

Case Series

Surgical use of intramedullary k-wires in the fixation of fifth metacarpal neck fracture

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ABSTRACT

This is a study report of 20 patients, having fracture of fifth metacarpal neck, also called as Boxer's fracture, treated with closed reduction with JHASS maneuver and internal fixation with two antegrade intramedullary K-wires, to verify the functional outcomes with this treatment modality. All patients were followed up at least for six months (range 6-12 months, mean 8.85 months). Radiological outcomes were assessed based on AP and Oblique roentgenograms. All patients had bone union and underwent removal of K-wires in outpatient department at the end of 4 weeks. Pre-operative mean angular deformity was 61.75° (range 43° to 73°) which was corrected to acceptable level; post-operative mean angular deformity was 18.05° (range 15° to 20°). Patients were assessed for functional outcomes at the end of six months using Mayo wrist score. At the end of six months of follow up 18 patients (90%) had excellent functional outcome whereas 2 patients (10%) had good functional outcome. No patient had poor or fair functional outcome. None of the patients had post-operative rotational deformity. 1 patient developed superficial skin infection which was treated with oral antibiotics. We recommend this treatment modality for the treatment of Boxer's fracture, as it is percutaneous, day care and easy to perform procedure with excellent functional outcomes, with minimal complications.

Keywords: Boxer's fracture, Fifth metacarpal neck, Antegrade intramedullary K-wires, Day care procedure

INTRODUCTION

Fractures of the metacarpals are very common injuries of the skeletal system and in approximately 50% of cases, involve neck of the fifth metacarpal bone.¹ The metacarpal neck fractures are among the most common of hand fractures with those involving the fifth metacarpal being most common.² Fifth metacarpal neck fracture also called as Boxer's fracture, usually result from direct injury or axial force acting along the fifth metacarpal. These fractures are more common in young active men, especially dominant hand.^{3,4}

This fracture is known for leading to rotational and angular deformities due to comminution of cortex and forces of

interosseus,⁵ and functional limitations⁶ if not treated properly. A number of modalities of treatment options^{7,8} is available for these fractures including internal fixation using k-wires, plating and intramedullary k-wires.^{1,8-12}

Complications related with conservative treatment and plaster cast/slab application are residual rotational and angular deformity, decreased hand grip strength and sometimes may lead to skin complications.¹³ Plating is an open surgical procedure with risk of infection, periosteal strapping and compromised blood supply, adhesions. It needs second open surgery for removal of implant. Percutaneous transverse K-wires fixation has potential complications like possibility of damage to dorsal cutaneous branch of ulnar nerve.¹⁴ Intramedullary k-wire

fixation is relatively simple procedure, requiring less operative time, minimal radiation exposure, and can be performed as a day care surgery.¹⁵ In retrograde k-wiring MCP joint is involved whereas Antegrade intramedullary k-wire fixations spares MCP joint, which can be mobilized early. Antegrade intramedullary splinting is superior to retrograde percutaneous crossed pinning and thus should be preferentially considered for displaced neck fractures of the fifth metacarpal.¹⁶

Keeping in view the diverse modalities of fixation in metacarpal fractures and their varied results, there is no clear consensus regarding ideal method of treatment. Thus the results of osteosynthesis in fracture of neck of fifth metacarpals with antegrade intramedullary K-wires were studied.

CASE SERIES

Current series included patients with fracture of the fifth metacarpal neck and treated with antegrade intramedullary K-wires fixation in the Department of Orthopaedics, HOSMAT Hospital, Bangalore. Patients with open Boxer's fracture, age less than 18 years and associated injuries of the same or contralateral hand were excluded.

We studied only closed fractures to remove associated soft tissue injury factors that were going to affect the final functional result. Huffaker et al studied factors influencing final range of motion in the fingers after fractures of the hand. They concluded that an associated crush injury, flexor or extensor tendon injury or skin loss caused more frequent decrease in final ROM of both fractured and unfractured fingers of same hand.¹⁷

The patients were assessed pre-operatively after an informed consent, with special reference to the mode of injury, occupation and hand dominance. Examination was carried out to rule out any soft tissue damage likely to affect function later on. Any associated injuries were also noted. Antero-posterior and oblique view roentgenograms were obtained in all patients.

