization.

MATERIALS AND METHODS

Over a period of March 2021–May 2022, 12 patients, 9 men and 3 women, at a mean age of 29 years (range 21–36), with fractures of the metacarpal bones and phalanges were treated in the author's institution according to functional protocol, without immobilization. The following criteria of inclusion were employed:

- oblique and spiral fractures of the metacarpal shafts,
- oblique and spiral fractures of the phalanges (proximal and middle),
- fractures of the base of proximal phalanges.

Two patients had spiral fractures of metacarpal bones, 5 had the oblique or spiral fractures of proximal phalanges, 3 had the fractures of middle phalanges, and 2 had the fractures of the base of proximal phalanges. All fractures were without or minimal displacement, except 1 case with a moderate displacement of the proximal phalanx fracture (Fig. 1). All patients were treated without any immobilization, according to the following protocol:

- the patients were encouraged to make a full fist with the fingers in 1 block (Fig. 2),
- full finger flexion should be maintained for about 30 sec, followed by the extension of the fingers,
- repeating these exercises 6 times a day, of 10 full flexion-extension cycles.

The patients were allowed to use their hands in light daily activities and at work, i.e. using a computer, hand-writing with a pen, or carrying light objects.

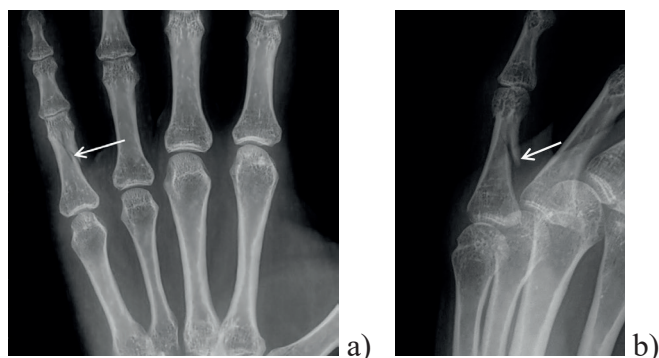


FIGURE 1. Fracture of the proximal phalanx of the little finger, moderately displaced: a) p-a view; b) lateral view

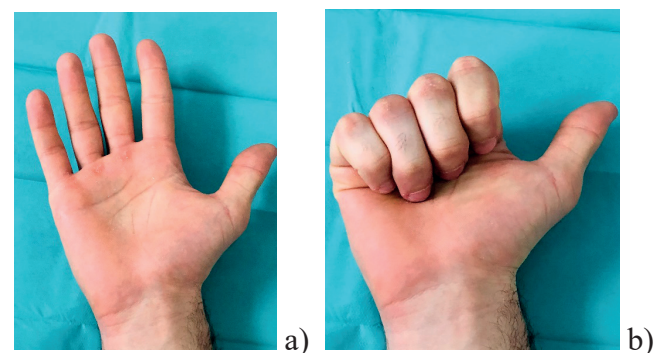


FIGURE 2. Functional treatment of metacarpal fracture – full finger: a) extension; b) flexion

Clinical examination consisted of the evaluation of pain experienced by patients in reaction to a moderate pressure applied on the fracture site using the thumb and index finger of the examining physician. The intensity of pain was estimated on the numeric rating scale (range: 0 – no pain; 10 – maximum pain). The patients were examined at admission, and then at second, third, and finally at fourth week. Over and above a range of motion on the involved finger was assessed in a categorical scale: full vs. limited range of motion. X-ray imaging was performed at 4 and 8 weeks post-fracture and viewed for estimation of bone union and presence of possible displacement.

RESULTS

The results of assessment of pain in reaction to pressure applied at the fracture site are shown in Table 1. A gradual reduction in pain is clearly visible, which – in line with the preliminary assumption – shows the consolidation of the fracture. At the final assessment at 4 weeks, the mean value of pain was 0.6, which indicated that the fracture site was painless. With regard to the range of movement, at 2 weeks, 5 patients had full finger motion, and 7 patients had reduced motion. At 3 weeks, all patients achieved a full range of motion of the involved finger. At the final assessment at 4 weeks, all patients were able to freely grasp objects with the affected hand and all returned to normal daily activity. Four patients returned to light manual work at 4 weeks, including 1 dentist who resumed her work 2 weeks after fracture. She was particularly happy with this method of examination as it allowed her to avoid financial loss.

TABLE 1. Pain experienced by the patients in reaction to pressure applied on the fracture site in the consecutive weeks after injury

Week of assessment	Pain in reaction to pressure (NRS)	
	mean	range
At baseline	6.4	5–8
2 weeks	4.1	3–6
3 weeks	3.2	2–5
4 weeks	0.6	0–3

NRS – numeric rating scale

Radiological assessment

X-ray imaging performed at 4 weeks showed no significant displacement of the fractures. The traditional estimation of fracture healing showed uncertain bone union in 4 cases and an absence of union in the remaining 8 (Fig. 3, 4). This did not, however, obstruct our treatment regime which allowed the patients to use their hands freely and return to work. Radiological assessment at 8 weeks showed firm bone union in 4 patients and uncertain union in the remaining 8. All patients were fully satisfied with this method of fracture management, thanks to which they could quickly return to using their affected hand in normal tasks (Fig. 5).



