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Retrospective analysis of Intramedullary K-Wire fixation of Metacarpal Fractures

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Introduction: The majority of fractures of the metacarpal bones occur at a young age.Most of the times these metacarpal fractures can be treated conservatively in a POP slab(cock up slab) producing good functional results.Surgery was indicated in patients with palmar dislocation of >30° and shortening of >5 mm.Our study aimed to evaluate the clinical results of all metacarpal fractures treated surgically by intramedullary Kirschner-wire fixation presented in our hospital.**Materials and Methods**: It was a retrospective study in which we included 50 patients with metacarpal fractures(both open andclosed) that came in our hospital, treated surgically by closed reduction and were fixed with two intramedullary k-wires**. Result:** K-wires were removed after 4 weeks postoperatively,under local anaesthesia in the OPD. Metacarpal joint functions (flexion, extension, rotation) were clinically followed up in all patients, on the median periodof6 months (3 months to 9 months). In our study, we found in all patients,flexion and extension were normal on both sides.**Conclusion**: Closed reduction and intramedullary k-wire fixation of metacarpal bone fractures produce good functional results in the longterm. We found a very low rate of complication and thus recommendthis surgical method for the stabilization of all these types of fractures.

Keywords: Metacarpal, Flexion, Extension, Rotation, K-wire

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Introduction

The majority of fractures of the metacarpal bones occur at a young age [1].Metacarpal fractures are among the most commonly treated upper extremity injuries in adults, and represent about 10% of all fractures [2].The most commonly affected metacarpal bone is the 5thmetacarpal bone and sub-capital fracture is more common than a diaphyseal one [3].Metacarpal fractures are most often caused by axial loads applied to the hand, frequently with the wrist flexed [4]. The usual etiologies are a direct blow during fisticuffs, or a fall [6]. Indirect torsional forces can also result in metacarpal fracture [4].With the pull of intrinsic muscles on the metacarpal capitulum, the distal fragment is dislodged in the palmar direction. Most of the times these metacarpal fractures can be treated conservatively in a POP slab (cock up slab) producing good functional results[5,6].

Surgery was indicated in the following cases [7]:

- palmar dislocation of >30°
- shortening of >5 mm.
- open fractures
- fractures with intra- articular displacements

Our study aimed to evaluate the clinical results of all metacarpal fractures treated surgically by intramedullary Kirschner-wire fixation, presented in our hospital.

Materials and Methods

It was a retrospective study in which we included 50 patients with metacarpal fractures(both open and closed)that came in our hospital, treated surgically by closed reduction and were fixed with two intramedullary k-wires. All patients between 1 January 2019 to 31 July 2020 who came to our hospital were included in the studyPreoperative X-rays of hand (AP and Oblique view) were taken to assess palmardeviation, shortening and rotatory deficiency.

The fracture was classified based on AO recommendation: A type: diaphyseal fractures, B type: epiphyseal and metaphyseal fractures and C type: intra-articular fracturesThere are various ways of fixations but we preferred intramedullary k-wire osteosynthesis of the metacarpal bones because of the simplicity of the method and also it puts minimum strain on the sliding tissue.

Intramedullary stabilization of sub-capital metacarpal fractures using Kirschner wire (k-wire) was introduced by Foucher [7,8]. After anesthesia (general/regional), painting and draping weredone and the fracture was reduced with k-wires under C-arm intensifier. P.O.P. cock-up/below elbowslab was applied after the surgeryAll patients were discharged the next day after the surgery after getting their postoperative x-rays. In our study, 12 cases were open fracture and 5 cases had associated injuries whose duration of stay was prolonged (mean duration was 4 days)

All patients were called for follow up at 15 days, 4th week (k-wire was removed and repeat x-ray wasdone), third month and sixth month postoperatively Metacarpal joint function (flexion/extension) and rotatory displacement was clinically assessed during follow-up examinations. After a radiological demonstration of bone healing normally after 4 weeks, the k-wires were removed under local anesthesia in OPD. Physiotherapy (all movements) was done under the supervision of the treating doctor and physiotherapist and the patient was advised to do the same at home.

Result

Most of the patients in our study were young male of the age group 20-30 years. There were 34 males (68%) and 16 females (32%) in our study. The dominant hand (right in all cases) was affected in about 56% (n=28) cases and the non-dominant hand (left hand in all cases) was affected in about 44%(n=22) cases.

The most common cause fell on hand (38%;n=19), followed by fight (assault) in 12 cases, road traffic accident (RTA) in 08 cases, fall of the heavy object directly on the hand in 5 cases and other causes like hitting against any object like a wall, table etcwere seen in 6 cases. The most common fracture pattern was AO type B fracture (epiphyseal and metaphyseal) seen in 48% of cases. (n=24),there were 32 %(n=16) A type fractures and 20% (n=10)cases of type C fractures

After preoperative evaluation including an x-ray of the injured hand (AP and Oblique view), surgery was planned for patients having palmar dislocation of >30°,shortening of >5 mm. and cases with open fractures.

K-wires were removed after 4 weeks postoperatively, under local anaesthesia in the OPD.

