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Original article

Simplified internal fixation of fifth metacarpal neck fractures

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ABSTRACT

Background: Fifth metacarpal neck fractures (boxer's fractures) are common injuries that contribute 20% of all hand fractures. Divergent percutaneous pinning (bouquet fixation) as described by Foucher has gained popularity but is challenging and at times arduous, as it requires the insertion of several slender K-wires into a narrow medullary canal. Here, we report on a simplified technique in which a single thick K-wire is inserted.
Technique: An 18/10 K-wire is bent at one end then mounted on a drill chuck. The incision is performed and the entry hole created using the K-wire, which is then advanced along the medullary canal. After reduction of the metacarpal head using the Jahss manoeuvre, the K-wire is inserted across the fracture site into the subchondral bone. Any persistent rotational malalignment is corrected by rotating the metacarpal around the K-wire. Immobilisation is by buddy taping covered by a resin guard.
Methods: We collected follow-up data for 30 patients treated using our technique, at a mean age of 32 years.
Results: 90 days after surgery, the fracture was healed in all patients. No patients had rotational malalignment. Mean operative time was 14 minutes. No complications were recorded.
Discussion: The use of a single thick K-wire proved simple, effective, reproducible, and rapid. No rotational malalignment occurred. This technique is faster and easier to perform than divergent pinning with multiple K-wires.
Conclusion: This technique can be used to treat fifth metacarpal neck fractures.

1. Introduction

Fifth metacarpal neck fractures (FMNFs) or boxer's fractures are common injuries that contribute nearly 20% of all hand fractures [1]. The main cause is a direct impact on the closed fist [2]. When displaced, FMNFs can result in loss of strength, loss of extension range, rotational malalignment, and cosmetic disfigurement due to loss of the prominence of the fifth metacarpal head at the dorsal aspect of the hand [3,4]. No consensus exists about the indications of surgery, and non-operative treatment has been reported to provide excellent outcomes [5,6]. However, many internal fixation techniques have been described. Among them, the reference standard [7] is divergent intramedullary pinning (bouquet pinning) as described by Foucher in 1976 [8,9]. This technique consists in using an awl to create a hole in the ulnar cortex of the fifth metacarpal (M5) then inserting three blunt-tipped slender (8 or 10/10) K-wires into the medullary canal. It has been proven effective [10] but is challenging and tedious to perform, because the slender K-wires have limited rigidity and are therefore difficult to advance along the medullary canal, as they tend to bend or to follow inappropriate trajectories. The resulting need for repeating the manoeuvres increases the operative time and the risk of injury to the extensor apparatus or dorsal cutaneous branch of the ulnar nerve [11].

These difficulties have prompted the development of alternative surgical techniques such as double L-shaped pinning [12,13], transverse pinning alone [14] or with external connection of the pins [15], retrograde pinning [16], or intramedullary nailing [17]. However, these techniques are as complex as divergent pinning, and some of them require specific equipment. There is general agreement that surgery is in order when the angulation exceeds 30–40° or rotational displacement exists [18,19]. In contrast, the optimal technique remains debated [14,18,20]. We therefore suggest a simple intramedullary pinning technique that uses a single thick K-wire.

The objective of this study was to assess the outcomes of this original technique in a prospective cohort of 30 patients.

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Fig. 1. The end of the 18/10 K-wire is bent.

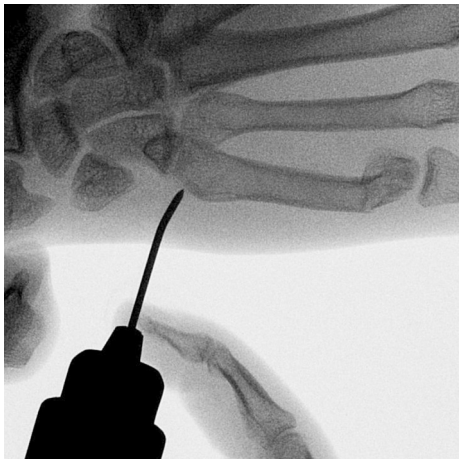

Fig. 2. Fluoroscopy is used to identify the entry point at the base of the fifth metacarpal.

