

Original research paper

Functional outcome of Antegrade Intramedullary k-wire fixation for fifth metacarpal neck fracture

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Abstract

Background: The fracture of the fifth metacarpal neck (also called a boxer's fracture) is the most common fracture of the hand. Displaced fractures often end in volar angulation of the metacarpal head, shortening, and residual malrotation. Although many fractures can be treated conservatively, surgery is indicated in patients with excessive volar angulation, relevant shortening, or rotational deformity.

Methods: In a prospective study conducted June 2019 to June 2021 we analysed the clinical results of 20 patients with metacarpal neck fractures that had been treated by closed reduction with intramedullary pre bent k-wires. Patients were followed at 2 weeks, 6 weeks, 12 weeks for functional outcome and assessed by total active motion of affected and unaffected hand.

Results: Most of the patients were young, with good bone quality and low anaesthetic risk, and they had suffered the fractures as a result of a direct trauma. Predominantly uncomplicated. Surgical treatment was indicated for a palmar axis dislocation of $>30^\circ$ or if a rotatory deficiency $>10^\circ$ was present.

Metacarpophalangeal joint function and correction of rotatory displacement could be assessed on median after a period of six months. In all 20 patients flexion and extension was normal and comparable on both sides. All the patients have pain free range of motion, cosmetic acceptability, without any residual deformity and complete functional restoration.

Conclusion: Intramedullary k-wire fixation is a minimally invasive method for stabilizing metacarpal neck fractures. The excellent long-term clinical results are due to the fact that the gliding tissue around the fractures are not affected by the surgical procedure.

Keywords: K wires, metacarpophalangeal joint, Boxer fracture

Introduction

Injuries to small bones of the hand are commonly encountered in casualty, resulting in fracture of metacarpal and phalanges. Among all metacarpal fractures, fracture of neck of fifth metacarpal is commonest. It's also called "Boxer's fracture" which account for about 36% of all metacarpal fractures ^[1, 2]. The incidence of boxer's fracture is about 20% of all hand injuries and also the prevalence is more in young, active males ^[3, 4]. The foremost common mode of injury is an axial impact on a clenched fist. It is commonly observed in young individual with aggressive behaviours. A bio mechanical study showed that a fracture angle of more than 450 produced significant muscle restriction that can limit movement of fifth digit but a fracture angle up to 300 is compatible with normal functions ^[5]. Surgery is

usually recommended when clinical malrotation of fifth finger as noted on flexion and longitudinal shorting more than 3mm. Several surgical techniques are used such as antegrade intramedullary K-wire, retrograde intramedullary K-wire, retrograde cross pinning with k-wire, transverse pinning K-wire, external fixation, intraosseous wiring and plate fixation [6, 7]. Foucher *et al.*, suggested that antegrade intramedullary K-wire technique is reliable and safe technique produces good fracture reduction and excellent ROM for the patient with fifth metacarpal neck fractures [8-10]. Our aim of the study is to evaluate the functional outcome of fixing the boxers fracture with two intramedullary pre bent K wire introduced in antegrade fashion.

Methods

Our study was a prospective study conducted in the department of Orthopaedics, Vijayanagara institute of medical sciences, Bellary, after obtaining ethical committee clearance. The study duration was two years from June 2019 to June 2021.

All patients presenting with fracture neck of fifth metacarpal were managed by antegrade intramedullary k wire fixation using a prebent K wire. Patient demographics including age, sex, handedness and other associated medical problems were collected. The mechanism of injury was noted and also the side involved was clinically examined for rotational deformity. A series of 20 patients with fractures of the neck of the fifth metacarpal bone (boxer's fracture) were included within the study.

Inclusion criteria were angulation greater than 45° versus the contralateral uninjured side when measured on a 25° pronated (oblique view) on plain X-ray of both hands preoperatively.

Open fracture, concomitant fractures and children younger than 18 years were excluded, articular fractures were not included in the study.

Surgical technique

We used Dorso-ulnar approach to 5th metacarpal base. Under c arm guidance, the entry point is made without damaging the carpo-metacarpal joint and respecting the insertion of the extensor carpi ulnar tendon. The dorsoulnar cortex is opened with a 2 mm drill bit.

