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The Outcome of Different Surgical Methods of Fixation of Metacarpal and Phalangeal Fractures During the Egyptian Revolution

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ABSTRACT

The mode of hand trauma had been changed during the first two years of the Egyptian revolution (2011-2012). Injuries due to sharp objects predominated. We compared the results of several methods of fracture fixation such as: 1- Plates and screws. 2- Only screws. 3- K-wires. 4- External fixators based on goniometric study as a fixed parameter. The key of success is the early induction of active movement of the affected joints which is possible with plate and screws and only screw fixation. The range of motion of the metacarpophalangeal (MCP) joint is better with plate and screws and only screws than K-wire and external fixation. Generally, the metacarpophalangeal (MCP) joint active range of motion regained earlier than the proximal interphalangeal (PIP) and the distal interphalangeal (DIP) joints. Screw fixation of articular and mallet fractures gave better results than those fractures fixed by external fixators.

INTRODUCTION

The hand is a delicate and sensitive organ that requires both flexibility and stability in order for optimal function. Every hand injury is unique and treatment must be tailored to the injury, the patient and the skill of the treating physician [1]. Hand fractures represent a considerable burden upon society in terms of medical costs and reduced work-place productivity, so minimizing the functional loss that may occur following injury is important not only in terms of the patient's quality of life but also to minimize the overall cost to society [2].

Most digit fractures will unite without intervention, so the over-riding aim of treatment of the skeletal elements of hand injuries is to restore function to the hand by maintaining joint mobility and stability and to avoid the two most prevalent sequelae of conservative treatment: Stiffness and deformity [3]. Successful closed reduction and immobilization in intrinsic plus position for three to four weeks relies on little to no displacement of the fracture and good compliance of the patient [4]. Percutaneous K-wire fixation is a useful technique that is relatively easy to perform and useful in many fracture scenarios. K-wires can be used to fix fragments during either closed reduction percutaneous pinning or open reduction [5]. Interfragmentary screws are useful in long oblique fractures and for capturing isolated intra-articular large fragments [6]. Plate fixation allows for relatively rigid fixation that can allow for early mobilization similar to screw fixation [7].

Tension band wiring also provides relatively rigid fixation and is not as bulky as plate fixation [8]. Intramedullary nail fixation helps to achieve good functional results with minimal soft tissue disruption and complications in the management of unstable metacarpal fractures [9]. Cerclage-wiring was one of the earliest forms of internal fixation in the hand. With cerclage-wiring, the multiple fragments are gathered, reducing the fracture components to 2 or 3 main fragments. This helps to maintain the reduction, so provides sufficient initial stability for placement of another fixing device as a plate and screws [10]. Interosseous loop wire fixation is another method of fixation. It has been found to be rigid enough to allow immediate postoperative finger mobilization in a wrist splint and achieve good functional results [11]. External fixation is another tool that has been used in open fractures and those involving segmental bone loss and/or infection with good clinical outcome [12]. Bone grafting should be taken in consideration while dealing with high-energy injuries associated with bone loss [13].

The aim of this work is to study and analyze the hand trauma presented to our emergency hospital during the Egyptian revolution and study the outcome of different surgical methods of fixation of metacarpal and phalangeal fractures.

MATERIAL AND METHODS

In our Emergency Hospital Mansoura University and as regard Plastic Surgery Department, we

have the duties of hand surgery six days per month. During the first two years of the Egyptian revolution, we have received 290 hand cases. Cases with hand fractures represented 152 cases (about 52.41% of all hand injuries), all of them were open fractures. Only 112 cases (38.62% of all hand injuries) are due to sharp trauma and 40 cases (13.79%) due to crushed injuries as shown in Table (I). Different methods of fixation were used taking in consideration the pattern of fracture, associated soft tissue injury, general condition of the patient and available resources.

Hand fractures due to sharp trauma were found in 112 cases presented with 188 fractures. 10 of them were carpal, 50 were metacarpal and 128 were phalangeal fractures as shown in Table (II). They were all open fractures.

Transverse fractures were the commonest pattern of metacarpal and phalangeal fractures. They were fixed with plate and screws as shown in Figs. (1-4). We did not use post-operative immobilization for these cases. Early exercise was carried out from the first post-operative day. Fractures with bone loss, comminution or intra-articular fractures were managed by external fixators that had been removed six weeks after the operation as shown in Fig. (5). Active exercise had been carried out immediately after removal of the external fixators. K-wires were used to fix fractures of the neck and the base of the metacarpals and phalanges and intra-articular fractures with relatively large fragments. K-wires were removed after four to six weeks followed by induction of physiotherapy as shown in Fig. (6).

