

JESS FIXATOR FOR METACARPAL AND PHALANGEAL FRACTURE

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ABSTRACT

The fractures of metacarpal and phalanges of the hand are the most common injury encountered in emergency department. Most often these injuries are neglected as minor injuries and later on develops a functional limit of the hand. Joshi's external stabilizing system (JESS) fixator based on the principle of ligamentotaxis, stabilize the unstable and intraarticular fractures of metacarpal and phalangeal and also provides an environment for rapid soft tissue healing without further damaging the microvascular circulation. The study includes total number of 38 patients with a diagnosis of fracture of Metacarpal and phalanx of hand admitted in Nepal Medical college and Teaching Hospital who were treated with JESS fixator. The functional outcome after the removal of JESS fixator was assessed by calculating American Society for Surgery of Hand and Total Active flexion (ASSH TAF). Among the 38 patients, all fractures went to union with an average union period of 6 weeks. The mean period of treatment for metacarpal fractures was 12 weeks and for phalangeal fractures 16 weeks by which time patients regained full functional activity of hand and returned back to their respective works. The functional outcome assessed by ASSH-TAF score was excellent in 28 patients, good in 10 patients and none of them had a poor result. The complication was seen in 9(23.68%) cases, superficial pin tract infection and K Wire Loosening. JESS fixator is cheap, easily available and less technically demanding, provides with an effective treatment for the metacarpal and phalanges fracture, as it provides adequate stability that allows early rehabilitation with soft tissue care and has got a good functional outcome

KEYWORDS

American Society for Surgery of Hand and Total Active flexion (ASSH TAF), Fixator, Joshi's external stabilizing system (JESS), Metacarpal and Phalangeal fracture

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INTRODUCTION

The fractures of metacarpal and phalanges of the hand are the most common injury with the prevalence of 10-30% of all fractures.^{1,2} The incidence of hand injury is seen more during the young age group with male dominance.³ These hand fractures are commonly encountered in emergency department, due to multiple causes like road traffic accidents, machine injury, crush injury, assaults and explosion based injury.^{4,5} Most often these injuries are neglected as minor injuries and later on develops a functional limit of the hand.⁶ The optimal goal of the treatment of hand injuries are healing of wound, bony union and most important restoration of the functions.

The hand injury is mainly treated conservatively with plaster and splints but surgical intervention is required in unstable, comminuted, intraarticular fractures and in open fractures for soft tissue and bony healing in optimal position with early range of movement of joints to preserve the functions of the hand.^{7,8} There are different surgical techniques with various fixation devices having their own merit and demerit such as Kirschner (K) wires fixation, mini plates and external fixator application used to depend upon the fracture pattern and soft tissue condition.

The external fixator, which works on the principle of ligamentotaxis is an effective and useful device for the fixation especially in intraarticular, displaced comminuted fracture and open fracture, where we have to deal with both bony and soft tissue injury.

Joshi's external stabilizing system (JESS) fixator based on the principle of ligamentotaxis, stabilizes the unstable and intraarticular fractures with the use of thin smooth K-wires placed away from the injury site, which is attached to rods for a stable configuration and also provides an environment for rapid soft tissue healing without further damaging the microvascular circulation with less risk of infection, makes nursing care easy in open fractures. The early rehabilitation can be done which helps to prevent joint stiffness, which is

most common complication in hand injuries and patient can return back to his work at the earliest.

The aim of the study was to evaluate the functional outcome of metacarpal and phalanges fracture after the JESS fixator application and assess the usefulness in our set up.

MATERIALS AND METHODS

The present prospective study includes total number of 38 patients with a diagnosis of fracture of metacarpal and phalanx of hand admitted in Nepal Medical college and Teaching Hospital from 2015 to 2017, who was treated with JESS fixator. Informed consent was obtained by explaining the operative and post-operative complication and all of them were followed up at regular intervals of 2, 6, 24 weeks and 1 year for clinical and radiological evaluation. The inclusion criteria were skeletally matured patients having unstable, open fracture (Gartlands type I, II), intra articular fractures of metacarpal and phalanx of hand. The patients with stiffness, deformity due to previous injury and those patients who had pathological fracture and crush injury were excluded from the study. The basic components of JESS fixator are Kirschner wires, connecting rods, beta clamp, distraction and compression external fixator.

The fracture reduction was achieved by traction and manipulation under the image intensifier, once reduction was achieved, to maintain reduction JESS fixator was applied, initially by passing at least 2 k wires proximally and 2 distally to the fracture at safe zones. These constructs were connected using connecting rods after the distraction achieved especially in intraarticular fractures. In case of open fracture, initially proper debridement was done followed by JESS fixator application and regular dressing done postoperatively. Antibiotics were given for 48 hours and prolonged in cases of open fracture upto 5 days. Postoperatively patients were advised for the active mobilization of the uninjured fingers immediately. The pin tract



Fig. 1a: Preoperative X ray



Fig. 1b: Postoperative X ray

dressing and tightening of the clamps of connecting rods was done regularly. JESS fixator was removed after 6 weeks interval with immediate vigorous mobilization of the joints of hands and wrist was done. The functional outcome after the removal of JESS fixator was assessed by calculating American Society for Surgery of Hand and Total Active flexion (ASSH TAF) was done.⁹

Table-1: ASSH TAF Score System

Degree of Flexion	Rating
TAF from MCP to DIP: Digits 2-5	
>220	Excellent
>180 - 220	Good
<180	Fair
TAF from MCP to DIP: Thumb	
>120	Excellent
>100 - 120	Good
< 100	Fair

RESULTS

A total of 38 patients with injury meeting the inclusion criteria were studied and analyzed. Among them 31(81.5%) were males and 7 (19.5%) were females. The patients were in between the age group of 19 to 57 years with an average age of 32.4 years. The right-side hand was involved in 33 (86.84%) patients and 5 (13.36%) patients had left sided hand involvement.

