



Prospective Study of External Fixators in Fractures of Hand

KEYWORDS

Mini long bones fractures, external fixators Key Messages: external fixators indispensable ornamentarium in treating hand fractures

* Prof. Sureshkumar Arunachalam

M.S.(Ortho), Tirunelveli medical college, tirunelveli
* Corresponding Author

Karthicoumaran

M.S.(Ortho), Tirunelveli medical college

Mageswaran Shanmugavelu

M.S.(Ortho), Tirunelveli medical college

Prof. Elangovan Chellappa

M.S.(ortho), D.Ortho, Tirunelveli medical college

ABSTRACT Prospective study of external fixators in fractures of hand

Context:

Fractures of mini long bones of hand are common fractures of extremities, untreated fractures and wrongly treated fractures lead to miserable life, in this background we evaluated our treatment of mini long bones of hand with external fixators.

Aims:

To evaluate "Functional outcome analysis of mini external fixator in short long bones of hand and foot" in Department of Orthopaedics, Tirunelveli Medical college Hospital, over a period of two years and 3 months from October 2013 to January 2016

Settings and Design:

This is a prospective study of 100 patients carried out in the Department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli from October 2013 to January 2016

INCLUSION CRITERIA

1) Closed and open metacarpal and phalangeal fractures of hand

EXCLUSION CRITERIA

Associated vascular injury

Methods and Material:

with external fixator 100 patients received in casualty with unstable fractures of hand both closed and open injuries are chosen for treatment

This is a prospective study of 100 patients carried out in the Department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli from October 2013 to January 2016

Implants and instruments

1.8mm threaded pins Mini external fixator (Hinged or Non hinged) JESS clamps and rods K wires Allen key

General instruments



Anaesthesia

For Hand - Supra clavicular block or wrist block

Position

Supine position

Statistical analysis used:

Functional outcome in hand fractures is analysed using DUNCAN score at the end of 6 weeks.

Results:

Mini external fixators are of great value in treating fractures both closed and open mini long bone of hand especially in developing countries.

Conclusions:

Mini External fixator is one of the ideal treatment modality in the management of these fractures especially in

- a) Open fractures
- b) Communitated fractures
- c) Intraarticular fractures
- d) Fractures with bone loss

Advantages of mini external fixator are

Promote wound healing in open injuries

Allows mobilization in non fractured digits

Indirect reduction of intra articular fractures using distraction

Aids in reduction of fractures through manipulation of pins

Introduction:

Fractures of the miniature long bones are the most common fractures of the extremities. It includes metacarpal and phalanges fractures in hand, metatarsals and phalanges fractures in foot.

Optimum treatment depends on location of fracture site

(intra articular versus extra articular), fracture pattern (transverse, spiral, oblique, comminuted), deformity (angular, rotational, shortening), open or closed, associated soft tissue injuries, and stability of fracture. Outcome is also influenced by other factors such as patient's age, occupation, socio economic status, the presence of systemic illness, surgeon's skill and the patient's compliance. In general, fractures of miniature long bones are classified into stable or unstable fractures. Stable fractures require minimal immobilization, whereas unstable fractures may require closed or open reduction with internal fixation, external stabilization. Fractures with articular step-off, open fractures (especially in those with bone loss and significant soft-tissue injury), fractures with significant shortening or bone loss, and fractures that fail closed reduction are indications for surgical treatment. Internal fixation should be achieved with minimal soft-tissue disruption in order to limit scarring and disruption of the blood supply of the fractured bone.

Comminuted fractures are inherently unstable and are more frequently associated with injuries to tendons, nerves, and vascular structures than are simple fractures. Ultimate stiffness correlates with severity of initial injury to bone and soft tissues. Comminuted fractures tend to lead to a higher risk for stiffness than simple fractures. This is especially true of articular fractures as compared with extra articular fractures.

External fixation devices are positioned to avoid compromise to the tendons, so that early motion is not compromised. The fracture was exposed through a longitudinal incision along the extensor tendon, which gave excellent exposure; this stable construct allowed protected motion early. The aftercare and supervised rehabilitation program is very important to achieve maximum recovery and function. Dynamic external fixation methods have been developed for treatment of difficult articular fractures, especially about the PIP joint. These methods are technically challenging. Operating room fluoroscopy units are useful aids in reduction and placement of fixation devices.

