Operative treatment of metacarpal and phalangeal fractures with Kirschner wire fixation - a review

Tomislav D. Palibrk¹, Aleksandar R. Lešić¹,², Sladjana Z. Andjelković¹,², Ivan Milošević¹,², Rodoljub B. Stefanović¹, Suzana M. Milutinović¹, Slaviša G. Zagorac¹, Marko Ž. Bumbasićević²
¹Orthopedic and Traumatology Clinic, Clinical Centre of Serbia, Belgrade, Serbia
²School of Medicine, University of Belgrade, Serbia
³Anesthesiology and reanimatology center, Clinical Center of Serbia, Belgrade, Serbia

Although hand fractures are most common fractures treated in orthopedic practice, many practitioners treat them as trivial injuries. Improperly managed they can cause consequences and impair hand function. Metacarpal and phalangeal fractures are classified based on geometry, anatomic localization and wound presence and treatment depend on mechanism of injury. Many of them can be treated nonoperatively with reposition and immobilization, but in some cases osteosynthesis is a method of choice. Surgeon can choose various range of fixation material, and choice depends on fracture type and surgeon's affinity. Kirschner wire fixation is one of the most frequently used operative procedure for hand fracture treatment. It provides good stability, early mobilization and excellent functional result.

Key words: metacarpals, phalanges, fracture, hand, k-wire fixation.

INTRODUCTION

Isolated fractures and dislocations of the hand are one of the commonest orthopaedic injuries. They constitute about 1.5% to 28% of all emergency department visits and about 10% of skeletal fractures in general. Unfortunately, they are often neglected and treated as trivial injuries. Importance of these injuries can be understood when they start to interfere with daily activities and produce some amount of disability. Although general principles of trauma care can be applied into any part of the body, hand as a structure, responsible for communication with the environment, has its own specificity.¹²³

The metacarpal bones (MC) represent the base of each digit. On metacarpal we can differentiate the shaft, the base and head. Base is articulated above with the carpus, forming carpo-metacarpal articulations (CMC). Largest range of motion is in first CMC joint, II and III CMC joints are most rigid, and IV and V CMC joints are moderately mobile.

Metacarpal heads form with the base of proximal phalanges mobile metacarpo-phalangeal joints (MCP). When metacarpal bones are fractured intersosseus muscles with their contraction affect on fragment orientation.⁴⁵

The metacarpal bone of the thumb is shorter and stout then the rest. On the radial, rough, edge of the base is the insertion of abductor pollicis longus muscle which dislocate proximal fragment when the base is fractured.

The phalanges are the bones of the digits. They are little, long, cylindrical bones. Thumb consists of two phalanges, proximal and distal, while other fingers have three phalanges, proximal, medial and distal. Fragment dislocation in phalangeal fractures depends on muscle attachments.⁴

The type of fracture and the treatment choice depends on mechanism of injury, force direction, type of force applied and its amount.¹ Classification of the fractures has been based largely on the location within the bone (head, neck, shaft, base), fracture geometry (transverse, spiral, oblique), wound presence (open, closed). We can also classify them as intra-articular or extra-articular, simple or complex (communited). They can be stable or unstable, epiphyseal and avulsion. Dislocations have been described by the direction the distal segment travels (dorsal, volar, rotatory).¹²

DIAGNOSIS

Diagnosis is based on well-taken history and clinical examination, followed by imaging studies. We can notice the swelling, hematoma and in some cases deformity. There can be present palpation sensibility, pain, skin tenderness, pathological mobility and crepitation. It is very important, during the examination, to assess neuromuscular integrity and tendon function. The history, and these signs and symptoms are enough to suspect that fracture occurred. Imaging studies will confirm our suspicions.
Plain radiographic evaluation includes at least two projections, standard posteroanterior (PA) and lateral, with the beam centered at the level of interest. The lateral view is difficult to interpret because of the adjacent overlying of metacarpals. A third, oblique view is often quite instructive, revealing displacement not evident on the standard PA or lateral. For fracture of the head of the MC bone special views like Brewerton’s view and skyline view are required. Computed tomography (CT) is imaging standard in diagnosis of complex bone fractures. CT scanners can show sub-millimetric bone fragments, number and location of bone fragments and the percentage of articular involvement. Magnetic resonance imaging (MRI) is the most reliable imaging tool that we usually use for evaluation of soft tissue damage.

**THERAPY**

Metacarpal and phalangeal fracture treatment can be no-operative or operative. Isolated and undisplaced fractures are usually treated conservatively. For most fractures of the metacarpals and phalanges, closed reduction and proper splinting produce good functional result. Certain fractures, like unstable and axially displaced, require operative treatment. Choice of method applied depends on different factors: fracture location, geometry, presence of deformity. It depends also on skin integrity and fracture stability. We also must consider patients age, occupation, socioeconomic status and comorbidity. Main goal is to achieve full range of motion of the hand, minimize dorsal angulation, malrotation and shortening.

Indications for fixation of metacarpal and phalangeal fractures are: intra-articular, irreducible or subcapital fractures. We also treat operatively fractures with malrotation, segmental bone loss and open fractures.

