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Prospective Study of Surgical Outcome of Metacarpal and Phalengel Fractures Treated With JESS Fixator

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ABSTRACT
The human hand has evolved into an organ of exceptional prehensile function capable of highly complex movements and manipulation. 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. Joshi's external stabilizing system (JESS) fixator based on the principle of ligamentotaxis, stabilize the unstable and intra articular fractures of metacarpal and phalanges and also provides an environment for rapid soft tissue healing without further damaging the micro vascular circulation. To study JESS fixator for metacarpal and phalangeal fractures and to clinically evaluate the results of the JESS fixator for metacarpal and phalangeal fractures. The present prospective study was conducted in Department of Orthopaedics, Vijayanagara Institute of Medical Sciences, Bellary from December 2020 to August 2022. This study comprises 30 patients of both sexes and all age groups with hand injuries i.e. close or open type were recruited to assess the role of all types of JESS frame in metacarpal and phalanges fractures. Among the 30 patients, majority of cases, 36.7% belongs to the age group of 31-40 years. The mean age of the patients was 35.33 years. 86.7% were males. 60.0% had sustained right hand injury, Metacarpal bones were involved in 46.7% of patients, 46.7% of cases had transverse fracture pattern and around 60.0% had closed fractures. The functional outcome assessed by Duncan score was excellent in 15 patients, good in 11 patients and 4 had a fair result. 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.

INTRODUCTION

The human hand has evolved into a prehensile organ capable of performing extremely complex movements and manipulation. Hands play a distinct and important role. It is an organ that can perform both powerful grasping functions, such as lifting heavy objects and delicate pinch and hook functions[1]. Hand is more prone to variety of fractures by multiple causes especially by road traffic accidents, industries, assaults and various other causes[2,3]. Hand fractures especially to metacarpals and phalanges are the most common and are often neglected as minor injuries which accounts for 15% of the admissions at emergency departments[4]. The incidence was more at the age of 10-40 years with male dominance[5]. Most fractures are functionally stable either before or after closed reduction (CR) and fare well with protective splint age and early mobilization[4]. The standard treatment of fractures of the hand involve intraosseous wiring, plating and K-wires, this may lead to further damage of the already injured soft tissue, joint stiffness and delay in regaining complete function of the hand. Plate fixation of extra-articular fractures of the metacarpals has been found to have complications rates in up to 33% of patients including infection, complex regional pain syndrome and plate loosening[7].

The principal management involves restoration of articular congruity and fixation of the fracture with an internal or an external fixation device. Anatomical reduction and stable fixation, followed by early mobilization represent the key treatment of these fractures. Inadequate treatments can lead to poor outcomes including chronic pain, stiffness, deformity, and premature degenerative arthritis[7]. External fixation is indicated for severe fractures/Open fractures when anatomic reconstitution of the skeleton is not feasible[8]. External fixation does not cause the amount of osteopenia seen with more rigid systems such as plating. External fixation allows fracture reduction to normal bony length via a rigid external support[9]. Mobilization at joints proximal and distal to the fracture can be achieved across the external apparatus. In the hand, however, it is more commonly used when a fracture is not amenable to internal fixation (e.g. highly comminuted fractures or complex intra-articular fractures)[10].

Joshi's external stabilizing system (JESS) is a simple, versatile and light weight fixation with the added possibility of incorporation of splints or conversion to dynamic mobilization units. JESS provides rigid fixation of bones in which other forms of immobilization are not appropriate e.g., open fracture. It is possible to compress, neutralize or distract a fractures fragment and also allowing aggressive and simultaneous treatment of bone and soft tissue lesions[11]. There have been few reports of the use of JESS fixator for metacarpal and phalangeal fractures. Therefore, this study has been undertaken at Vijayanagara Institute Of Medical Sciences, Ballari to evaluate the outcome of metacarpal and phalangeal fractures managed with JESS fixator.

