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ORIGINAL ARTICLE

Operative Management of Metacarpal and Phalangeal Fractures

Amit Thakur

Abstract

Fractures of metacarpals and phalanges are probably the most common fractures in the skeletal system and are often neglected as minor injuries. Most of the fractures are treated conservatively but some form of fixation is often indicated in unstable fractures, intra-articular fractures, open fractures and multiple fractures. Various implants ranging from K-wires to mini-plates are used. A retrospective analysis of 50 cases of metacarpal and phalangeal fractures treated by different methods over a period of one year was undertaken. The study showed that right hand was more commonly involved. Most common mechanism of injury was fall and second ray was most commonly involved. Most common fracture pattern was transverse and K-wires were frequently used as mode of fixation followed by mini-plates. The patients were followed up at regular intervals and union was achieved in 98% of fractures. From our study we would emphasize that operative management of metacarpal and phalangeal fractures has definitely an advantage over the closed methods of treatment especially in displaced, unstable, comminuted, intra-articular, open and multiple fractures. Operative management of hand fractures should be undertaken only if a definite indication exists. Indiscriminate use of it should be avoided. The operative management of metacarpal and phalangeal fractures results in accurate reduction of the fracture and joints should be mobilised early following fixation to prevent stiffness of the fingers and regain the desired range of motion at the joint.

Key words

Unstable fractures, Kirschner wires, mini-plate, Total active movement, Range of motion.

Introduction

Hand injury is extremely common and accounts for about 15% of the attendance at accidents and emergency departments. Fractures of metacarpals and phalanges are probably the most common fractures in the skeletal system. Some of the common causes of hand injuries are crush /compression injuries, blunt trauma, fall, road traffic accidents, machinery injury, sports related activity and explosions / fire arm injuries(1). The majority of hand fractures are stable. A fracture is considered unstable if it is irreducible, if acceptable reduction cannot be maintained, or if motion at adjoining joints cannot be started without loss of reduction(2). Some form of fixation is often indicated in the following instances:- Unstable fractures, Intra-articular displaced fractures, When a fracture is part of a major ligamentous or tendnous avulsion, Multiple fractures, Open fractures implantation of amputated digits(3).

Various implants used are K-wires, needles, mini DCP plates, interfragmentary screws, intraosseous wiring, tension-band wiring, absorbable pins including sapphire, PGA (polyglycolic acid) and PLA (polylactic acid); intramedullary rods, intramedullary screws and mini external fixator /JESS fixator.

Materials and Methods

A retrospective analysis of 50 cases of metacarpal and phalangeal fractures treated by different methods over a period of one year was undertaken.

with associated soft tissue injury, Fractures with segmental defects and bone loss, Disabling mal-unions and non-unions, Re-

Inclusion criteria

1. Age : Skeletally mature patients.

2. Sex : Both males and females.

3. Duration of injury : Less than 3 days in closed and less than 24 hours in open fractures.

4. Multiple fractures.

5. Open fractures : Swanson's Type-I compound fractures.

From the Deptt. of Orthopaedics, Acharya Shri Chander College of Medical Sciences (ASCOMS) & Hospital Sidhra, Jammu.

Correspondence to : Dr Amit Thakur, *Lecturer,* Deptt. of Orthopaedics, ASCOMS & Hospital Sidhra, Jammu (J&K) - 180017

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Kirschner wires should be sharpened on both ends so that after being drilled in one direction they can be drilled retrograde if necessary.

A slow insertion speed is recommended. The wire should project from the driver less than 5 cm to prevent bending during insertion, when more than 5 cm is needed, the first 5 cm is inserted first, and the drill is then moved on the wire(4,5).

In case of cross-wires, K-wires should never cross at the fracture site, since this will cause rigid distraction. K-wires should cross

Exclusion criteria

1. Skeletally immature.

2. Swanson's Type-II open fractures.

3. Open fractures with associated neurovascular injury.

4. Fingers with amputated digits.

5. Duration : More than 3 days in closed; more than 24 hours in open fractures.

6. Patients with any underlying medical contraindication to surgery.

Based on the above evaluation, the following data was prepared regarding:- Site of fracture (bones involved), Anatomical location - base, shaft, neck, head, Fracture pattern - transverse, oblique, spiral, avulsion or comminuted, Whether closed or open, Associated soft tissue injury, Deformity - angulation, rotation, shortening, Whether stable or unstable. After carefully studying the fracture details, the nature of operation, incision, approach and mode of fixation (implant) was planned.

