

## Assessment of the Functional Outcomes of Isolated Fifth Metacarpal Fractures Treated by Antegrade Intramedullary K-Wiring

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**Background:** Fractures of the neck of the fifth metacarpal is known as Boxer's fractures; they are among the most common fractures of the hand. Despite the variety of conservative and surgical options available, no one technique has been established as the reference.

**Objective:** To evaluate functional outcomes of isolated fifth metacarpal fractures treated by antegrade intramedullary K-wiring.

**Design:** A Retrospective Review.

**Setting:** Bahrain Defence Force Hospital, Kingdom of Bahrain.

**Method:** A retrospective review of patients who underwent surgical fixation of fractures of the neck of the fifth metacarpal using intramedullary K-wires inserted in an antegrade fashion treated from July 2007 to February 2013.

**Result:** Twelve patients met inclusion criteria. Mean follow-up was 34.5 months, a range of 23 to 56 months. The patients had a mean of 97.8% range of motion in the injured hand compared to the non-injured. They had a mean of 90.2% strength on the injured hand compared to the non-injured. Complex regional pain syndrome was documented in one patient. Radiographically, all patients showed full union on follow-up. Subjectively, Visual Analogue Scale (VAS) scores had a mean of 1.08. Disabilities of the Arm, Shoulder and Hand (DASH) scores had a mean of 6.9 and Steele scores had a mean of 378.5.

**Conclusion:** Surgical fixation of Boxer's fractures using intramedullary K-wires inserted in an antegrade fashion is an effective method of fixation.

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Injuries to the hand are common; fractures of the fifth metacarpal bone accounting for approximately 50% of these injuries<sup>1,2</sup>.

Treatment of the fifth metacarpal bone fractures includes conservative and operative management. Conservative treatment includes splinting, functional taping, functional bracing and compression bandage. Surgical or operative treatment includes K-wiring, both intramedullary (antegrade and retrograde) intermetacarpal, locking plates and non-locking mini fragments. These techniques have been reported in the literature with varying levels of effectiveness. Surgery is often indicated when the metacarpal head displacements exceed 45 degrees<sup>3</sup>.

The aim of this study is to evaluate the functional outcome of isolated fifth metacarpal fractures treated surgically by antegrade intramedullary K-wiring.

### METHOD

Inclusion criteria were patients with closed, isolated fifth metacarpal fractures which were treated between July 2007 and February 2013. Multiple fractures of the metacarpals,

polytrauma and patients managed with locking plate were excluded. The patients who met inclusion were followed up in the clinic between April and June 2013.

Antegrade K-wires for the fixation of fifth metacarpal Boxer's fracture was performed under general anesthesia. A tourniquet was used and a small dorso-ulnar longitudinal incision was made proximal to the base of the fifth metacarpal bone. Blunt dissection was performed to expose the insertion of the extensor carpi ulnaris tendon to avoid injury to the dorsal sensory branch of the ulnar nerve. Using fluoroscopic guidance, identification of the entry point at the base of the fifth metacarpal bone and hole entry was performed using a bone awl.

Two 1.4 mm K-wires were prepared by bending the tip at approximately 45 degrees. Insertion of the first K-wire was performed under fluoroscopy till it reached the fracture site, then reduction of the fracture was performed by flexing the metacarpophalangeal and proximal interphalangeal joints to 90 degrees and using the proximal phalanx to push up the metacarpal head (Jahss maneuver), then permit the K-wire to cross the fracture site till it reached its place in the head of the metacarpal.

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The second K-wire was inserted after the reduction was confirmed on fluoroscopy with anteroposterior, lateral and oblique views, keeping in mind that both K-wire angles should be in an opposite-divergent-way as possible. Finally, the wound was irrigated using normal saline and closed with 3.0 ethylene and application of ulnar gutter splint.

The result was analyzed subjectively and objectively. Objective outcomes were assessed both clinically and radiographically. Clinical outcomes included wrist strength of both the operated and contralateral hand by taking the average of three measurements using the Jamar Dynamometer. The range of motion was measured using a finger goniometer in both the ipsi- and contralateral hands. The ASSH (American Society for Surgery of the Hand) Total Active Flexion Scale (TAF) was used to assess the final outcome of motion. Complications were taken into consideration including regional pain syndrome, neurological deficit, infection, malunion and aesthetic deterioration. Radiological outcomes were measured by taking anteroposterior and oblique X-rays pre-operatively, postoperatively and at follow-up, see figures 1-3. Angulation was measured in the oblique view.