Operation is conducted in local, regional or general anesthesia. We use tourniquet during the operation. After fracture reduction and fixation, position of bone fragments and osteosynthetic material is checked using radiography. Postoperatively, hand is elevated next two days and protective splint is applied. Prophylactic use of anti-biotics is standard procedure.

Depending on type of injury and skill and preference of the surgeon, we treat fractures with closed or open reposi-

![Figure 1A](image1a.png)

**FIGURE 1A**

**MULTIPLE METACARPAL FRACTURES AND PROXIMAL PHALANX FRACTURE OF INDEX FINGER**

![Figure 1B](image1b.png)

**FIGURE 1B**

**AFTER REDUCTION AND K WIRE FIXATION**

THE FIRST MC BASE FRACTURES.

Thumb accounts for almost 40% of hand function. Because of its great functional significance, the fractures of the base of first MC are very important. Bennett’s fracture dislocation is intra-articular fracture of first MC base. The proximal part of the fractured bone is attached to trapezi-
um with strong ligamentous connections and distal part is supinated and dislocated radially by the abductor pollicis muscles.

Rolando’s fracture is a comminuted version of Bennett’s fracture with three or more intra-articular fragments. Fragments can form either “T” or “Y” pattern.

Although reduction is easy to perform, maintaining the position with splint is difficult because of m.abductor pollicis longus effect on MC base. In most cases surgery is indicated. Percutaneous K-wire fixation results in a stable fixation of the fracture fragments. This technique can be safely used in treatment of extra-articular fractures as well as intra-articular fractures of first metacarpal base.

THE FIFTH MC BASE FRACTURES.

Intra-articular fracture of fifth MC base is often called "mirrored" Bennett fracture because of same fragment dislocation mechanism. Fragments are dislocated proximal and medial due to m.extensor carpi ulnaris contraction. Malunion can lead to late degenerative changes, range of motion reduction, grip weakness and chronic pain. Good results can be achieved with closed reduction and K wire fixation.

OPEN FRACTURES.

When we treat open fractures, after wound debridement, it’s necessary to stabilize fracture. K-wire fixation allows us to check the wounds without fear of fragment shift. Judgment is required to determine whether the wound is sufficiently clean to permit primary closure after debridement and irrigation. When in doubt, do not close. Antibiotics and anti-tetanus shot are mandatory.

COMPILATIONS.

Malunion is a frequently encountered complication owing to a wrong fracture treatment approach. Disordered muscle balance leads to grip weakness and delicate finger move impairment. Rotational deformity, unnoticeable when fingers are extended, is present when fist is formed. Nonunion is a rare complications in hand fractures. It is caused most often by distraction of the fragments by traction. It’s also seen if infection is present or when immobilization is inadequate. Other reasons are lack of fixation resulting in motion and gaps between bone ends from bone loss. Stiffness is the most feared complication and certainly one of the most common following a hand fracture. It is a product of the duration of immobilization, the position of immobilization and the invasiveness of any surgical intervention. Despite the excellent vascularity of the hand, adequate preoperative preparation and antibiotic therapy, infection, as complication of operative treatment still occurs. An 11% infection rate occurs in Gustilo type II and III injuries. Post-traumatic arthritis is consequence of intra-articular fractures with cartilage damage. It’s characterized by pain and joint range of motion limitation. Nail deformities can occur when a crush mechanism of injury includes the zone of the nail or when fixation hardware damages the delicate matrix tissues.

CONCLUSION

Although rough guidelines can be drawn from the published literature, it remains the responsibility of individual surgeons to judge which fractures and dislocations can be managed by each of the various methods. Most impor-
tant is to achieve enough stability so early rehabilitation can start. Perfect anatomical and radiographical reduction doesn’t always bring good results. It’s often better to accept deformity with adequate functional result. Fixation with K-wires, percutaneous or open, can provide good stability, early rehabilitation and excellent functional result.

SUMMARY

OPERATIVNO LEČENJE PRELOMA METAKARPALNIH KOSTIJU I FALANGI KIRŠNEROVIM IGLAMA - PREGLED LITERATURE

Iako su prelomi kostiju šake najčešći prelomi sa kojima se susrećemo u ortopedskoj praksi, mnogi lekari se prema njima odnose kao prema trivijalnim povredama. Nestručno lečeni dovode do posledica i utišu na funkciju šake. Prelomi su podeljeni prema anatomskoj lokalizaciji, obliku, komunikaciji sa spoljašnjom sredinom, a lečenje zavisi i od mehanizma povrede. Mnogi od njih se mogu lečiti neoperativno, ortopedskom repozicijom i imobilizacijom, ali u određenim slučajevima osteosinteza je metod izbora. Na raspolaganju nam je veliki izbor osteosintetskog materijala, a od tipa preloma i ličnog iskustva hirurga odlučujemo se za određenu metodu. Fiksacija Kiršnerovim iglama je jedna od najčešće primjenjivanih operativnih procedura kod lečenja preloma kostiju šake. Omogućava nam stabilnu fiksaciju, ranu mobilizaciju i sprovođenje rane rehabilitacije.

Ključne reči: metakarpalne kosti, falange, prelomi, šaka, fiksacija k-iglama.

REFERENCES