

## Comparison of external and internal fixation methods for the metacarpo phalangeal fractures

Rajkumar K<sup>1,\*</sup>, Mohammed Abdul Azeem<sup>2</sup>

<sup>1,2</sup>Assistant Professor, Dept. of Orthopaedics, Shadan Institute Medical Science Teaching Hospital & Research Centre, Hyderabad, Telangana

**\*Corresponding Author**

Email: drmazeem7@gmail.com

### Abstract

**Introduction:** The goals of treatment of hand fractures are restoration of length, correction of rotational deformity, if present, establishing adequate stability, proper soft tissue management, and early initiation of movement. Various methods are used for this purpose including internal fixation by 'K' wires and external fixation by JESS technique.

**Material and Methods:** Detailed radiological study was carried out, systemic and clinical examination was made and charted. Appropriate drugs were administered for the alleviation of the pain, shock and anxiety. The patients were divided into two groups, Group I who were treated with internal fixation and Group 2 were treated with JESS fixation.

**Results:** Out of the total 60 cases, internal fixation was done in about 44 cases and JESS being performed on 26 patients. Transverse and comminuted were the most common type of fractures, together accounting for about 50% of the cases. The outcome of the treatment was excellent in 50% of the cases among those who were treated with JESS, while less than 40% had excellent outcomes and many had poor outcomes among the patients treated by internal fixation.

**Conclusion:** In the compound fractures, the use of JESS method would be more useful in the repair of hand fractures.

**Keywords:** External fixation, Internal fixation, 'k' wires, JESS,

### Introduction

Metacarpal fractures comprise between 18–44% of all hand fractures.<sup>(1,2)</sup>

Fractures of the metacarpal shaft occur as a result of axial loading, torsion, or direct falls and are classified as transverse, oblique, or comminuted.<sup>(3,7)</sup> The fractures of all metacarpals from the first to the fifth are characterized by swelling and deformity, and inappropriate treatment may result in functional loss in the hand and disability.<sup>(8,10)</sup>

The goals of treatment are restoration of length, correction of rotational deformity, if present, establishing adequate stability, proper soft tissue management, and early initiation of movement.

Fixation techniques involve the use of K-wires, intramedullary nails, cerclage wires, plating, lag screws, tension band wires, and/or external fixators.<sup>(11)</sup>

'K' wires are the most versatile, simplest and cheapest method of fixing the hand injuries. They can be introduced percutaneously without exposing the fractures. It is sufficiently stable to allow early motion without subjecting the hand to surgical trauma of open reduction.

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. It is possible to immediately move the proximal and the distal joints,

thereby reducing edema, preventing capsular fibrosis, joint stiffness and muscular atrophy.

This study was conducted to compare the outcome of the hand fracture treatment with 'K' wires or JESS.

### Materials and Methods

This study was conducted by the Department of orthopedics at Shadan Institute of Medical Sciences Teaching Hospital and Research centre during the period of two years. A total of 60 cases of compound and / or unstable fractures of metacarpal and phalangeal were included into the study. The stable fractures and hand injuries without fractures were excluded from the study.

On the arrival at the hospital, primary resuscitative measures were taken such as recording of vital parameters and rapid systemic evaluation. The wounds were cleaned with dilute hydrogen peroxide, normal saline and Betadine and covered with sterile dressings. Suitable splints were placed onto the hand.

Detailed radiological study was carried out and systemic, clinical examination was made and charted. Appropriate drugs were administered for the alleviation of the pain, shock and anxiety. Anti tetanus and anti gas gangrene vaccinations were also administered. All the patients were subjected to Blood tests for hemoglobin evaluation, complete blood picture, Erythrocyte sedimentation Rate, Blood grouping, Random blood sugar and urine tests for sugar. Anteroposterior and lateral X-rays were taken for the hand. The fractures were classified, and site, nature of the fracture and type of the wound.

Based on the type of fracture, the patients are divided into 2 groups, Group I who underwent standard

internal fixation methods and the Group II underwent external fixation by Joshi's External Stabilization System (JESS).

