

Functional and Radiological outcome of Antegrade intramedullary K-wire fixation in fracture shaft metacarpal

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Abstract

Aims and objective: To evaluate the functional and radiological outcome of antegrade K-wire fixation in fracture metacarpal.

Material and method: Study includes 25 patients with fracture shaft metacarpal of hand. These patients were treated with antegrade intramedullary K wire fixation between age group (20yr to 60yr). Patients were evaluated as per visual analogue scale (VAS) and disabilities of arm shoulder and hand (DASH) scoring system at 1 month, 3 months and 6 months post-operative.

Results: All patients treated in this study had clinical and radiological union by the 10th week. Patients had good range of movement at MCP joint following K-wire removal, better DASH score with no joint stiffness and earlier return to work with less complications.

Conclusion: Closed K-wire fixation is a good option for treatment of fracture shaft metacarpal. Functional outcome in antegrade intramedullary fixation was attributed to entry from base of metacarpal compared to the conventional retrograde fixation.

Keywords: Metacarpal, Anterograde, k wire

Introduction

Hand fractures are common in the general population with relative propensity seen in contact-sport athletes (For example, boxers, football players) and manual laborers^[1]. Almost one-third of hand injuries encountered by hand surgeons are metacarpal fractures^[2, 3]. Metacarpal fractures typically occur secondary to a direct blow or fall directly onto the hand. Sporting injury is frequently the cause among younger patients. Work-related injuries are often the cause in middle-aged patients while falls are typically the cause of the elderly. The goal of the treatment remains correction of dorsal angulation, restoring length and correcting malrotation^[4]. Kirschner wire for osteosynthesis of the metacarpal bones is a simple and effective technique^[8].

Over years surgical technique for K wire fixation in the metacarpals has evolved in terms of entry point, location of tip of wire, period of immobilization, rehabilitation protocol^[5, 6, 7, 8, 9, 10]. This study aims at evaluating the functional and radiological outcome of antegrade fixation technique.

Method and Material

A total of 25 patients were included in the study who presented between January 2019-January 2021 in MGM Medical College and MY Hospital Indore. All the patients who came to emergency or to OPD with closed metacarpal fractures which were confirmed by x-ray were included in the study. Written informed consent was obtained from all the patients. Standard radiographs of the hand (anteroposterior, and oblique) was taken. In the vast majority of cases, it was sufficient to confirm the diagnosis and form a management plan. Closed fractures of metacarpal were included in the study. Patients with intra articular

fractures, open wounds, crush injury, neurovascular injury or associated fractures in the same hand or limb were excluded from the study.

For the 5th metacarpal, the entry point is dorsoulnar at the metacarpal base, without damaging the carpometacarpal joint and respecting the insertion of the extensor carpi ulnaris tendon. For the other metacarpals the entry point is dorsally at the metacarpal base. Care must be taken that the protruding ends of the K-wires do not interfere with the gliding of the extensor tendons. The dorsoulnar cortex is opened with a 2 mm drill bit. Drilling is first done perpendicularly to the bone surface to prevent accidental slipping off the bone. A drill sleeve was to be used to protect the dorsal sensory branch of the ulnar nerve, or the extensor tendons. The drill was then tilted by approximately 60 degrees so that it enters the intramedullary canal at an obtuse angle. Care was taken not to pierce the opposite cortex. K-wires of 2 mm, diameter were inserted with the blunt tip first, to reduce the risk of perforating the thin cortex of the metacarpal head. Wire bent in the following way: The distal tip of the k wire 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 degrees. Wire is inserted manually into the medullary canal and advanced into the diaphysis without reaching the fracture zone with the bent tip pointing towards palmar direction. The wire was advanced manually, or with a hammer, across the fracture zone into the head. The correct position is checked using image intensification. The K-wire was then finally rotated so that the bent tips are pointing dorsally and diverging in slightly different directions (dorso-radial and dorso-ulnar). A removable splint is applied at the end of the operation, with the hand in an intrinsic plus (Edinburgh) position.

Clinical and radiological assessment was done after 3 weeks by eliciting tenderness at fracture site and to confirm the alignment and position respectively. The slab/splint was discontinued in absence of tenderness and good bony union achieved, protected active mobilization was started by the physiotherapist which continued for one week. Later free active assisted mobilization was initiated until full recovery was achieved. K wire removal was done at 1 month. Follow up was done monthly intervals upto 6 months. In each follow up outcome was measured by Grip Strength-measured with a dynamometer, range of motion, DASH scoring.