Objectives:

- To study the anatomical and functional outcome of JESS fixator for metacarpal and phalangeal fractures
- To clinically evaluate the results of the JESS fixator for metacarpal and phalangeal fractures
- To study the functional outcome of patients after JESS fixator

MATERIALS AND METHODS

This cross-sectional study was conducted in a Vijayanagara Institute of Medical Sciences hospital, Bellary, for a period of 20 months, from December 2020 to August 2022. 30 patients with history of hand trauma and got admitted for the management of metacarpal and phalangeal fractures with JESS fixator

Fig 1: Pre-op x-rays

Fig 2: Follow up x-rays at 4 weeks

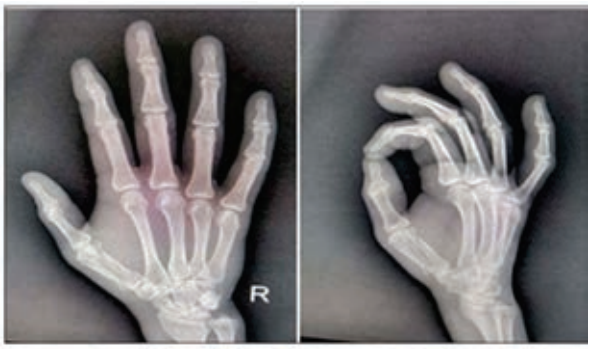

Fig 3: Pre-op x-rays

Fig 4: Post-up check x-ray

Fig 5: Follow-up x-ray at 8 weeks

were included. On admission detailed history regarding mode of injury and examination of the hand was done. After doing patient's hand X Rays of AP and oblique view evaluation of the fracture in reference to fingers of hand involved, Phalanx or metacarpal bone and anatomy of fracture whether Simple or compound, Comminuted or non-comminuted, Fracture geometry (transverse, oblique or spiral),Fracture line in relation

Table 1: Age and sex wise distribution of patients

Age in years	Number of cases	Percentage
≤ 20	3	10.0
21-30	9	30.0
31-40	11	36.7
≥41	7	23.3
Mean±SD	35.33±12.75	-----
Gender		
Males	26	86.7
Females	4	13.3
Total	30	100.0

Table 2: Clinical distribution of fracture cases

Side of injury	Number of cases	Percentage
Right hand	18	60.0
Left hand	12	40.0
Bones involved		
Metacarpal bones	14	46.7
Proximal phalanx	12	40.0
Middle Phalanx	4	13.3
Type of fracture		
Transverse fracture	13	43.3
Oblique fracture	3	10.0
Comminuted fracture	14	46.7
Type of fracture		
Closed	18	60.0
Open	12	40.0
Total	30	100

Table 3: Distribution based on mode of injury

Mode of injury	Number of cases	Percentage
Road Traffic accidents (RTA)	17	56.6
Self-fall	5	16.7
Workplace	5	16.7
Assault	3	10.0
Total	30	100.0

Table 4: Outcome of patients

Duncan score	Number of cases	Percentage
Excellent	15	50.0
Good	11	36.7
Fair	4	13.3
Total	30	100.0

Fingers	Thumb	Result
220-260	120-140	Excellent
180-220	100-120	Good
130-180	70-100	Fair
<130	<70	Poor

anatomy of fracture whether Simple or compound, Comminuted or non-comminuted, Fracture geometry (transverse, oblique or spiral),Fracture line in relation to joint. (Intra articular or extra articular), Displacement and deformity (Displaced or un displaced), angulation and its severity, associated soft tissue injury of the hand noted. Patient's attendees were explained about the nature of injury and complications. They were also explained about the need for surgery and its complications. Cases were selected for JESS external fixator's application after evaluating the above features. Informed and written consent taken.

Surgical Technique: With the affected hand scrubbed, draped and painted, fracture pattern was visualized under C-arm guidance. Depending on the fracture pattern and affected bone, K-wires of Size 1.2 mm to 1.5 mm were inserted into the phalanx and frames were made using the smallest link joint (2x2)and2mm

connecting rods;whereas,1.5mm K-wires were used for metacarpals to make frames with the medium link joint(3x3)using 2.5mm connecting rods. It was ensured that K-wires were passed as per the safe zones and all necessary precautions undertaken. Bi-cortical purchase was obtained using the K-wires. Number of K-wires inserted into a fractured fragment depends upon the size of the fragment. After inserting the K-wire, fracture fragments were reduced using traction and manipulation under C-arm guidance. Upon achieving adequate fracture reduction, external frame was constructed using link joints and connecting rods as mentioned. Finally, the link joints were tightened using an Allen key and fixation/reduction was reconfirmed under C-arm guidance ensuring no rotation or angulation of the fractured fragment is present. If no space is present on either side of fracture, then-K wire is introduced to adjacent Phalanx or metacarpal bone and the-K wire is fixed to the external connecting rod with the help of link joints. In comminuted Intra articular fractures-K wire is put on either side of involved joint.

