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Original Article

Mini-external Fixators in Fracture of Short Tubular Bones of Hand

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Abstract

Introduction: Fractures of the metacarpal and phalanges constitute 10% of all fractures. Nowhere in the body, the form and function are so closely related to each other than in hand. Too often, these fractures are treated as minor injuries resulting in major disabilities.

Aim: This study aims to evaluate the outcome of hand fractures managed with mini-external fixators.

Materials and Methods: This is a prospective study to determine the outcome of phalangeal and metacarpal fractures treated with mini-external fixators. Study consists of 40 patients with fractures of phalanx and metacarpal bones. Pre-operative work-up was done to exclude crush injury of hand beyond reconstruction and with vascular injury. Fracture fixation was done with K-wires and clamps. All our patients were reviewed clinically and radiologically at regular interval.

Result: Types of fracture; 25 were comminuted, 6 transverse, 5 oblique, and 10 spiral. Good results were in 16 cases, fair results in 5 cases, and there are no poor results. Fair results were in fracture with intra-articular extension due to the restriction of movements.

Conclusions: Our overall experiences with mini-external fixators for phalangeal and metacarpal fractures are encouraging; however, we are aware this is a short-term study and would require further evaluation and more inputs.

Key words: Mini-external fixators, Open and unstable fractures, Phalangeal and metacarpal bone

INTRODUCTION

Hand injury is extremely common and accounts for about 15% of the attendance at accidents and emergency departments.[1] Fractures of metacarpals and phalanges are probably the most common fractures in the skeletal system and are often neglected as minor injuries.[2] Diagnosis of phalangeal and metacarpal fractures can be made after careful clinical assessment and radiological examination. Radiological examination should include standard anteroposterior and lateral views of the injured bone.[3] 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, mini-plates to mini-external fixators are used to treat these fractures.[4] Even though these fractures are small and more often neglected, these fractures causes significant deformity and disabilities. The management depends on the type, site, and pattern of fracture. The treatment options are conservative and operative. We have different types of surgical treatments such as open reduction and fixation with K-wires, plates and screws, screws alone, and external fixators. Since mini-external fixation is less invasive and has the advantage of treating both open and closed fractures, we preferred mini-external fixators for phalangeal and metacarpal fractures. Other advantages of external fixators are gives good stability for fracture, easy for wound care, and early mobilization of joints.[5,6]

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Aim

This study aims to evaluate the outcome of hand fractures managed with mini-external fixators.

MATERIALS AND METHODS

This prospective study was conducted at Government Rajaji Hospital. 40 patients with fractures of phalanx and metacarpal bones were selected for this study. Pre-operative work-up was done to exclude crush injury of hand beyond reconstruction and with vascular injury. Pre-operative evaluation was done with complete hemogram, serological investigation for HIV, HBSAG, and radiography. Under local anesthesia under strict aseptic precaution, external fixators were applied. Two 2.0 mm "K" wires were applied on either sides of the fracture site on the dorsolateral aspect of the fingers at 45° angle to bone after provisional reduction under the guidance of image intensifier. The pins were then provisionally connected to a 2.5 mm "K" wire by metal clamps and the fracture reduced. In most cases, simple traction was sufficient, and after reduction, the K-wires were fixed firmly to the connecting bar. Three unstable fractures were fixed with more than two K-wires on either side. If the pins interfered with the soft tissues, they were bent in a dorsal direction through an angle of 40–60°. The skin wounds were not closed and, postoperatively, the injured hand was immobilized in plaster for 10 days to 6 weeks. Standard pin care was taught to the patients and discharged after soft tissue healing. Finger mobilization was started after 48 h and regular wound care was given. Inspection of the wounds and stability of the device were checked at weekly interval regularly. Radiographs were taken immediately after surgery and at 1–2 weeks and 4 weeks to check the position and healing. After bony healing, we removed the external fixators. Mobilization was started after the removal of the plaster splint. Patients were discharged from follow-up when improvement in function had reached a plateau. Recovery was scored on the basis of the total active range of movement of each injured finger separately, using the scoring system of Duncan *et al*.[7] for total active movement (TAM). This adds the active flexion of the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints, then subtracts the sum of the extension deficits at these three joints.

RESULTS

Sex ratio is male 28 and female 12. Most of fractures are in dominant hand right side 22 and left side 18. Their mean age was 35 years (15–69). Most had blunt injuries, nine were caused by traffic accident, 10 by machinery, 12 by falling or cutting objects, and five by physical violence and four by a fall. The distribution of the 29 phalangeal and 11 metacarpal fractures; the proximal phalanx of the ring finger was more often involved than that of the other fingers. Types of fracture; 25 were comminuted, 6 transverse, 5 oblique, and 10 spiral. There were 27 open fractures (Table 1-4).