Subjects and Methods:

This is a prospective study of 100 patients carried out in the Department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli from October 2013 to January 2016.

Inclusion criteria

1) Closed and open metacarpal and phalangeal fractures of hand

Exclusion criteria

Associated vascular injury

Mode of injury includes road traffic accident, accidental injury, assault, blast injury, animal bite. Open fractures are managed with thorough wound debridement, antibiotics, and emergency external fixation. Among 50 open wounds, 38 patients got primary

wound cover. 12 patients required delayed raw area management. 18 patients had tendon injury for whom tendon repair done

Closed and open fractures of hand are evaluated with radiographs and fractures in inclusion criteria of this study are treated with either open or closed reduction with external fixation done under fluoroscopic guidance. Post operative mobilization is started as early as possible.

Post operative radiograph taken and assessed for fracture reduction. Patients are followed up at weekly interval for 8 weeks.

External fixator are removed at 4 weeks for closed and 6 weeks for open fractures. Functional outcome in hand fractures is analysed using DUNCAN score at the end of 6 weeks.

Implants and instruments:

1.8mm threaded pins

Mini external fixator (Hinge or Non hinged)

JESS clamps and rods

K wires

Allen key

General instruments

Operative technique

Anaesthesia For Hand - Supra clavicular block /wrist block

Position supine

Procedure

Closed reduction

Closed reduction is attempted using standard reduction manoeuvre and checked under image guidance for anatomical reduction. If the fracture is reduced then pins are applied for external fixator construct.

The position of the pins depends upon

Site of the fracture

Tendon course

Vascular status

Ideally Pins are applied sparing the joint to allow mobilization. But intraarticular comminuted fractures mandates spanning of involved joint for maintaining the length and reduction of fracture.

External fixator pins are applied on the dorsolateral aspect of bone to avoid tendon impingement to allow tendon sliding for active mobilization. Intraarticular placement of Pins are avoided to possible extent to decrease stiffness secondary to synovitis or capsular inflammation

After fracture reduction is achieved, it is temporarily stabilized using k wires or bone clamps. Pins are then placed. Most distal and most proximal pin is inserted first using T handle after predrilling. Pins are inserted parallel to the

joint line and should have adequate bicortical purchase .

Mini external fixator is then fitted to the inserted pins,additional pins are then inserted using fixator as drill guide with adequate bicortical purchase .frame of fixator are kept roughly 2-3 cm away from skin.

In Communited fractures of shaft or communited intra-articular fractures ,pins are applied after correcting rotation deformity and external frame applied to maintain length.

Open reduction

Open reduction of closed fractures are done if closed reduction failed.Phalanges ,metacarpals and are approached using standard approaches and fracture reduction done .Once reduction achieved ,it is stabilized using external fixator and checked with fluoroscopy.

Open fractures

Thorough wound wash and debridement done immediately, appropriate antibiotics started .As the fracture site is exposed ,fracture is reduced and fixed in the same way using external fixator.Post operative antibiotics are continued for an average period of 7 days.

8 patients had bone loss and external fixator applied maintain rotation and length .

Postoperative protocol

Immediate limb elevation on day of surgery

Finger and wrist mobilization exercises as early as possible

Antibiotics for open fractures for an average of 7 days.

Alternate day Pin site cleaning

Suture removal on 10th day

External fixator removed at 4 weeks for closed fracture and 6 weeks for open fractures.

OBSERVATIONS OF THE STUDY

In the study which consisted of 100 patients of fractures of miniature long bones of hand,conducted from October 2013 to january 2016,the following observations were made.

DISTRIBUTION OF FRACTURE HAND FRACTURE

Closed fractures	62	62%
Compound fractures	38	38%

BONE INVOLVEMENT CLOSED FRACTURES

METACARPAL	17	27.41%
PHALANGES	34	54.83%
BOTH	11	17.74%

COMPOUND FRACTURES

METACARPALS	12	31.6%
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PHALANGES	18	47.4%
BOTH	8	21%

CLOSED FRACTURES SEX DISTRIBUTION

MALE	68	68%
FEMALE	32	32%

Mode of injury

RTA	48
ACCIDENTAL INJURY	22
INDUSTRIAL	12
ASSAULT	10
BLAST INJURY	6
ANIMAL BITE	2

Mean operative time 30 mins

COMPLICATIONS

Pin site loosening	9
Infection	6
Lack of purchase	3
Skin complications	6
Deformity	4
Tendon impingement	2
Amputation	1

Results:

Functional outcome in terms of total range of movements of injured finger is calculated using the scoring system of Duncan et al. Scores are applied to 100 patients in our study at follow up period of 6 weeks.