Intra-articular fractures with considerable volume of the fractured segment were managed by a screw fixation as shown in Fig. (7). Screw fixation was also the method of choice for long oblique fractures of the shaft (Fig. 8).

Goniometric study of the MCP, PIP and DIP joints was recorded to all cases three and six months post-operatively to evaluate the active range of motion (ROM) to these joints.

RESULTS

Hand fractures due to sharp trauma were found to be the major presentation of all hand fractures during the Egyptian revolution. They were found in 112 cases presented with 188 fractures. 10 of them were carpal, 50 were metacarpal and 128 were phalangeal fractures. They were all open fractures.

The cases of metacarpal fractures in which the articular surfaces are spared from the fractures, mini-plate fixation was the rule. As the hand is splint free, active exercise is early permitted. The active range of motion of MCP was very good three months from the operation. It was 70 to 80 degrees at the end of the first three months. Complete hand grip was reached at the end of six months postoperatively. Cases of the comminuted metacarpal articular fractures were managed by external fixators. At the end of the first postoperative three months, MCP active range of motion was about 30 to 40 degrees. The complete hand grip to these cases was obtained after nine months. The mid-shaft phalangeal fractures were managed by microplates and screws fixation. Their active range of motion regained completely early just after six months as early active exercise was the rule. Obligatory hand splinting was done to these cases managed by K-wires so, the active exercise was delayed about six weeks from the operation. Goniometric study to DIP and PIP was about 30 degrees three months from the operation. It was 60 degrees after 6 months. There was complete range of motion ten months after the operation. The MCP active range of motion was better than the interphalangeal joints. It was 50 to 60 degrees during the first three months. Total MCP flexion was reached after six months, preceding the interphalangeal joints by four months. Screw fixation gave a good result when used to fix articular large fragments and long oblique shaft fractures of the metacarpals and phalanges. Active exercise began after the patient's recovery from anasthaesia. The active range of motion was normal within four months from the operation.

The hand grip was good in the isolated cases of fractures either of the metacarpals or the phalanges. Dynamometer assessment of hand grip was done when the patient became pain-free and re-evaluated one month later. Those cases of associated tendon injury with fractures, their hand grip was weak after the operation even when the patient became pain-free. It had not been regained to its normal level within the first nine months post-operatively.

Table (I): Types of hand trauma.

	Number	%
Total hand cases	290	
Crushed injuries	40	13.79
Only tendon affection	138	47.59
Fractures due to sharp trauma	112	38.62

Table (II): Types of hand fractures.

Carpal	10
Metacarpal	50
Phalangeal	128

Fig. (1): Fifth metacarpal shaft fracture fixed with plate and screws.

Fig. (2): Second metacarpal shaft fracture fixed with plate and screws.

Fig. (3): Mid-shaft fracture of the proximal phalanx of the ring finger fixed with plates and screws.

Fig. (4): Fracture of the proximal phalanx of the thumb fixed with plate and screws.

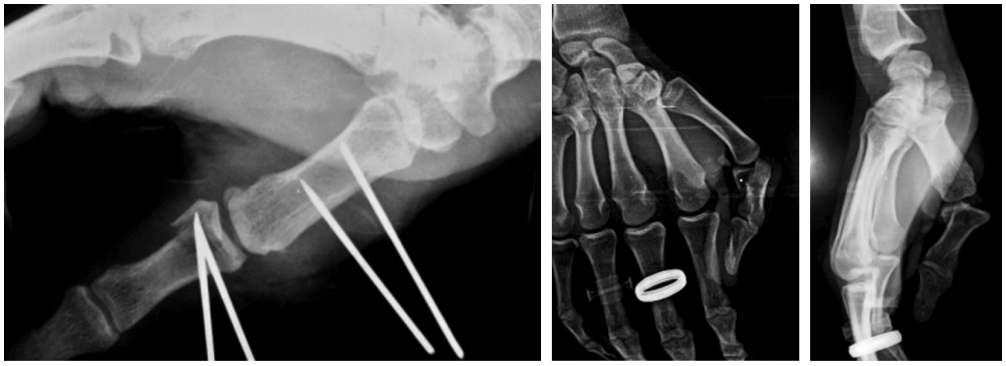

Fig. (5): Intra-articular fracture of the proximal phalanx of the thumb fixed with external fixator.

Fig. (6): K-wire fixation of mallet thumb.