The mean follow-up was 4.4 years (2.3–8.2), and there were no general complications. The external fixators were removed at a mean of 5.8 weeks for phalangeal fracture (3–11) and 6.1 weeks for metacarpal fracture (2–12) after fixation. 10 fractures showed complications during the period of fixation: In six patients, one of the pins became loose, in two part of the device interfered with the soft tissues of the adjacent finger, in one the device restricted movement of the adjacent finger, and in one the fracture became displaced. In five patients, pin loosening was managed by removal of the external fixators as the fractures had healed. In one case, fracture displaced due to pin loosening for which refixation was done. Interference with other fingers was seen only before we had made it our policy to bend the pins. The patient with a displaced fracture required rereduction at a second operation. The mean period of treatment for phalangeal fractures was 7 months and for metacarpal fractures 5 months. Six patients developed joint stiffness. No patient developed reflex sympathetic dystrophy. There were no sinuses after removal of the pins. None of the fingers had rotational or axial deformities. Eight out of the nine fractures of the middle phalanx and 12 of the proximal phalangeal fractures had excellent. Of the eight patients with fair or poor results, five had an injury to the tendon. The mean follow-up was 4 years external fixators were removed after 4 weeks. There were no general complications. There were no rotational and axial deformities. Functions of finger were assessed using TAM of digits scoring method. Good results were in 16 cases, fair results in 5 cases, and there are no poor results. Fair results were in fracture with intra-articular extension due to restriction of movements. Pin is looser was found is one case and it was corrected. There is no pain tract infection. In our study, we had few post-operative complications. One case of stitch abscess and one case of early post-operative infection treated appropriately.

Table 1: Distribution of types of fracture

Diagnosis	Male	Female	Total
Transverse fracture	4	2	6
Oblique fracture	2	3	5
Spiral fracture	6	4	10
Communited fractures	16	3	19

Table 2: Acceptable angulation and shortening of fingers

Fingers	Acceptable shaft angulation (degree)	Acceptable shaft shortening (mm)	Acceptable neck angulation (degree)
Index and long finger	10–20	2–5	10–15
Ring finger	30	2–5	30–40
Little finger	40	2–5	50–60

Table 3: Mode of injury

Mechanism of injury	Mini-external fixation	Conventional method	Total
RTA	16	15	31
Fall	3	3	6
Assault	2	1	3
Total	21	18	40

RTA: Renal tubular acidosis

Table 4: Side of injury

Side	Mini-external fixation	Conventional method	Total
Right	13	9	22
Left	7	11	18
Total	20	20	40

DISCUSSION

A fracture is considered functionally stable when during clinical examination; it is possible to actively move the fractured digit by 50% of range of motion painlessly. The fracture is considered radiologically stable when the radiographs of the fractured fragment in two planes show minimum angulation and displacement.[7] A fracture is considered unstable if it cannot be reduced or maintained in an anatomic or near anatomic position without implant fixation when the hand is placed in the safe or functional position.[8] The four factors that determine the stability are (1) external force, (2) muscle imbalance, (3) fracture configuration or personality, and (4) integrity of soft tissue including periosteal sleeve. The phalangeal fracture is exposed either through a dorsal vertical or a lazy "S" incision. Rarely, one may choose to go through one or both mid-lateral incision.[9] Extensor tendon on the proximal half of the proximal phalanx is incised vertically in the middle while in the distal half the plane is in between central and lateral slip. The incision over the extensor tendon on the middle phalanx is paramedian without violating the insertion of central slip at the base of middle phalanx. Although general anesthesia or regional anesthesia is widely used in hand surgeries, there is a distinct advantage of distal blocks or WASH which facilitates intraoperative movements of the fingers to confirm the rotational alignment. Most phalangeal and metacarpal fractures are treated conservatively.[10] Patients with unstable fractures require operative reduction and stabilization to obtain the optimal position for bone healing and to allow early movement. We used external fixation to help to avoid any additional injury to the bone and soft tissues. The technique is relatively simple, and even greater precision is added by the use of an image intensifier.[11,12] The best site for pin introduction is easily chosen. Predrilling with a drill guide has the advantage that the site and direction of the pins are better controlled. An image intensifier is sometimes necessary because of the brittle nature of the phalanges and metacarpals: What may seem to be a perfect drill hole may lead to incorrect pin placement if it is not checked by the image intensifier.[13,14]

CONCLUSION

External fixation provides an adequate basis for bone healing but does not guarantee good functional outcomes. These seem to depend on the severity of accompanying soft tissue injuries as shown by our fair or poor results in six patients in whom a phalangeal fracture was associated with tendon injuries. The functional results after metacarpal fractures were better than those after phalangeal fractures and fractures of the middle phalanx had better recovery than those of the proximal phalanx. External fixation proved to be a suitable technique for stabilizing unstable, open fractures with severe soft tissue injuries.

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