Surgical procedure

Small stab incision was made on dorso-ulnar aspect, just proximal to fifth metacarpal base. Making an entry point at base of fifth metacarpal with 2.7mm drill beat at 45 degree angle with Image Intensifier guidance, the hole was then enlarged with 3.2mm drill beat. Two pre bent (lazy s shape), blunt K-wires of appropriate thickness were entered through entry point into the medullary canal, and advanced slowly till a point, just proximal to the fracture site. Reduction of fracture by using JAHSS manoeuvre¹⁸- flexing MCP joint and PIP joint by 90°, and giving traction over fifth proximal phalanx. The wires were then advanced across the fracture site into the distal fragment under image

guidance. K-wires were then rotated so that the distal tips of K-wires are divergent. Wrist splint was applied, so that MCP joints remained free. Active movements of all fingers were started at hospital and the patient was advised and encouraged to continue the same exercises at home. Patient was discharged the same day.

Post operative care

Wrist splint was continued for 3 weeks from the day of surgery in each patient, and then the splint was discontinued. After one week from the surgery all patients were allowed daily routine activities involving light physical activities, use of computer and pen. All patients were assessed for fracture union after four weeks from the time of surgery. No or minimal pain on pressing at fracture site was considered as a sign of fracture union which was further confirmed radiologically. All the fractures were united at the end of 4 weeks. All patients underwent removal of K-wires in outpatient department, after 4 weeks from the date of surgery. No patient needed further treatment for the same after removal of K-wires.

Current study included total 20 patients. All patients were followed up regularly at least up to 6 months (range 6 to 12 months, mean 8.85 months). The mean age of patients in current study was 33.85 years with range of 22 to 56 years. 19 patients were male, 1 patient was female (Table 1).

Table 1: Distribution of sample by gender.

Sl. No.	Gender	Frequency	Percentage
1	Male	19	95
2	Female	1	5

16 patients were right hand dominant, 4 patients were left hand dominant (Table 2). 18 patients had injury of the dominant hand (Table 3).

Table 2: Distribution of sample by dominant hand.

Sl. No.	Dominant hand	Frequency	Percentage
1	Right	16	80
2	Left	4	20

Table 3: Injured hand in relation to dominance.

Sl. No.	Injured hand	Frequency	Percentage
1	Dominant	18	90
2	Non dominant	2	10

Mode of injury was RTA in 8 patients, punching in 6 patients and fall in 6 patients (Table 4). One patient had associated injury in the form of undisplaced mandibular fracture. One patient had medical co-morbidity, diabetes.

Table 4: Mode of injury.

Sl. No.	Mode of injury	Frequency	Percentage
1	Road traffic accident	8	40
2	Punching	6	30
3	Fall	6	30

All patients were assessed for functional outcome and radiological outcome using Mayo Wrist Score and X-rays at the end of 6 months. Active ROM of fifth metacarpophalangeal joints was measured using a goniometer. Grip strength was measured on both sides using a Jamar dynamometer, with the patient's shoulders in a neutral position, elbows flexed to 90 degrees, and forearms in neutral rotation. ROM of fifth MCP joint and Hand Grip Strength values were expressed as percentages of those of the contralateral uninjured hand of the patient.

Functional outcome

No. of patients who had Mayo score in the range of 90 to 100 were 18. These patients had excellent functional outcome. 2 patients had Mayo score ranging from 80 to 89 (Table 5). Mean Mayo score was 91.25. Rotational deformity was assessed clinically and there was no overriding of fingers and little finger pointed towards scaphoid tubercle when fingers were flexed, and little finger was parallel to other fingers in extension, in all the patients at the end of 6 months.

Table 5: Functional outcome according to Mayo Wrist Score.

Sl. No.	Mayo Wrist Score	Functional Outcome	Frequency	Percentage
1	90-100	Excellent	18	90
2	80-89	Good	2	10
3	65-79	Fair	0	0
4	<65	Poor	0	0

Radiological outcome

All fractures had united at the end of 4 weeks. Pre-operative angular deformity was assessed radiologically on oblique X-rays taken in 30° prone position of hand (Table 6).

Table 6: Radiological Assessment of angular deformity.

Sl. No.	Angular deformity	Range	Mean
1	Pre operative	43-73	61.75
2	Postoperative	15-22	18.05

DISCUSSION

Boxer's fracture is an injury predominantly of males and young active age group because of the fact that young

active males by nature of their outdoor physical activities, profession and impulsive nature are more prone to trauma of hand. The fracture of the neck of the fifth metacarpal is named as Boxer's fracture for the classic mechanism of injury in which direct trauma is applied to a clenched fist. Direct blow to clenched fist in the form of punch is the most common mechanism of injury leading to fracture of the neck of fifth metacarpal but in current study RTA contributed to the history of 40% of cases whereas punch and fall contributed to 30% cases each.¹⁹ This fracture is predominantly a fracture of dominant hand.