Results

This study consists of twenty-five patients presented with metacarpal fractures. Out of 25 patients 18 were male, 7 were female. The average age of the patient was 28 years (range 20-60). 19 patients had involvement of right hand and 6 patients had involvement of left hand. Most commonly affecting metacarpal was 5th metacarpal.

Table 1: Age & Sex Distribution

Age Group	Male	Female	Number of Patients
21-30 yr	7	3	10
31-40 yr	3	1	4
41-50 yr	2	1	3
51-60 yr	6	2	8
Total	18	7	25

With rising motor vehicles on the roads and the lack of driving sense with very few people following traffic rules, road traffic accidents were the major mode of injury sustained by our patients with respect to assault and fall.

Table 2: Mode of Injury

Mode of Injury	Number of Patients
RTA	9
Fall from Height	3
Fall on Ground	5
Assault	8

On radiological assessment-22 (88%) patients had good reduction, 3 (12%) patients had fair reduction. Fracture union was assessed clinically and radiologically. Clinical evaluation was done in terms of pain/tenderness on palpation/examination, mobility at fracture site, range of motion at adjacent joint and ability to perform activities of daily living. Radiological union was defined as callus formation on 3 cortices in two views. The mean union time for Antegrade intramedullary nailing was 5.92 weeks. There were no cases of non-union in this study.

Table 3: Fracture Union

Fracture Union	Antegrade Nailing
4 weeks	7
6 weeks	13
8 weeks	4
10 weeks	1

All patients were able to perform range of movement at metacarpophalangeal joint with mean ROM at MCP joint of 90 degrees. Mean DASH score was 1.6 and grip strength was measured with a dynamometer, was 95% compared to contralateral hand at the end of 6 months.



Fig 1: Pre-Operative X ray

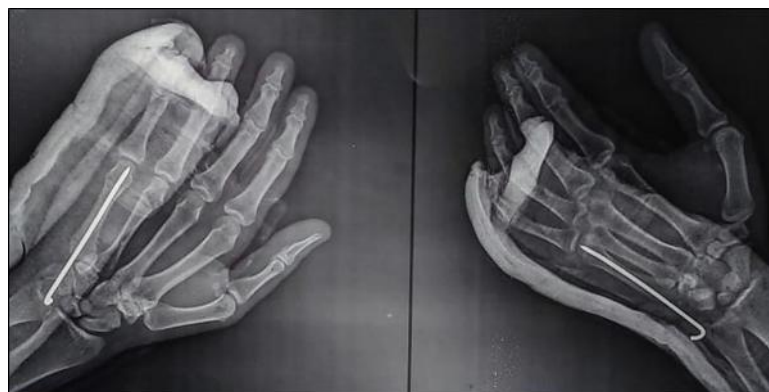


Fig 2: 4 weeks follow up X-Ray



Fig 3: 6 weeks follow up X ray



Fig 4: 10 week follow up X-Ray

Discussion

Metacarpal fractures are common fracture of hand which can be treated both conservatively and surgically. Intramedullary K-wires have proven very effective with descending or antegrade intramedullary K-wires proving to be the most popular technique^[11]. 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^[12]. Dorsal cutaneous branch of the ulnar nerve is at much greater risk in the retrograde approach than the antegrade^[13]. The conventional retrograde fixation introduced by Lord *et al.*^[14] is known to heal fractures well at the cost of stiffness due to involvement of intraarticular surface while making the entry. Results are inferior after k-wire removal even with extensive physiotherapy also associated with decreased grip strength and extensor lag postoperatively.

The antegrade technique has the disadvantage of requiring a dorsal skin incision compared to the retrograde technique described by Lee *et al.*^[15]. Another common complication is pin insertion site infections. There is always a possibility of extensor tendon damage or injury to dorsal sensory branch of ulnar nerve^[13]. Intramedullary nailing if done from base of metacarpal (antegrade nailing) obtain good results with good functional outcome in terms of ROM, grip strength and daily activity of living.

Conclusion

We found out that this antegrade percutaneous fixation of fracture shaft metacarpal is a reliable and safe method for the majority of the fracture types giving a higher ROM and less complications in comparison with ORIF, this study recommend usage of percutaneous K wire

fixation unless there is an indication for ORIF as in multifragmentary articular and peri-articular fractures, bicondylar fractures, segmental bone loss or when closed reduction fails.

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