Operative Management, Techniques and Implants used

K-Wire Fixation:

For the fracture of a hand that is reducible but unstable after reduction, the insertion of Kirschner wires across the fracture site or bridging bones for fixation is very useful *(Fig.-1)* **. A small hand-held power drill is used for insertion of Kirschner wires.**

either proximal or distal to the fracture and gain firm anchorage in the proximal and distal metaphysis(6). Various sizes for Kirschner wire used are:-

· 028 inches

· 0.035 inches

· 0.045 inches

· 0.062 inches

The Kirschner wires in our study were generally removed at 3 weeks

Mini-Plate Fixation: A 2.7 mm or 2.0 mm straight mini DCP was used for metacarpal shaft / base fractures. Generally, 2.7 mm DCP was used for base and 2.0 mm DCP was used for metacarpal shaft fractures (7,8).

Phalangeal fractures : Plate fixation of phalangeal fractures was restricted mainly to proximal phalanx *(Fig.-1)* **. A 1.5 mm straight mini DCP was used for phalangeal fractures(9).**

Screw Fixation:

Size of implants : 2.7 mm screws are best used in metacarpal base and in large adults in the metacarpal shafts *(Fig.-2)* **; smaller metacarpals _ 2.0 mm screws are used; Phalanges _ 1.5 mm screws are used(10, 11, 12).**

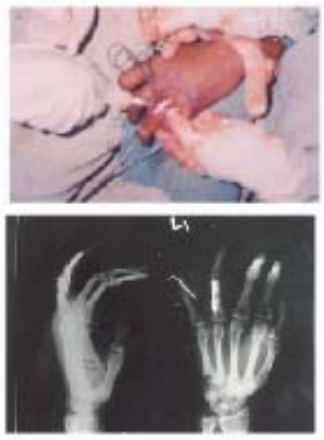

Fig.-1:- Photograph of hand showing phalangeal fractures fixed by means of mini-plate and K-wire.

Fig. 2:- Photograph of hand showing metacarpal fracture fixed by means of screws.

Post-Operative Management and Follow-Up

The limb was splinted in functional position and kept elevated. Intravenous antibiotic was given for 3 days followed by oral antibiotic for next 5 days. In most of the cases the splint was removed after 48 hours and active

range of motion (ROM) exercises started within the limits of pain tolerance. Intermittent ROM exercises out of splint were continued and the patients were discharged on 4th post-operative day with instructions regarding active ROM exercises out of splint. Thereafter these patients were followed-up in OPD(13, 14).

Sutures were removed on 10th postoperative day. the second week, motion was progressively increased. After 3 weeks increased loading was allowed gradually and patients were encouraged to use the involved hand in light routine day-to-day activities like eating, combing hair, washing face etc. Unrestricted activities were allowed only when the fracture and soft tissues were completely healed and the hand was thoroughly rehabilitated, which usually required 10-12 weeks(15).

Results

The present study comprised of 73 fractures of metacarpals and phalanges in 50 patients treated by operative means using various modalities of fixation. Most of the patients belonged to the age group of 20 _ 30 years (50%). Males dominated the study group (78%). The right hand was more commonly involved (58%). The most common mechanism of injury in our series was fall (28%), followed by blunt trauma and road traffic accident (24% each) *(Table-1)* **. 35 out of 50 cases were closed (70%), whereas 15 were open (30%). All the open fractures belonged to Swanson's Type-I category.**

Table 1: Cause (Mechanism) of Injury

36% of cases followed by miniplates (20%), screws (14%), crossed K-wires, multiple K-wires, needles (6% each) and external fixator (8%); and oblique K-wires (4% cases) *(Table-3)* **.**

Table 2 : Ray-Involved

Ray	No. of Fracture	Percentage
First (Thumb)	8	10.95
Second (Index)	20	27.39
Third (Middle)	18	24.65
Fourth (Ring)	16	21.91
Fifth (Little)	11	15.06
Total	73	100