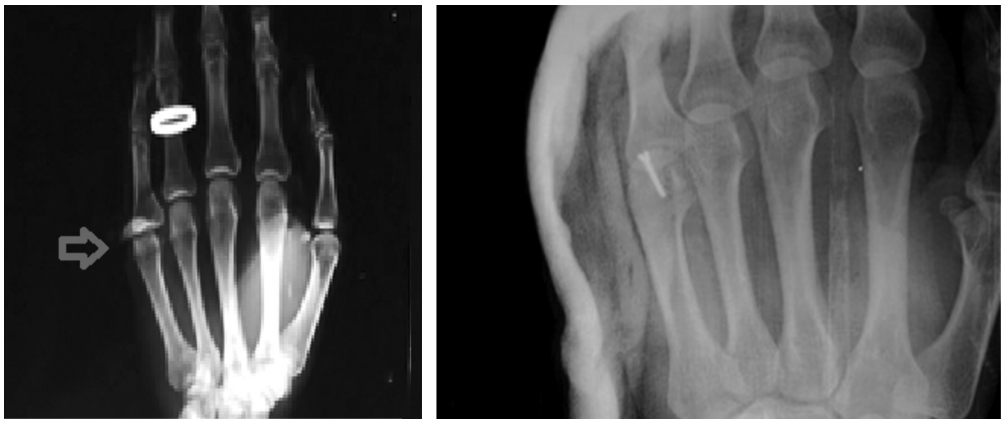

Fig. (7): Fifth metacarpal head fracture fixed with a screw.

Fig. (8): Fracture of the middle phalanx of the middle finger fixed with a screw.

DISCUSSION

Metacarpal fractures were usually transverse or short oblique which were best fixed with plate and screws (26 fractures) as recommended by some authors [14]. Long oblique fractures and intra-articular metacarpal head fractures were best fixed with miniscrews (10 fractures). 14 metacarpal fractures were fixed with K-wires; they were intra-articular metacarpal base fractures.

Most of phalangeal fractures were intra-articular and most of them were fixed with K-wires (86 fractures) while 4 fractures needed external fixation device as spanning arthroplasty. 22 fractures were transverse shaft fractures which were fixed with plates and screws. Plate fixation allowed rigid fixation enough to start early mobilization and avoid stiffness and tendon adhesions as most of these fractures were associated with flexor or extensor tendon injuries. 12 fractures were intra-articular which were fixed with miniscrews.

Ramdhian and his colleagues [15] compared between the use of plate and screws and Intramedullary K-wire fixation with six weeks immobilization. They found that: Plate fixation with immediate mobilization paradoxically provides poorer mobility than the Intramedullary K-wire. The metacarpal head fractures are usually intra-articular due to heavy axial loading. Open reduction and internal fixation is required to achieve adequate reduction and alignment of joint surface. The most appropriate method is screw fixation [16]. In this work, screw fixation was the method of choice if the articular fractured fragment is large enough to hold the screw. The external fixators had been used to those cases of severe bone comminution or bone loss. The key of functional success is the immediate post-operative active motion. This is the major advantage of plate and screw fixation and only screw fixation with adequate stability of the fracture.

Balaram and Bednar [17] described many complications of the fracture management such as infection, tendon rupture, malrotation, joint stiffness and non-union. bone loss is the major factor causing rotation, malunion and stiffness [18]. During any hand operation, tissue manipulation must be delicate to avoid intrinsic muscle injury to keep their important function normal (fine movement of the fingers). Meunier and his team [19] described the severe deformity of the hand due to intrinsic muscle dysfunction due to its fibrosis or nerve injury. The obligatory immobilization with the use of K-wire fixation contributes in joint stiffness and prolongs the post-operative period of physiotherapy. However; Paksima and his team [20] reported better functional results than open reduction and internal fixation even with screws or plate and screws. The active range of motion of the affected joints was measured by a goniometer as an accurate parameter to judge the results. Kronlage and Faust [21] reported good results when they used screws to fix the mallet fracture superior to that fixed with K-wires. Other authors like Zhang [22] fixed the mallet fractures with K-wires, they reported no fracture fragmentation due to manipulation during surgery, no skin necrosis or infection. Actually, in this work the use of screw fixation is so superior to the use of K-wires as regard the results. Comminuted intra-articular phalangeal fractures with associated dislocation are difficult cases to treat. The conservative measures lead to stiffness and decreased range of motion. The external fixators is an ideal method of fixation [23]. This method obligatory delays the active therapy induction. This leads to prolongation of the post-operative period of hand rehabilitation and minimizes the end results.

Conclusion:

Incidence of hand trauma in Egypt has been grossly increased during the revolution. Mode of trauma also changed and sharp injury predominated as a result of spread of sharp weapons as knives and swords. Many cases with hand fractures due to sharp object were presented to our Emergency Hospital at Mansoura University and this improved our experience in dealing with hand fractures. The use of screws and plate and screws fixation were better than the use of K-wires and external fixators. Early active exercise induction is the key factor for improving the results.

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