2. Material and methods

2.1. Patients

Consecutive patients presenting with an isolated FMNF with more than 30 [20] angulation on the true lateral radiograph or with physical signs of rotational displacement were included in this prospective study between May 2014 and May 2016. Exclusion criteria were compound fracture, fractures in addition to the FMNF, and a history of fracture of the same hand. Of the 30 included patients, 13 (42%) were operated on by a surgery resident and 17 by a senior surgeon.

Fig. 4. Postoperative immobilisation.

2.2. Operative technique

The patient was supine on a table with an arm rest. A pneumatic tourniquet was placed at the root of the upper limb. An image intensifier (Orthoscan FD OR) was used. One end of an 18/10 K-wire was bent at a 10–20° angle (Fig. 1). The K-wire was then inserted into a drill chuck. An incision was performed along the ulnar edge of the hand, over the base of M5. The blood vessels and nerves were reclined using Halstead's forceps, with special attention to the sensory branch of the ulnar nerve. The tip of the K-wire was placed at the base of M5 under fluoroscopy guidance (Fig. 2). Gentle oscillating movements were used to insert the K-wire into the medullary canal of M5. The classical step of using an awl to create an entry hole was not performed. The K-wire was then advanced along the medullary canal under fluoroscopic guidance to the fracture site. Before crossing the fracture site, the head was reduced using the Jahss manoeuvre [21]: the head was first released from the shaft by gentle traction along the axis of the finger, the metacarpo-phalangeal (MCP) and proximal inter-phalangeal (PIP) joints were then flexed at 90°, and pressure was applied along the axis of the proximal phalanx concomitantly with counter pressure on the metacarpal to correct the anterior tilt of the metacarpal head. Once the head was reduced and any rotational displacement was corrected by flexing and extending the fifth finger, the K-wire was advanced across the fracture site to the subchondral bone. Any persistent rotational displacement was corrected by using the drill chuck to rotate the K-wire. The base of the K-wire was bent at 160° then cut using cutting pliers (Fig. 3). The skin incision was closed. Postoperative immobilisation was achieved by buddy taping M4 and M5 then covering the site with a resin guard that allowed full motion of the wrist and MCP joint (Fig. 4). After 2 weeks, the guard was removed and buddy taping alone was continued for

Fig. 3. Postoperative radiograph.

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4 additional weeks. At week 6, the K-wire was removed under local anaesthesia and rehabilitation therapy was started. Sports activities were resumed after 3 months (Video).

2.3. Data collection

Operative time, radiation dose, and intra-operative difficulties and complications were recorded. All 30 patients attended visits 21, 45, and 90 days after surgery. At each visit, antero-posterior, lateral, and three-quarters oblique radiographs of the hand were obtained. At the day-21 and day-45 visits, the patients were examined for infectious complications, secondary displacement, and K-wire migration. At the day-90 visit, clinical evidence of nerve injury, infection, and rotational malalignment was sought. Fracture healing was assessed on the radiographs, which were assessed for signs of secondary displacement or malunion.

2.4. Statistical analysis

EXCEL software version 15.19 (Microsoft, Redmond, WA, USA) for Mac OSX was used to determine means, standard deviations, medians, and ranges. Statistical tests were run on GraphPad Prism version 6.0 (GraphPad Software, San Diego, CA, USA) for Prism 6 Mac. Values of $p < 0.05$ were considered statistically significant.

3. Results

The study included 30 patients, 25 males and 5 females, with a mean age of 32 years (range, 19–55 years). The injury was on the dominant side in all patients. The mechanism was a punch in 24 (79%) patients. Table 1 lists the features of the population. Mean operative time from the incision to the dressing was 14 minutes (range, 7–28 minutes). Operative time was not significantly different between the groups operated on by junior versus senior surgeons ($p = 0.31$) (Table 2). Mean radiation dose was 0.145 ± 0.048 mGy. No evidence of infection, secondary displacement, or K-wire migration was found at the day-21 and day-45 visits. At last follow-up on day 90, no patient had evidence of injury to the sensory branch of the ulnar nerve, evidence of infection, skin healing problems, or rotational displacement. Fracture healing was achieved in all patients, with no cases of secondary displacement or malunion. Of the 30 patients, 21 had the K-wire removed under local anaesthesia during the day-45 visit. Of the 9 remaining patients, 3 refused to have the procedure under local anaesthesia alone during the visit and 6 required outpatient local and regional anaesthesia after failure of K-wire removal under local anaesthesia alone, due to the wire having been cut too close to the hand. No complications were recorded during follow-up.