Various treatment modalities are available for the fracture neck of fifth metacarpal. Although flexible intramedullary nailing is indicated for any displaced or unstable fracture of the fifth metacarpal neck; first described by Foucher in 1975, the "bouquet" technique of closed antegrade nailing of metacarpal fractures using multiple small pre-bent K-wires, is currently one of the surgical procedures of choice.²⁰ Still the management of boxer's fracture is controversial.

Sarathy et al studied 15 patients for functional outcome after intramedullary K-wire fixation of fifth metacarpal neck fractures, and found that, all patients had radiological bony union with no rotational deformities. Volar tilt pre-op was 55-60° and post op was 15-20°. All patients had complete pain relief, regained hand grip and achieved full extension of little finger. None of the patients had any rotational or angulation deformities on follow-up.²¹

Schadel-Hopfner et al studied total 30 patients which were divided into 2 groups. Group A consisted of 15 patients which were treated with antegrade intramedullary splinting and group B, treated with retrograde pinning and found that, ROM of fifth metacarpophalangeal joint was significantly decreased after retrograde pinning (-15°; range -45 to +5°) compared to antegrade splinting (0°; range -25 to +10°).¹⁶

Kim et al studied 46 patients with fifth metacarpal neck fracture. Patients were divided in 2 groups. 23 patients were treated by antegrade intramedullary pinning and 23 patients were treated by retrograde intramedullary pinning. Their study results show that treatment of a displaced fifth metacarpal neck fracture by antegrade intramedullary pinning produces better clinical outcomes at 3 months postoperatively than percutaneous retrograde intramedullary pinning, but that the differences in clinical parameters are not sustained at 6 months postoperatively.²²

Boussakri et al conducted a study on twenty-eight patients affected by closed fractures of the neck of the fifth metacarpal bone (boxer's fracture), treated with percutaneous antegrade elastic intramedullary nailing using single wire. At the final follow up no patient reported residual pain and all the fractures proceeded to union but one fracture has to be revised for failed fixation and three superficial wound infections needed antibiotic treatment. They recommend that this minimally invasive,

percutaneous intramedullary nailing using a single K-wire in all fifth metacarpal neck fractures (boxer's fractures), especially when severe swelling of the hand is present, with good functional results and low morbidity.²⁰

In current study, we report the outcomes in 20 patients of Boxer's fracture treated with closed reduction and percutaneous internal fixation with two antegrade intramedullary K-wires, followed up at least for 6 months (range 6-12, mean 8.85). We were able to achieve excellent functional outcome as per Mayo Wrist Scoring system in 18 patients which was 90% of the study sample. In remaining 2 patients i.e. 10% of the study sample had achieved good functional outcome as per this scoring system. None of the patients were found to have fair functional outcome or poor functional outcome in Current study. None of the patients under study had rotational deformity at the end of 6 months.

In the literature there is a wide variation on the degree of angulation that might be acceptable for neck fractures of the fifth metacarpal. This is partly due to the different methods of measuring the angulation, but mainly represents the difference in opinions.^{23,24} Whereas some authors believe that an angulation exceeding 30° requires reduction, others would tolerate angulations up to 40°, 50°, or even 70°. ^{10,23,25-31}

A 30° angulation is associated with flexor digiti minimi grip strength of 92% maximum and preserves 78% of the intact finger's range of motion. So, 30° angulation is the upper limit for final acceptable angulation.³²

In current study range of angular deformity preoperatively was 43° to 73°, with the mean of 61.75° whereas range of post-operative angulation deformity was found to be 15° to 22° with the mean of 18.05°.

Limitation

The study was limited by a small sample size (n=20), a short follow-up period of 6–12 months (mean: 8.85 months), and the absence of a matched comparison group.

CONCLUSION

Use of antegrade intramedullary two K-wires gives adequate stability in metacarpal fractures, thereby allowing immediate post-operative active movements of hand. Stable fracture fixation and immediate mobilization led to fracture union, excellent functional outcomes and early return to normal activity.

Fifth metacarpal being small bone requires meticulous technique while drilling the hole for entry point. Removal of K-wires after union can be performed as outpatient department procedure with appropriate aseptic precautions. As in other fractures, the functional results do not correspond to excellence of fixation seen radiologically.

Antegrade intramedullary K-wire fixation is an excellent treatment modality for fracture of neck of fifth metacarpal i.e. Boxer's fracture. It is easy to perform, can be done as a day care procedure, allows immediate finger movements, gives excellent functional outcome if finger ROM exercises are done regularly and has very low complication rate if proper intra-operative precautions are exercised.

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Ethical approval: Not required

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