FIGURE 3. Spiral fracture of the fourth metacarpal; X-ray image at 4 weeks showing uncertain union

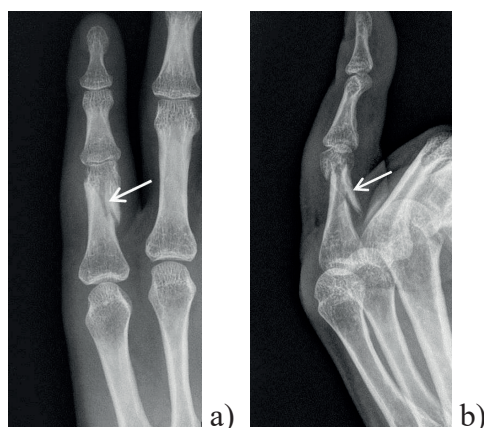


FIGURE 4. X-ray image of the fracture at 4 weeks; a) the same displacement, uncertain union; b) the same displacement, uncertain union

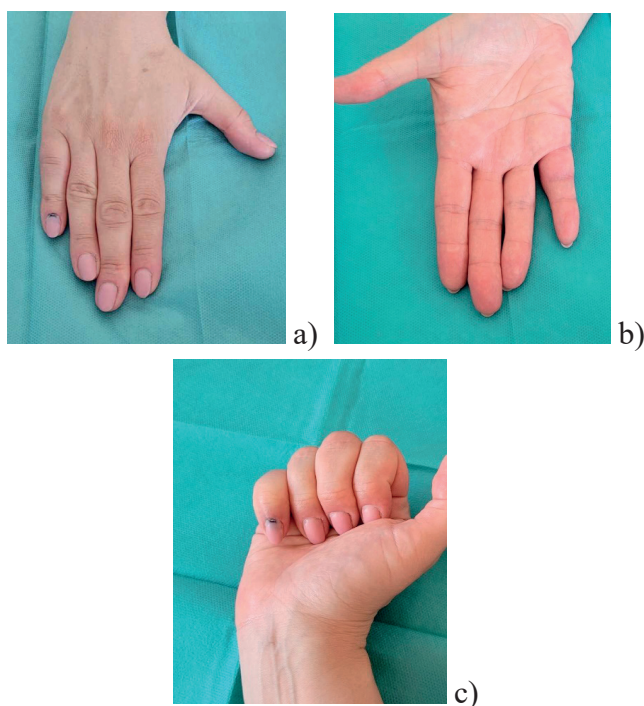


FIGURE 5. The appearance of the hand with a fractured little finger at 4 weeks; Figures 4a and 4b – full finger extension. Figure 4c – full finger flexion

DISCUSSION

The presented method of clinical estimation of bone union in hand fractures allowed confident and accurate assessment of fracture union without X-ray imaging, in which the features of bone healing would likely be absent. This concept of estimation of consolidation of hand fractures was presented in only 2 articles and did not undergo scientific verification [3, 4]. This study is the first and successful attempt at clinical and scientific investigation of this concept. The results obtained in this study are very good and prompt the propagation of this method of treatment of hand fractures and estimation of bone healing.

The author of this paper found only 2 articles about the functional treatment of hand fractures, but no one concerned the estimation of bone healing. Kahn and Giddins reported the outcome of functional treatment of 28 spiral and oblique metacarpal fractures according to the same protocol as in the present study. At a mean of 1-year follow-up, 23 patients had an excellent outcome and 2 had good outcomes. All the fractures united with some minimal shortening which did not affect the function of the hand. All patients achieved full finger movement and grip strength that were roughly the same as before injury and all returned to their original occupation (if employed) [5, 6].

In the author's earlier study, the results of the functional treatment of 6 patients with stable fractures of the metacarpal bones and phalanges were reported. At the 3-month follow-up all patients achieved full finger movement, good function of the hand, and consolidation of their fractures confirmed radiologically. Change of the treatment into operative was not necessary in any of the patients [7].

The results of this study demonstrate that the clinical assessment of phalangeal or metacarpal fracture healing based on lack of pain in reaction to pressure applied on the fracture site is a simple, accurate, and reliable method. The weak point of this study is a low number of patients; thus, its results should be treated as a preliminary report.

REFERENCES

1. Feehan LM, Sheps SS. Treating hand fractures: population-based study of acute health care use in British Columbia. *Can Fam Physician* 2008;54(7):1001-7.
2. Held M, Jordaan P, Laubscher M, Singer M, Solomons M. Conservative treatment of fractures of the proximal phalanx: an option even for unstable fracture patterns. *Hand Surg* 2013;18(2):229-34.
3. Lalonde D, Ayhan E, Ahmad AA, Koehler S. Important updates of finger fractures, entrapment neuropathies and wide-awake surgery of the upper extremity. *J Hand Surg Eur Vol* 2022;47(1):24-30.
4. Lalonde D. Preferred methods which are against traditional teachings. *J Hand Surg Eur Vol* 2021;46(3):327-30.
5. Giddins GE. The non-operative management of hand fractures. *J Hand Surg Eur Vol* 2015;40(1):33-41.
6. Khan A, Giddins G. The outcome of conservative treatment of spiral metacarpal fractures and the role of the deep transverse metacarpal ligaments in stabilizing these injuries. *J Hand Surg Eur Vol* 2015;40(1):59-62.
7. Żyłuk A. Outcomes of the treating hand fractures without using immobilization. *Pomeranian J Life Sci* 2022;68(3):1-4. doi: 10.21164/pomjlifesci.825.