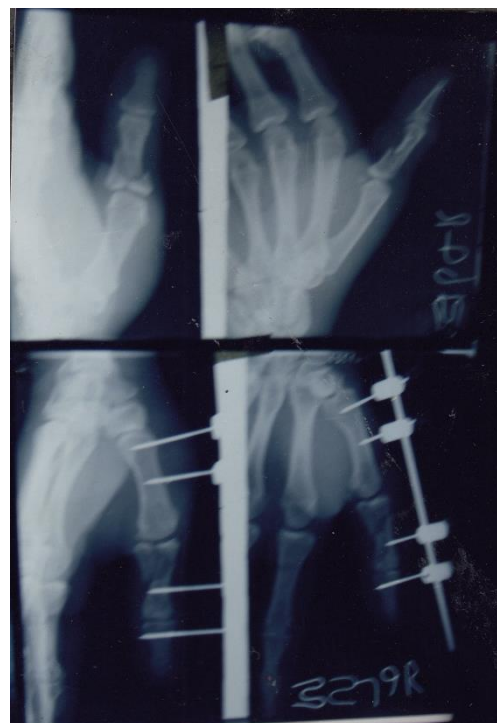
At the operation Table, the necrosed skin was excised at wound margins and necrosed muscle excision was done. Very small size loose bone pieces were removed. Large pieces were washed with saline and preserved. Foreign particles were removed and swabs were taken for culture and sensitivity.

For internal fixation, 'K' wire or 'SS' wire fixation by standard method was done.

For JESS technique, the first wire is passed in the coronal plane in the distal radius about 2.3cm proximal to the radial styloid, engaging both cortices of the radius. The second wire was passed in the same plane at the junction of upper third and lower two third of the radius to engage both cortices. The next two wires are passed at similar levels though the ulna in the coronal plane. A 'K' wire was passed in the base of the second metacarpal in the coronal plane and advanced to engage the third metacarpal.

A 'K' wire is passed in the neck of the second metacarpal in the same place and advanced to engage the third metacarpal if possible. The next two wires are passed similarly from the 5<sup>th</sup> and 4<sup>th</sup> metacarpal from the ulnar side in the coronal plane, one in the base and other in the neck. A 300 mm connecting rod is bent at 20° after measuring the approximate level of the wrist joint. One such bent connecting rod is applied to the two radial pins and to metacarpal pins from the radial side keeping the wrist in the dorsiflexion position. Link clamps are used to clamp the connecting rod to the 'K' wire. Similarly another rod is applied to the ulnar side.

A biaxial hinge is fixed to both these connecting rods at the level of metacarpo phalangeal joint. The ends of the two extended connecting rods are spanned using the 150mm connecting rod and clamped by standard link joints. The anchor points are set for positioning the fingers (Fig. 1).



**Fig. 1: Comminuted intra-articular fracture of proximal phalanx right thumb stabilized with JESS basic frame (before and after surgery)**



**Fig. 2: Use of the hand on 1<sup>st</sup> post-operative day**

Antibiotics are administered in all the cases and subsequent changes were made according to the culture and sensitivity pattern.

### Results

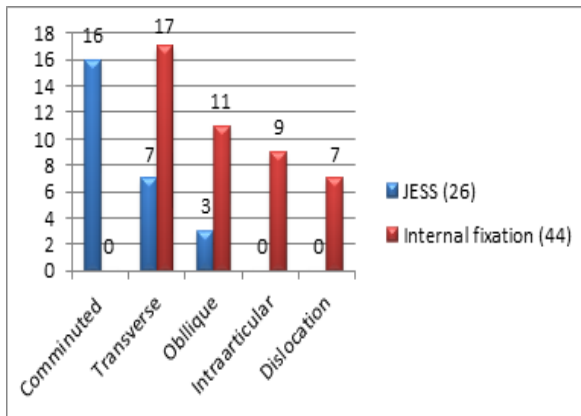
All the patients were between 5-50 years of age, but the most common age group seemed to be the younger age group .i.e. below 30 years of age. Males were more affected than females probably due to the different lifestyles of the males and females. Right hand side was more easily affected than the left hand, being the dominating hand with 60% of the injuries.

Road traffic accidents were the most common cause followed by assault injuries and violence (Table 1).