Subjective criteria included work status, mechanism of injury and time of work. Validated questionnaires were also administered to the patients, including the Arabic version of the British Pain Society Visual Analog Scale (VAS) with the Arabic version of the DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire.



Figure 1: (A) Anteroposterior and (B) Oblique X-Rays Show Isolated Fifth MCB Fracture of the Right Hand with Angulation of More than 45 Degrees

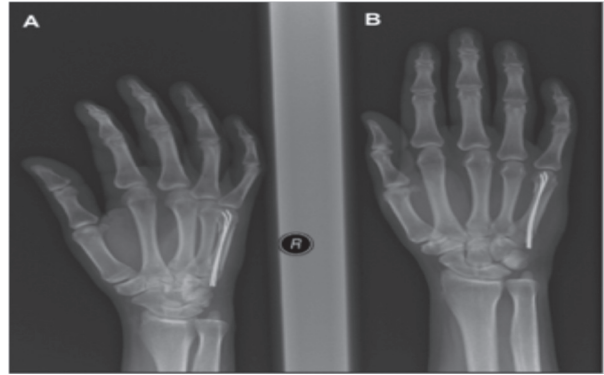


Figure 2: (A) Anteroposterior and (B) Oblique X-Rays Show the K-Wire which was Inserted with Antegrade Approach on Place

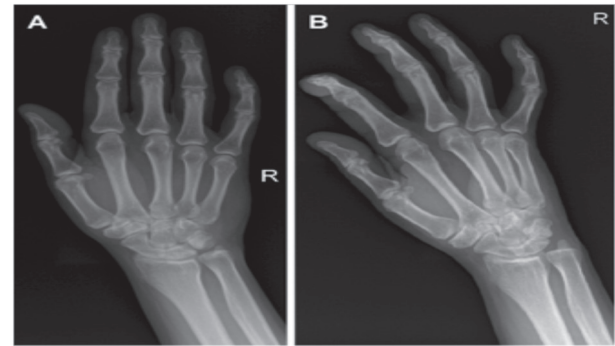


Figure 3: (A) Anteroposterior and (B) Oblique X-Rays Show Full Fracture Union with Excellent Alignment

**RESULT**

Twelve patients were included, 11 (91.6%) were males and one (8.3%) was female, see table 1.

Follow-up time from 23 to 56 months with a mean of 34.5 months (SD=10.2). The mean age was 35 years (range 22-51 years, SD=9.6). Only one (8.3%) patient injured the non-dominant hand. The majority in our study were

Table 1: Patients’ Characteristics and Operative Outcomes

Patient No	Gender	Age	Side Operated	Mechanism of Injury	Pain VAS Score (0-10)	DASH score (0-best, 100-worst)	% Range of Motion Compared to Contralateral Hand	% of Grip Strength Compared to Contralateral Hand	Radiology (Postop Angulation)	Steele Score	Grading
1	Male	36	Dominant Hand	Fall	0	5	100	58	30	385	Good
2	Male	47	Dominant Hand	Punch	0	1.6	100	92	30	392	Good
3	Male	26	Non Dominant Hand	Fall	0	0	100	100	35	400	Excellent
4	Male	26	Dominant Hand	Fall	0	0	100	100	25	400	Excellent
5	Male	51	Dominant Hand	Punch	0	5.8	100	110	35	400	Excellent
6	Female	47	Dominant Hand	Fall	5	0.8	74	83	30	307	Fair
7	Male	40	Dominant Hand	Fall	0	0	100	100	35	400	Excellent
8	Male	29	Dominant Hand	Punch	3	8.3	100	80	35	350	Good
9	Male	39	Dominant Hand	Fall	0	0.8	100	95	20	395	Good
10	Male	33	Dominant Hand	Fall	0	8.3	100	100	30	400	Excellent
11	Male	28	Dominant Hand	Punch	0	1.6	100	90	30	390	Good
12	Male	22	Dominant Hand	Fall	5	50.8	100	74	35	324	Fair

males, which is comparable to other studies<sup>4</sup>. The mechanism of injury was either a fall (8 patients; 66.7%) or a punch (4 patients; 33.3%).