Table 3 : Mode Of Fixation Used

Ray	No. of Fracture	Percentage
First (Thumb)	8	10.95
Second (Index)	20	27.39
Third (Middle)	18	24.65
Fourth (Ring)	16	21.91
Fifth (Little)	11	15.06
Total	73	100

The patients were followed up at regular intervals and final assessment (clinical and radiological) was done at 6 months. The results were based on a scoring system which took into account three criteria, namely union (5 points), functional result based on total active movement (TAM) (0 _ 5 points),16 and complications (negative points). Union was achieved in 98% of the fractures in our series. Functional results based on TAM were excellent in 68%, good in 22%, fair in 8% and poor in 2% of cases. So functional results were excellent / good in 90% of cases in our study.

The average TAM of digits other than thumb was 227.30 whereas for the thumb fractures average flexion range at MCP + IP joints was 126.66%.

Ray	No. of Fracture	Percentage
First (Thumb)	8	10.95
Second (Index)	20	27.39
Third (Middle)	18	24.65
Fourth (Ring)	16	21.91
Fifth (Little)	11	15.06
Total	73	100

The second ray was most commonly involved in our series (27.39%), whereas the first ray was the least commonly involved (10.95%) *(Table-2)* **. Out of total 73 fractures, 39.72% of the fractures involved the metacarpals (29 fractures), 36.98% of the fractures involved the proximal phalanx (27 fractures), 10.95% of the fractures involved the middle phalanx (8 fractures) and 12.32% of the fractures involved the distal phalanx (9 fractures).**

The most common fracture pattern encountered in the study was transverse (46%), followed by oblique (24%), comminuted (14%), spiral and intra-articular (8% each). Three patients (6%) had associated tendon injury, two patients had cut FDS and FDP and one had cut extensor expansion, which was repaired simultaneously. Longitudinal K-wires were used as a mode of fixation in

The overall results derived by combining above criteria were :-

Excellent in 70.45%

Good in 11.36%

Fair in 11.36%

Poor in 6.83%

Discussion

and fractures are often neglected as minor injuries and relegated for treatment to the more inexperienced members of the medical team. The results of the treatment of fractures in hand are not universally good and the incidence of stiffness, mal-union and prolonged functional disability and economic loss is striking. Sir Reginald Watson Jones pointed out that an open fracture

be managed conservatively should be avoided.

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of a phalanx is no less worthy of the skill of an expert than an open fracture of the femur.

This fact was reiterated by Sir John Charnley, who said, "the reputation of a surgeon may stand as much as jeopardy from a fracture of proximal phalanx of finger as from any fracture of femur."

In hand, restoration of mobility is of utmost importance. Prolonged immobilization leads to joint stiffness and dystrophy of soft tissues. As per Dr. Alfred Swanson, "hand fractures can be complicated by deformity from no treatment, stiffness from over treatment and both deformity and stiffness from poor treatment."

From our study, we would like to emphasize that

operative management of hand fractures should be undertaken only if a definite indication exists. Indiscriminate use of it should be avoided.17 Detailed clinical and radiological assessment of the fracture and careful pre-operative planning are a must to select the appropriate approach as well as the implant. Adequate facilities including complete instrumentation as well as wide range of implants should be available. A thorough knowledge of anatomy is important and the surgeon should be well versed with the technique. The dissection should be meticulously performed to avoid soft tissue trauma and excessive periosteal stripping. The technique requires high degree of precision. The procedure can be time consuming and may test the patience and skill of even the most experience surgeon(18, 19).

Conclusion

The operative management of metacarpal and phalangeal fractures has definitely an advantage over the closed methods of treatment especially in displaced, unstable, comminuted, intra-articular, open and multiple fractures. As already mentioned hand is an important instrument of performance and protection so even a small deformity in the hand can manifest later with severe inability to use the hand and interfere in person's day-to-day activities and loss of livelihood(20).

The operative management of metacarpal and phalangeal fractures results in accurate reduction of the fracture without any angulation or rotation, better stability at

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the fracture site, hastens union of the fracture. The joints should be mobilised early following fixation to prevent stiffness of the fingers and regain the desired ROM at the joint. The postoperative physiotherapy of the hand is must.

Complications should be minimized by precision as far as in the selection of case and operative technique. Indiscriminate use of operative fixation especially in fractures which are stable, undisplaced and which can

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