**Table 1: General parameters of the patients**

General Parameter	No. (%)
<b>Age:</b>	
5-20 Years	17 (28.3%)
21-30 Years	18 (30%)
31-40 Years	13 (21.7%)
41-50 Years	5 (8.3%)
51-60 Years	7 (11.7%)
<b>Sex:</b>	
Males	49 (81.67%)
Females	11 (18.33%)
<b>Side of fracture:</b>	
Right	46 (76.67%)
Left	14 (23.33%)
<b>Causative Agents of Trauma:</b>	
Road Traffic Accident	34 (56.67%)
Assault Injuries	17 (28.33%)
Industrial / Domestic Violence	9 (15%)

Out of the total 60 cases, internal fixation was done in about 44 (63%) of the cases and JESS being performed on 26 (37%). Transverse and comminuted were the most common type of fractures, together accounting for about 50% of the cases (Fig. 3).

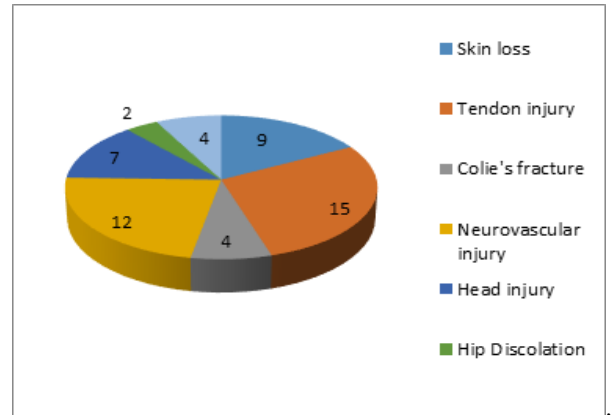


**Fig. 3: Type of fixation for different types of fractures**

The period that was required for internal fixation was predominantly 4 weeks in both the cases though in many cases of JESS, the fixation time was only 3 weeks.

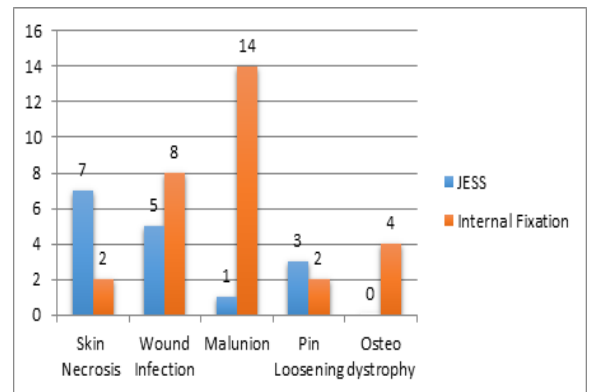
In all the patients fixed by JESS method, adjoining joints were mobilized from the first day itself.

Tendon injury and neurovascular injuries were the most commonly associated injuries in these cases (Fig. 4)



**Fig. 4: Associated injuries**

Skin necrosis and malunion were the most common complications observed (Fig. 5).



**Fig. 5: Postoperative complications**

The outcome of the treatment was excellent in more than 50% of the cases among those who were treated with JESS, while less than 40% had excellent outcomes and many had poor outcomes among the patients treated by internal fixation (Table 2).

**Table 2: Overall outcomes of the two surgeries**

	JESS	Internal fixation
Excellent	15 (57.7%)	15 (34.1%)
Good	7 (26.9%)	7 (15.9%)
Fair	1 (3.8%)	9 (20.5%)
Poor	3 (11.5%)	13 (29.5%)

**Discussion**

The management of hand injuries has always been the topic of controversy as there are so many different types of treatment with advantages and disadvantages. Most phalangeal and metacarpal fractures are treated conservatively. Patients with unstable fractures require operative reduction and stabilization to obtain the optimal positioning for bone healing and to allow early movement. The main objective of management is early skeletal stabilization and immediate motion of adjacent

joints to prevent long term complications like joint stiffness.

JESS external fixation is proved to be a suitable technique for stabilizing unstable, open fractures with severe soft tissue injuries. 'K' wire or 'SS' wire alone cannot provide a stable fixation as they need to be further supplemented with external splints to avoid complications like malunion. In addition, with these internal fixation methods, there may be a secondary displacement at fracture site, stiffness at wrist, MP and PIP joint.

All 'K' wires, whether used in the external or internal fixations could be easily removed after the fracture healing, without additional surgery or anesthesia, at the OPD itself. Moreover JESS is more cost effective than the other types of external fixators.

In the present study, the mean age of patients was 31, with most of the patients being less than 40 years of age. Males were more prone to fractures in the hand. In a similar study by Ashmead et al,<sup>(12)</sup> the mean age was found to be 32 years and it was 39 years in a study by Drenth et al.<sup>(13)</sup> In both the studies, males were the predominant gender to be affected.