DUNCAN'S SCORE

FINGER	THUMB	RESULTS
220-260	119-140	EXCELLENT
180-219	98-118	GOOD
130-179	70-97	FAIR
<130	<70	POOR

Score is calculated by summation of active flexion present in MCP and IP joints of injured finger subtracting the summation of extensor deficits present in these joints

our study ,results obtained among 100 patients are given below

FUNCTIONAL OUTCOME IN PATIENTS WITH ISOLATED METACARPAL FRACTURES

OUTCOME	NO OF PATIENTS	PERCENTAGE
EXCELLENT	12	41.3%
GOOD	10	34.4%
FAIR	5	17.24%
POOR	2	6.8%

FUNCTIONAL OUTCOME IN PATIENTS WITH ISOLATED PHALANGAL FRACTURES

OUTCOME	NO OF PATIENTS	PERCENTAGE
EXCELLENT	21	40.38%

GOOD	17	32.69%
FAIR	7	13.46%
POOR	7	13.46%

FUNCTIONAL OUTCOME IN PATIENTS WITH BOTH METACARPAL AND PHALANGEAL FRACTURES

OUTCOME	NO OF PATIENTS	PERCENTAGE
EXCELLENT	6	31.57%
GOOD	5	26.31%
FAIR	4	21.05%
POOR	4	21.05%

DISCUSSION

Most of the fractures of miniature bones of hand are treated conservatively, in selected cases like unstable fractures operative intervention needed.

In our study, mini external fixator is applied to all types of fractures ,both closed and compound fractures of hand as per our inclusion criteria of our study detailed earlier except those associated with vascular injury .External fixator avoids additional injury to the soft tissue. It also promotes wound healing in case of compound fractures.Operative technique is simple with the use of image intensifier.

Initially ,we used JESS clamps and pins for external frame construct. Later , Mini External fixator with compression distraction unit is used.In our study of 100 patients,incidence of closed fractures are high compared to open fractures.RTA is the most common mode of injury followed by accidental injury and assault.

Mini external fixator is applied with two pins proximally and two pins distally.Most common complication encountered is pin site loosening which may be due to poor quality bone . Other complications are infection ,deformity due to malunion,skin complications.One patient landed up with amputation of finger due to vascular compromise.

In our study among hand fractures functional outcome is analysed using DUNCAN score .It measures total range of motion in injured finger.Functional result obtained among metacarpal fractures is better compared to phalangeal fractures which in turn is better than combined fractures.

The results obtained in our study is better than the study conducted in 33patients that includes 29 phalangeal and seven metacarpal fractures

J Bone Joint Surg [Br] 1998;80-B:227-30. Received 7 July 1997; Accepted after revision 10 November 1997, where the study group is small.

Excellent to good results are obtained in 82.5% of patients with metacarpal and phalangeal fractures which is better than 69% and 71.4% with phalangeal and metacarpal fractures respectively,obtained in the above mentioned study

Discussion:

Most of the fractures of miniature bones are treated conservatively. Open reduction and internal fixation is performed for unstable fractures for absolute stability,thereby promoting early union and movement of joints. But open reduction and internal fixation cannot be achieved in all cases due to nature of injury. Also open reduction and internal fixation requires additional soft tissue stripping which sometimes hinders union or leads to adhesion pre-

venting active movement of digits.

In our study, mini external fixator is applied to all types of fractures ,both closed and compound fractures of hand and foot except those associated with vascular injury .External fixator avoids additional injury to the soft tissue. It also promotes wound healing in case of compound fractures.Operative technique is simple with the use of image intensifier.

**CASE 1
CLINICAL PICTURE**



X -RAY



JESS FIXATOR



UNDER IMAGE INTENSIFIER



CASE 2
CLINICAL PICTURE



JESS FIXATOR



POST OP X RAY



MINI EXTERNAL FIXATOR



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