Assessment of Range of Movements: Range of Movements were assessed on post-operative day 7, 21 and 42. Functional assessment was done based on total active range of movements in degrees of each injured finger separately according to Duncan[12] scoring. This adds the active flexion of metacarpo phalangeal, Proximal inter phalangeal and distal inter phalangeal joints, then subtracting the sum of extension deficits of these three joints.

Evaluation of Outcome: Functional assessment based on total active range of movements in degrees of each injured finger separately according to Duncan *et al*.[12]

Statistical Analysis: Continuous variables are expressed as mean±SD. Discrete variables are presented as absolute numbers and percentages.

RESULTS AND DISCUSSIONS

Majority of cases, 36.7% belongs to the age group of 31-40 years. 10.0% of patients belonged to the age group= 20 years. The mean age of the patients was 35.33 years. 86.7% were males and 13.3%of cases were females. 60.0% had sustained right hand injury, Metacarpal bones were involved in 46.7% of patients, 46.7% of cases had transverse fracture pattern and around 60.0% had closed fractures. Majority of patients mode of injury was road traffic accidents (RTA) accounting to 56.6%, followed by each 16.7% of patient's mode of injury was self-fall and work place injury and in around 10.0% of patients mode of injury was assault. Out of 30 patients, 50.0% of patients had excellent recovery of range of movements, 36.7% of patients had good recovery and 13.3% of patients had fairly recovered range of movements of fingers. There is good functional outcome in patients undergoing JESS fixation in fractures of the metacarpal and phalanges.

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 preventing active movement of digits. The average age group was 35.33 years in our study, whereas in Parson *et al*[13]. study the average age group was 28 years. The involvement of the hand injury is more in younger age group population as they are the one who are more involved in the daily activities of the life. There was involvement of injury more in the right hand accounting 60%. The dominant hand seems to be injured more often. This is comparable to a study by Rajkumar *et al*[14]. had reported that right side was affected more than the left side.

Injury was observed more in males than in females. This is comparable to other studies. Naidu *et al.*[15]. had 41 (82%) males and 9 (18%) females, a study by Raj Kumar *et al*[12]. had reported that males were commonly affected than females. Salunkhe *et al*[15]. had also reported similar findings stating that males were commonly affected. This rightly corresponds to the ambulant life led by males. In our study the bulk of the cases involved the metacarpal bones (46.6%), proximal phalanx (40%). In metacarpal fractures we have used dorso oblique frames. In fractures of proximal and middle phalanx unilateral or coplanar frames were used.

A study by Drenth *et al*[16]. the most common mode of injury was road traffic accident followed by machinery injuries and fall of heavy object. A study by Parson *et al*[13]. found wide variety of mechanism of injury in their study ranging from acute sudden impact (as from punching or crushing) to industrial works. This was comparable to our study where 56.6% patients sustained injury due to RTA. Naidu *et al*[14]. showed maximum injury rate due to road traffic accidents 15 (30%) followed by machinery 14 (28%).Parson *et al*[13]. showed most injury occurring due to road traffic accidents 11 (55%), fall injury 7 (35%) and physical assault 2 (10%). Our Study revealed that out of 30 patients, assessed according to Duncan score, 50.0% of patients had excellent outcome, 36.7% of patients had good outcome and13.3% of patients were fairly recovered. There is good functional outcome in patients undergoing JESS fixation in fractures of the metacarpal and phalanges which is comparable to the

study conducted by Darshil Shahl *et al*[17]. where 38% patients had excellent, 32% good and 26% Fair Functional outcome at the end of 6 weeks.