The bore is then enlarged with a 2.7 mm or 3.2 mm, drill bit. Two K-wires of 1 mm or 1.25 mm, diameter have to be inserted with the blunt tip first, to scale back the chance of risk of perforating the thin cortex of the metacarpal head.

The distal tip is bent upwards with pliers by about 20 degrees. About 2 cm further, the wire is bent in the same direction by not more than 10 deg.

At a point where the wire is slightly longer than the metacarpal into which it will be inserted, the proximal end of the wire is bent through 90 degrees in the same plane. This way, the direction of the insertion can always be controlled.

To avoid injury, the sharp end of the wire is bent over. Two wires are inserted manually into the medullary canal and advanced into the diaphysis without reaching the fracture zone. The bent tip should point in a volar direction. The fracture is preliminarily reduced by flexing the MP and PIP joints to 90 degrees and using the proximal phalanx to push up the metacarpal head (Jahss manoeuvre) [11]. The wires are now advanced manually, or with a hammer, across the fracture zone into the head.

The correct position is checked using image intensification. The K-wires are then rotated so that the bent tips are pointing dorsally and diverging in opposite directions (dorso-radial and dorso-ulnar).

Ideally, the blunt tips lie underneath the dorsal cortex of the head. This enables for a 3-point fixation which increases the stability of the construct and prevents the K-wires from backing

out proximally. The K-wires are then bent at the level of the entry portal and cut. A removable splint is applied at the end of the operation, with the hand in an intrinsic plus (Edinburgh) position. While the patient is in bed, use pillows to keep the hand elevated above the level of the heart to reduce swelling.

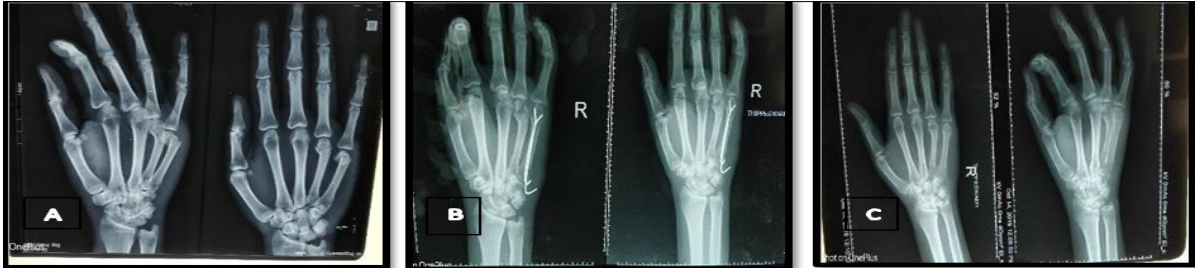


Fig 1: (A) Pre-operative x-ray with angulation at 5th metacarpal neck, (B) angulation corrected after k wire insertion by antegrade manner, (C) complete union without any angulation

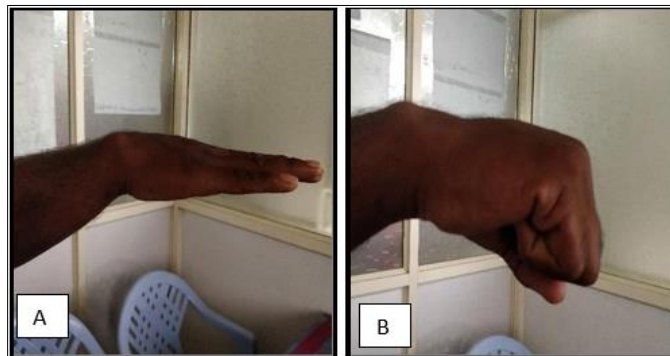


Fig 2: (A) showing MCP joint extension, (B) MCP joint flexion



Fig 3: (A) Preoperative neck shaft angle-90; (B) postoperative neck shaft angle-200

Follow up

Patient is regularly followed up. Alternate day dressing is done and check x-rays are taken to substantiate that no secondary displacement has occurred. Active mobilization is started at about 10-12 days, supervised by a physio therapist. The splint is continued. Additional x-rays are taken at 6 weeks. K wires are removed at 6 week follow up.