Metacarpal joint functions (flexion, extension, rotation) were clinically followed up in all patients at15 days, 4th week (k-wire was removed), third month and sixth month postoperatively. In our study, we found in all patients, flexion and extension was normal on both sides at the end of the sixth month

Table 1: Gender distribution of patients

Sex	Cases
Male	34
Female	16
Total	50

Table 2: Distribution based on side involved

Side	Total
Right	28
Left	22
Total	50

Table 3:Distribution based on AO classification:

AO classification	Cases
Type A	16
Type B	24
Type C	10
Total	50

Table 4: Distribution based onaetiology:

Etiology	Cases
RTA (roadtrafiic accident)	08
Assault	12
Fall on hand	19
Fall of a heavy object	5
Other causes	6
Total	50

Fig 1: Post Op Xray

Preoperative evaluation of hand function of all patients was done and range of motion in terms of flexion, extension and rotation was noted of all patients.

None of the patients was found to have any pre-existing functional deficits. Preoperative X-rays were done of all patients to note down palmer dislocation and shortening.

In all patients, when compared with the normal opposite side, the hand functions was not found to be impaired.

Discussion

Most of the times these metacarpal fractures can be treated conservatively in a POP slab(cock up slab) producing good functional results [7]. Surgery was indicated in patients with palmar dislocation of >30° and shortening of >5 mm. [7]. In 1939, Kuntscher et al. first described intramedullary [10]. Fixation of long bones [11,12]. In the study,it was found that intramedullary fixation decreased infection rates, shortened hospital stays, and allowed for rapid return to function.

Intra medullary fixation was first used for metacarpal fractures by a military surgeon, Lord [13]. In 1975, Foucher et al. [8]. Introduced the "bouquet" method in which he used to pass three Kirschner wires (K-wire) longitudinally into the medullary in a divergent fashion. Bouquet osteosynthesis gained popularity through Europe thereafter [7]. and since then many articles with different variations in techniques were published with good results [10,14,23]. Also various retrospective and case series studies with good results are published in favour of intramedullary fixation of metacarpal fractures[10,13,17,22,24].

This technique of intramedullary fixation was found to be technically easy with a lesser complications rate and shorter hospital stay. In a study by Wong et al., they noted while using intramedullary fixation there was K-wire migration and distal perforation of the metacarpal head which can be avoided by using Foucher's bouquet technique [25]. Since then,the treatment of metacarpal fractures had been extensively discussed and several guidelines are now available [26,27,28].

In a cadaver study by Low et al. (9), palmar dislocation of >30° and shortening of >5 mm resulted in considerable impairment of flexion and extension. This is the reason that we considered surgery for all such cases [29,30,31].

Even though there arereports of very good metacarpal joint functionality after meta carpal fracture healingin an extreme false position [6,29].

Intra medullary fixation of metacarpal fractures can be done on an outpatient basis under general anesthesia [10,16,17,18,22]. a regional block [10,13,15,18,19,22]. or local anesthetic [10]. A tourniquet may [13,18,19]. or may not be applied [16,17]. A closed reduction is performed first before the procedure. Then surgeons may choose their approach based on the site of the fracture (i.e., a proximal incision for a distal fracture of distal incision for a proximal fracture) [15,20,22].

Depending on whether an antegrade or retrograde approach is taken, a small incision is then made over the affected metacarpal base [8,13,14,16,18,23]. or head (10,17,21), respectively. The K-wires are cut to approximate the metacarpal length, and then bent according to the surgeon's preferences, which usually involves making a small curve in the wire and sharp bends (13) at the blunt end to act as a handle [19]. An awl is used to open the medullary canal and the appropriate placement is confirmed using fluoroscopy.

Imaging is routinely used for guiding K-wire insertion, although Foucher originally argued it is not necessary [14]. The number of K-wires can vary from one [14,15]. to four (18,20), although greater than one K-wire provides better rotational stability [23]. The number of K-wires used depends on surgeon experience, size of the medullary canal, K-wire diameter, and fracture stability [14,18]. The K-wires can be cut to lie subcutaneously [14,22,23]. entirely within the IM canal [14,19,20]. or with a short protruding portion to allow for easy removal [10,13,16,17]. K-wires were removed after 4 weeks postoperatively, under local anaesthesia in the OPD.

At the end of the sixth months, we found complete restoration of all hand functions in our patients.The recent evidence-based review by Friedrich and Vedder (28) suggested that an intramedullary fixation is an attractive option for metacarpal fracture treatment. Intramedullary fixation of metacarpal fractures was first introduced in 1957, and its efficacy has been demonstrated in multiple case series and observational studies [10,14-23]. Foucher et al. (7,8) introduced the bouquet osteosynthesis technique in 1976.

The technique is relatively quick and reproducible, while allowing for early mobilization. Rhee et al. (10) recently published a large prospective series metacarpal neck and shaft fractures with excellent functional and cosmetic results. Compared with

The other available surgical methods (open reduction with subsequent screw or plate osteosynthesis; closed reduction with external fixator), intramedullary splinting of metacarpal bones is the mostsimple method, lesser duration of stay and it does not harm the sliding tissue [3,29,30]. Closed reduction with subsequent intramedullary k-wire stabilization of metacarpal bone fractures produces good functional results in the longterm. With a low rate of complications, the method can be recommended for the stabilization of such fractures. The intraoperative need fora C-arm intensifier is the only drawback. Implant removal at the outpatient department is a further advantage.

Conclusion

Closed reduction and intramedullary k-wire fixation of metacarpal bone fractures produce good functional results in the longterm. We found a very low rate of complications and thus recommendthis surgical method for the stabilization of all these types of fractures.

What does this study add to present knowledge?

Closed reduction with subsequent intramedullary k-wire stabilization of metacarpal bone fractures produces good functional results in the longterm.

Author contribution

SKK, SU: conceptual framework, data collection.

SU, SS, AV: a review of literature, methodology review.

SKK, SU: manuscript writing and editing.

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