All patients had a full range of motions except one (8.3%) patient who had some limitation (74% compared to the right hand). Grip strength showed some variability with a mean of 90.2% compared to the non-injured hand (58-110%, SD=14.32). Only one (8.3%) patient had reduced ROM, whose symptoms were consistent with complex regional pain syndrome, see figure 5.



Figure 5 (A)



Figure 5 (B)

**Figure 5 (A and B): Show One Patient's Hands Postoperatively Demonstrating Optimal Cosmetic Outcome and Regain of Full Range of Movement**

Radiographic assessment showed no evidence of delayed union, non-union or malunion. Angulation mean was 30.8 degrees with a range of 20 to 35 degrees and an SD of 4.7.

Subjectively, only 3 (25%) patients reported pain on the Visual Analog Scale. The mean score was 1.08 with an SD of 2.02. The median DASH score was 1.6 and the median Steele score was 393.5.

One patient had a particularly high DASH score, who never presented post-operatively for K-wire removal. The patient was promptly booked for surgery to remove the K-wire.

## DISCUSSION

Many conservative treatments of fifth metacarpal bone fractures have been reported in the literature; however, Cochrane Review reported that there is no study that is methodologically rigorous enough to support any given treatment<sup>6</sup>. Recently, a prospective randomized study by Hofmeister et al compared two methods of casting, a short-arm cast with volar outriggers and a short-arm cast extended to the proximal interphalangeal joint with a 3-point mold. Both techniques were shown to be effective and achieved sufficiently low DASH scores<sup>7</sup>. There was a limited range of motion following removal of the immobilization device, which was corrected with physiotherapy. Some fractures were excluded due to the necessity of surgical therapy. Van Aaken et al attempted conservative treatment with buddy taping; however, the range for the QuickDASH score was 0-36, indicating significant disability in a minority of the patients (median QuickDASH=0)<sup>8</sup>.

Many surgical options have been discussed in the literature, including intramedullary K-wires inserted in a retrograde or antegrade fashion, transverse pinning using K-wires, locking plates and mini fragment screws and plates.

Transverse pinning using K-wires showed good results in some series. Potenza et al had a good outcome with DASH, a range of 1 to 8. Two patients had an extension deficit<sup>9</sup>. One of the main problems with the use of K-wires was a minor local infection at the site of insertion of the K-wires<sup>9</sup>. Another problem that has discouraged the use of the transverse pinning technique is the potential damage to the interosseous muscles or their tendons<sup>10</sup>.

Mini fragment plates and screws had been used, which needs an open surgery and hence it carries the risk of deep infection. A series by Soni et al showed satisfactory results with a DASH range of 1 to 26 and many other papers in the literature have shown satisfactory outcomes with this technique<sup>11</sup>.

Facca et al compared the locking plate with antegrade intramedullary K-wire. A rare complication associated with the locking plate was necrosis of the head of the fifth metacarpal and range of motion was much more limited in the locking plate group than the K-wire group due to the open approach required for the locking plates<sup>3</sup>.

Intramedullary K-wires have proven very effective with descending or antegrade intramedullary K-wires proving to be the most popular technique. However, even this technique has its challenges. Some studies have shown complications, such as K-wire migration and damage to the dorsal cutaneous branch of the ulnar nerve<sup>3</sup>. Dorsal cutaneous branch of the ulnar nerve is at much greater risk in the retrograde approach than the antegrade<sup>12</sup>. The retrograde approach also has the propensity towards MCP joint stiffness<sup>4</sup>. The antegrade technique has the disadvantage of requiring a dorsal skin incision compared to the retrograde technique described by Lee et al<sup>10</sup>. Another common complication is pin insertion site infections. In our study, only three patients reported pain on the Visual Analog Scale. The mean score was 1.08 with an SD of 2.02. The median DASH score was 1.6, and the median Steele score was 393.5. Our result is similar to other studies utilizing antegrade K-wires<sup>5</sup>.

## CONCLUSION

**Our paper had some inherent limitations given that it was retrospective, had a lack of a control group and had a small number of patients. However, we feel our outcomes justify and reinforce the status of intramedullary antegrade K-wiring as the reference technique.**

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