The most common mode of injury was road traffic accident, which was the same in these studies also,<sup>(12,13)</sup>

Among the post surgical complications, the most common ones observed in our study was skin necrosis in the patients treated with JESS and malunion in the patients treated with internal fixation (44.67%). Malunion was seen in one case in the treatment with JESS accounting for 6.3% of the overall complications seen in this mode of treatment.

In similar studies conducted by Joshi et al,<sup>(14)</sup> Duffield et al,<sup>(12)</sup> and Drenth et al<sup>(13)</sup> malunion was found to be leading cause of complications.

The overall outcome with JESS was far better than with the internal fixation technique. It was excellent in 57.7% of the cases and good in more than 26% of the cases, with more than 75% of the patients satisfied with the treatment with external fixation. With internal fixation only 50% of them had an excellent to good result. The number of poor results were also more in this group, could be due to the fact that there were more malunions in this method.

Joshi et al reported 90% excellent results among patients who were treated with external fixation.<sup>(14)</sup> Duffield et al also reported a very high success rate of 91% while the rate was 55% in the study by Drenth et al.

Our study showed only 34% of the patients with excellent results in internal fixation. This was in accordance to a study by Chow et al,<sup>(15)</sup> who observed a

25.2% excellent result and 30% by Pun et al.<sup>(16)</sup> Although Mark Richard et al reported an excellent rate of 61%.<sup>(17)</sup>

## Conclusion

Though 'K' wire is the preferred treatment, the external fixation method by JESS is much more stable with very good results. Therefore in the compound fractures, the use of JESS method would be more useful in the repair of hand fractures.

## References

1. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. *J Hand Surg [Am]* 2001;26:908–15.
2. Gudmundsen TE, Borgen L. Fractures of the fifth metacarpal. *ActaRadiol.* 2009;50:296–300.
3. Diaz-Garcia R, Waljee JF. Current management of metacarpal fractures. *Hand Clin* 2013;29:507–18.
4. Adams JE, Miller T, Rizzo M. The biomechanics of fixation techniques for hand fractures. *Hand Clin* 2013;29:493–500.
5. Blazar PE, Leven D. Intramedullary nail fixation for metacarpal fractures. *Hand Clin* 2010;26:321–5.
6. Dean BJB, Little C. Fractures of the metacarpals and phalanges. *Orthopedics and Trauma* 2011;25:43–56.
7. Henry MH. Fractures of the proximal phalanx and metacarpals in the hand: preferred methods of stabilization. *J Am Acad Orthop Surg* 2008;16:586–95.
8. Sennet BJ. Operative treatment of metacarpal fractures of the hand (excluding thumb metacarpal fractures). *Operative Techniques in Orthopaedics* 1997;7:127–33.
9. Black D, Mann RJ, Constine R, Daniels AU. Comparison of internal fixation techniques in metacarpal fractures. *J Hand Surg Am* 1985;10:466–72.
10. Fusetti C, Garavaglia G, Papaloizos M. Re: Souer JS, Mudgal CS. Plate fixation in closed ipsilateral multiple metacarpal fractures. *J Hand SurgEur Vol* 2009;34:560–2.
11. Kawamura K, Chung KC. Fixation choices for closed simple unstable oblique phalangeal and metacarpal fractures. *Hand Clin.* 2006;22:287–295.
12. Ashmead Duffield W, Rothkopf DM., Treatment of hand injuries by external fixation. *J Hand Surg*;1992;17(A):956-964
13. Drenth DJ, Klasen HK., External fixation for phalangeal and metacarpal fractures. *J Bone Joint Surg (Br)*, 1998;80(B):227-230.
14. Joshi BB., Modern concepts in hand surgery, 1998. *J Bio-Med Feb-Mer*:26-28.
15. Chow SP, Pun WK., A prospective study of 245 open digital fractures of the hand, *J hand surg (B)*. 1991;16(B)137-140.
16. Pun WK, Chow SP. A prospective study on 284 digital fractures of hand. *J hand surg.* 1989;14(A):474-481.
17. Mark Richard Belsky, Eaton RG., Closed reduction and internal fixation of proximal phalangeal fractures, *J Hand surg*; 1989;14(A):474-481.