Table 1
Characteristics of the 30 study patients.

	n (%)
Age, years, mean (range)	32 (19–55)
Gender, n (%)	
Male	25 (84)
Female	5 (16)
Dominant side, n (%)	
Right	27 (90)
Left	3 (10)
Smoking status, n (%)	
Smoker	16 (53)
Non-smoker	14 (47)
Mechanism of injury, n (%)	
Punch	24 (80)
Fall from own height	3 (10)
Other	3 (10)
Fractured side, n (%)	
Right	27 (90)
Left	3 (10)
Fracture on dominant side, n (%)	30 (100)

Table 2
Characteristics of the surgical procedures.

	n (%)
Anaesthesia, n (%)	
Local and regional	28 (93)
General	2 (7)
Pin removal, n (%)	
During a visit	21 (70)
Outpatient surgery	9 (30)
Surgeon, n (%)	
Junior	13 (43)
Senior	17 (57)
Operative time, minutes, mean	
Junior surgeon	16, $p = 0.32$
Senior surgeon	13
Overall (range)	14 (7–28)

4. Discussion

The internal fixation technique described in this study proved reliable and reproducible. Speed and simplicity are its main advantages and make it accessible to junior surgeons. Despite the use of a single K-wire, no rotational displacements were noted at last follow-up. No complications occurred with this surgical technique.

This technique has several advantages. First, the rigidity of the thick 18/10 K-wire limits the risk of bending or inappropriate trajectory that occurs with slender K-wires. In addition, the technique is well-suited to the small diameter of the medullary canal in females. Although most patients were male, no technical difficulties occurred in the 5 females. Thus, the 18/10 K-wire size is appropriate for both males and females. However, 15/10 K-wires may be suitable when the medullary canal is narrow, although this possibility was not assessed in our study. A second advantage of this technique is the use of a single K-wire, which decreases the operative time to a mean of 14 minutes. In addition, creation of the entry point with the K-wire itself has two advantages: the smaller hole thus obtained offers better cortical support at the base, and there is no need for a bigger entry point as used by Boussakri et al. [22] to perform a technique similar to ours but involving the creation of an entry hole using a 2.5-mm drill.

Bending the end of the K-wire and routinely adding buddy taping seems to limit the risk of secondary displacement and rotational malalignment. Neither of these complications occurred in any of our patients.

The K-wires were to be removed under local anaesthesia during a follow-up visit. However, 6 (20%) patients required K-wire removal in the operating room, because the wire had been cut too short. To facilitate K-wire removal, thereby minimizing the risk of injury to the sensory branch of the ulnar nerve, the end of the wire should be long enough to protrude under the skin. The use of a resin hand guard leaving full range of motion at the wrist and MCP joint has the advantages of protecting the surgical site and dissuading these often young and impulsive patients from repeating harmful behaviours [23] during the early postoperative period.

Intramedullary pinning has several limitations. Major dorsal comminution or presence of a third fragment may make the procedure more challenging and increase the operative time. In this situation, the risk of inappropriate K-wire trajectory in the medullary canal is greater. However, using a single K-wire is less

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difficult than using several K-wires. Thus, posterior comminution or a third fragment may create technical challenges but does not modify our treatment policy.

Pinning is usually deemed preferable over plate fixation for the treatment of FMNFs [24]. Many techniques have been described. Transverse pinning [25] requires the insertion of a K-wire in the epiphysis, i.e., into the joint and therefore carries a risk of injury to the MCP ligament complex [26] and of fragilization and fracture of additional metacarpals [27]. L-shaped pinning was described almost simultaneously in 1981 by Kapandji [13] and by Vives et al. [12] and has since then been recommended by others. [26] This method also requires an intra-articular epiphyseal K-wire. Although all these methods produce good clinical outcomes, simplicity and rapidity are unique characteristics of the technique described here.

5. Conclusion

Internal fixation of FMNFs using a single thick intramedullary K-wire is simple and reproducible. Compared to other techniques, it substantially decreases the operative time and produces satisfactory clinical outcomes without inducing rotational malalignment. It can be used routinely in clinical practice.

Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.otsr.2017.12.010.

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