CONCLUSION

Patients with comminuted fractures, open fractures, intra- articular fractures require operative reduction and stabilisation to obtain the optimal position for bone healing and to allow early movement. JESS method is a simple and good alternative to established methods of management of small bone fractures which are open, intra articular, comminuted. JESS is simple to operate, technically less demanding and can be used by a surgeon in an average operating environment. JESS simplifies the postoperative management of both injured finger and limb. It allows early mobilization, which prevents joint stiffness. JESS fixator also reduces surgical trauma and protects the vascular integrity and has good to excellent functional outcome. JESS outcome also depends on severity of accompanying injuries like opens fractures and commented fracture pattern, delay in proper physiotherapy and delay in mobilization of fingers leading to stiffness.

REFERENCES

1. Butala, R., A. Garg, S. Singh, P. Garg, A. Agarwal, N. Gohain and S.K. Mukherjee, 2016. Jess fixator for hand fractures: Our experience in 20 patients. J. Evol. Med. Dent. Sci., 5: 1946-1949.
2. Chong, K.A., 2011. Principles in the management of a mangled hand. Indian J. Plast. Surg., 44: 219-226.
3. Tintle, L.S.M., L.M.F. Baechler, C.G.P. Nanos, L.J.A. Forsberg and M.B.K. Potter, 2010. Traumatic and trauma-related amputations. J. Bone. Joint. Surg. Am., 92: 2934-2945.
4. Stern, P.J., 1993. Factures of metacarpals and phalanges. In: Green's operative hand surgery., Hotchkiss, R.,N, Pederson and W.C., (Eds.)., Churchill Livingstone, New York, pp: 1695-1758.
5. de Jonge, J.J., J. Kingma, B.V. Lei and H.J. Klasen, 1994. Fractures of the metacarpals. a retrospective analysis of incidence and aetiology and a review of the english-language literature. Injury., 25: 365-369.
6. Fusetti, C., H. Meyer, N. Borisch, R. Stern, D.D. Santa and M. Papaloïzos, 2002. Complications of plate fixation in metacarpal fractures. J. Trauma. Inj. Infec. Crit. Care., 52: 535-539.
7. Thomas, R.,K,R.S. Gaheer, R.D. and Ferdinand, 2008. A simple external fixator for complex finger fractures. Acta. Orthopædica. Belgica., Vol. 74.
8. Hastings, EHL., 1988. Open fractures and those with soft tissue damage, treatment by external fixation.
9. Fred, B., 1989. General theory and principles of external fixation. Clin. Orthop., 241: 15-20.
10. Hastings, H. and J.M.J. Ernst, 1993. Dynamic external fixation for fractures of the proximal interphalangeal joint. Hand. Clin., 9: 659-674.
11. Rajkumar, K.,M.A. and Azeem, 2016. Comparison of external and internal fixation methods for the metacarpal fractures. IJOS., 2: 322-325.
12. Duncan, R.W., A.E. Freeland, M.E. Jabaley and E.F. Meydrech, 1993. Open hand fractures: An analysis of the recovery of active motion and of complications. J. Hand. Surg., 18: 387-394.
13. Parsons, S.,W. J.A.W. Fitzgerald and J.R. and Shearer., 1992. External fixation of unstable metacarpal and phalangeal fractures. J. Hand Surg., 17: 151-155.
14. Naidu, K.V.D., 2018. Management of metacarpal and phalangeal fractures with JESS fixator: A prospective study. IJOS., 4: 383-387.
15. Salunkhe, R.,M.H. Joshi, T.K. and Pisal, 2016. A prospective study of dynamic treatment of fracture phalanx and metacarpals of the hand with Kirschner-wire fixation / external fixator and finger splint: Day care management (30 cases). Med. J. Patil. Univ., 9: 708-713.
16. Drenth, D.J. and H.J. Klasen, 1998. External fixation for phalangeal and metacarpal fractures. J. Bone. Joint Surg., 80: 227-230.
17. Shah, D., 2019. Functional outcome of fracture of metacarpals and phalanges managed with jess. Int. J. Orthop. Traumatol. Surg. Sci., 5: 176-182.