Results

Twenty patients were included in our study and the mean follow up period was 6 months and the total study duration was of 2 years. All the fractures involved the dominant hand (16 right and 4 left). Out of the 20 patients operated, 18 are male and 2 females. With most typical

mode of injury being RTA seen in 12 patients, assault (6), and fall from height (2), with age distribution ranging in between 18-40 yrs. All the patients had good functional range of motion, no residual deformity, and cosmetic acceptance.

The mean Total active motion (TAM) of the affected hand at the last follow-up was recorded and was compared therewith of the unaffected hand. We found that at the last follow up the mean TAM of the affected hand was 223.50 (Table 1). At the end of the follow-up there was no significant difference in the Total active motion (TAM) in the affected and the unaffected hand.

Table 1: Total Active Motion at the last follow-up and its comparison with the unaffected hand

Sl. No.	Active motion (AH)	Total active motion (UAH)	% Improvement
1	220	225	97.7
2	215	230	93.4
3	225	230	97.8
4	210	220	95.45
5	215	225	95.5
6	225	230	97.8
7	220	225	97.7
8	230	230	100
9	230	235	97.8
10	230	240	95.8
11	235	245	95.9
12	215	225	95.5
13	230	235	97.8
14	225	230	97.8
15	230	240	95.8
16	210	220	95.4
17	220	225	97.7
18	225	235	95.7
19	225	230	97.8
20	230	240	95.8
mean value	223.25	230.75	96.74
SD	7.3	6.75	0.55

Discussion

Fifth metacarpal fracture is extremely common. Most of the fractures are simple, closed and stable and are treated conservatively [1, 2, 4]. If the fractures aren't stabilized properly cosmetic and functional problems may occur. Closed reduction of displaced metacarpal neck fracture is reported to be difficult to realize and impossible to retain in reduced position by non-operative methods. By closed means using plaster slab, three-point fixation cannot be achieved [12-14]. Green and Rowland mentioned that all the fractures of metacarpal neck are inherently unstable due to deforming muscle forces and volar comminution at the fracture site [15, 16]. Indications for operative treatment include mal-rotation, longitudinal shortening and excessive angulations of the head. Majority of surgeons agree that a shortening of the metacarpals by more than 3 mm and any rotation deformity is poorly tolerated and needs correction. Open reduction and internal rigid fixation using plates has been recommended for unstable fractures [1, 2]. These may cause problems with fracture healing, soft tissue tethering, extensor tendon adhesions, and wound breakdown. Both ante grade and retrograde percutaneous pinning have been describe in literature. Kim *et al.* conducted a study within which he compared ante grade vs retro grade pinning in displaced fractures [6]. They found that ante grade pinning achieved better outcomes than patients in the retrograde group for all

clinical parameters at 3 months postoperatively.

In our study we have used a pre bent k wire introduced in ante grade fashion to provide reduction of the fragment. We found that the pre bent k wire not only provides good reduction but also provides a stable 3-point fixation. There was no significant difference between the affected and the unaffected hand with respect to the TAM at the end of 6 months.

Conclusion

Metacarpal neck fractures are very common fracture type in young active adults. Conservative management is usually associated with shortening and angular deformities. Percutaneous fixation of the fracture with pre-bent K wire placed in antegrade fashion provides good stability at the fracture site. The bent nature of the wire helps in correction of rotation and angular deformities. This is a relatively easy technique with good post-operative results (cosmetic, functional) and with short learning curve.

Ethical approval

All procedures followed were following the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. This study was approved by our institutional review board.

Consent

Written consent has been taken from all patients to participate in the study without sharing their personal information, signed and inserted in their medical files.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Acronyms and Abbreviations

- K-wire = Kirschner wire.
- MP = metacarpophalangeal joint.
- TAM = total active motion.
- AH = affected hand.
- UAH = unaffected hand.

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