The most common mode of injury was due to injuries by machinery, which was followed by physical assault (Table-2).

Table-2: Mode of injury

Mode of injury	No. of patients	
	n=38	%
Injuries by machinery	17	44.74
Injuries by Road Traffic Accident	11	28.94
Injuries by Physical Assault	8	21.05
Injuries by House hold Activities	2	5.26

There were 22 (57.89%) cases of intraarticular fracture and 16 (42.11%) cases were of extraarticular fracture. The maximum number of bony injuries were seen in metacarpal and least in middle phalanx of fingers (Table-3).

The injury associated with open fracture was seen in 24 (63.15%) patients and 14 (36.85%) of them had a close fracture. In open fracture injury, all the

wound was healed without any complication. All the fractures were reduced by closed manipulation, none of them required open reduction. Among the 38 patients, all fractures went to union with an average union period of 6 weeks.

Table-3: Bony involvement of injury

Bony Involvement	No. of patients	
	n=30	%
Metacarpal	21	55.26
Proximal phalanx	12	31.57
Middle phalanx	5	13.15
Distal phalanx	0	0.0

The mean period of treatment for metacarpal fractures was 12 weeks and for phalangeal fractures 16 weeks by which time patients regained full functional activity of hand and returned back to their respective works. There were no cases of axial or rotational deformity was observed. The functional outcome assessed by ASSH-TAF score was excellent in 28 patients, good in 10 patients and none of them had a poor result (Table-4).

Table-4: TAF at 1 year

TAF Grading	Frequency	%
Excellent	28	73.70
Good	10	26.30
Poor	0	-
Total	38	100

The complication was seen in 9 (23.7%) cases, superficial pin tract infection and K-wire loosening (Table-5). The superficial pin tract infections were treated with oral antibiotics which was healed in all cases.

Table-5: Complications

Complication	Frequency	%
Superficial pin tract infection	7	77.8
K-wire loosening	2	22.2
Total	9	100

DISCUSSION

Metacarpal and Phalangeal fractures are common encountered injury, which are often neglected as a minor injury. Most of these fractures can be treated conservatively.^{10,11} James *et al* reported that closed method used in treatment of unstable fractures had loss of function in 77 % of fingers.¹² So, unstable, intra

articular and open fractures operative treatment is indicated as active reduction and stabilization is required to achieve the optimal position for bone healing and to allow early movement.¹³

The unstable fracture requires a stable fixation for healing, whereas fixator provides a stable construct with easy application and quick procedure. The intra-articular fractures are more likely to obtain a better functional result whenever the ligamentotaxis principle is applied through the fixator.

Open fractures are commonly combined with severe comminution, soft tissue damage and wound contamination, application of fixator provides the stability at the fracture site and as well as it is easy for a regular dressing for soft tissue injury leading to both bone and soft tissue healing together. These factors, combined with the ease of placement of JESS fixator, allowing bony healing without further damage to the soft tissue and early rehabilitation make such a JESS fixator a choice of device for the metacarpal and phalanges fractures.

In our study, injury was seen more in males than in females: male 31 (81.5%) and female 7 (19.5%). This is comparable to other studies. Naidu *et al*¹⁴ had 41 (82%) males and 9 (18%) females, Parson *et al*¹⁵ had 26 (86.66%) males and 4 (13.44%) females and Schuind *et al*¹⁶ had males 21 (80.7%) and females 5 (19.3%). The predominance of males having hand injury may be due to their type of occupation. This is supported by our study, where the mode of injury is maximum in machinery accidents 17 (44.74%), road traffic accidents 11 (28.94%) followed by physical assault 8 (21.05%). This was comparable to other studies. Naidu *et al*¹⁴ showed maximum injury rate due to road traffic accidents 15 (30%) followed by machinery 14 (28%). Parson *et al*¹⁵ showed most injury occurring due to road traffic accidents 11(55%), fall injury 7 (35%) and physical assault 2 (10%).

The average age group was 32.4 years in our study, whereas in Parson *et al*¹⁵ study the average age group was 28 years. The involvement of the hand injury is more in younger age group population as there are the one who are more vigorously involved in the daily activities of the life.

There was involvement of injury more in the right-hand accounting (86.84% (n= 33) and left hand 13.36% (n=5) in our study, which can be compared with the study of Parson *et al*¹⁵ where it accounts for 55% (n=11) of right hand and 45% (n=9) in left hand. The dominant hand seems to be injured more often.

The average radiological union was achieved in 6 weeks, when the fixator was removed and rehabilitation was started. This finding is similar to the study done by Parson *et al*¹⁵ where average union was seen in 4.8 weeks.

The excellent outcome was seen in 73.70% (n=28) followed by good in 26.30% (n=10) according to the ASSH-TAF score. This shows that the patients regain their range of movement of the fingers and were able to perform their activities without any compromise due to the limited motion of the joints.

The superficial pin tract infection was seen in 7 cases (18.5%) and loosening of K-wires was observed in 2(5.25%) cases in our study, whereas Naidu *et al*¹⁴ observed K-wire loosening in 8 cases (16%) and pin tract infection in 7 cases (14%), Drenth *et al*¹⁷ had 6 cases (11.5%) of K-wire loosening.

In conclusion, JESS fixator is cheap, easily available and less technically demanding, provides effective treatment for the metacarpal and phalanges fracture as it provides adequate stability that allows early rehabilitation with soft tissue care and has good functional outcome.

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