

ORIGINAL RESEARCH

Management of metacarpal and phalangeal fractures with jess fixator**¹Dr. Abhilash S, ²Dr. Irfan Umar CP, ³Dr. Sunil Kumar P, ⁴Dr. Vinay Reddy****Corresponding author:Dr. Vinay Reddy**

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Abstract**Background:**The present study was conducted for managing metacarpal and phalangeal fractures with jess fixator.**Materials & methods:**The present study was conducted for managing metacarpal and phalangeal fractures with jess fixator. The study consisted of 30 cases of hand trauma meeting the inclusion and exclusion criteria, admitted for operative management of metacarpal & phalangeal fractures in Vijayanagara institute of medical sciences hospital, Bellary between December 2020 to August 2022. Cases were selected for JESS external fixator's application after evaluating the above features. Functional assessment was done based on total active range of movements in degrees of each injured finger separately according to Duncan et al scoring. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.**Results:**The mean age of the patients was 35.33 years. 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. Out of 30 cases, in 15 patients (50.0%) fracture union was seen in the range of 0—8 weeks, in 10 patients (33.4%) fracture union was seen in the range of 9—12 weeks. In 2 patients (3.3%) fracture union seen in 12-20 weeks range.**Conclusion:**Patients with comminuted fractures, open fractures, intra-articular fractures require operative reduction and stabilization 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, intraarticular, comminuted.**Key words:** Metacarpal, Phalangeal, JESS Fixator**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. Hand is more prone to variety of fractures by multiple causes especially by road traffic accidents, industries, assaults and various other causes.¹⁻

³The closed treatment has gained a poor reputation because of problems of malunion, stiffness, and sometimes loss of skin or other soft tissues. Selection of the optimum treatment depends on a number of factors, including fracture location, fracture geometry, deformity, whether they are open or closed, and fracture stability.⁴These fractures are mostly comminuted, associated with tiny fragments and nearby combined dislocations. Reduction is difficult to achieve in most of the patients. A distracting force from adjacent joints usually causes loss of reduction leading to malunion, incongruity, or joint space narrowing. Outcome is affected by the severity of damage to ligaments, tendons, or articular capsule during

injury.^{5, 6} These fractures can be treated conservatively or operatively depending on the nature of injuries, fracture pattern, and fracture stability.^{7- 10}

The standard treatment of fractures of the hand involves intraosseous wiring, plating & K-wires (Lister, 1978) etc. 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.¹¹

In comminuted and intra-articular fractures, open reduction with internal fixation simply using Kirschner's wire usually leads to incapability of early mobilization secondary to the smaller size of bone fragments. It is also not ideal when there is a risk of infection because of open wounds and when further soft-tissue damage has to be avoided.^{12, 13} External fixation is indicated for severe fractures/Open fractures when anatomic reconstitution of the skeleton is not feasible. Example includes highly comminuted open fractures with or without bone loss and fractures associated with injury or loss of soft tissue structures.¹⁴ External stabilization system is an effective treatment modality for unstable and compound injuries. With the use of thin smooth wires, which are placed away from the injury site in a stable configuration, Joshi's external stabilizing system (JESS) provides a stable skeletal environment aiding rapid healing of soft tissue with establishment of microvascular circulation, immediate active and passive mobilization of the uninjured adjacent joint.¹⁵

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.¹⁶ Hence; the present study was conducted for managing metacarpal and phalangeal fractures with jess fixator.

Materials & methods

The present study was conducted for managing metacarpal and phalangeal fractures with jess fixator. The study consisted of 30 cases of hand trauma meeting the inclusion and exclusion criteria, admitted for operative management of metacarpal & phalangeal fractures in Vijayanagara institute of medical sciences hospital, Bellary between December 2020 to August 2022. 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 to joint. (Intra articular or extra articular), Displacement and deformity (Displaced or undisplaced), angulation and its severity, associated soft tissue injury of the hand noted. Attention is also given to any associated systemic illness, medication and drug allergies. Patients' attenders 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. Patient was taken up for surgery under Supraclavicular block/wrist block/Ring block. Patient placed supine on OT table with fractured upper limb on arm board. Image intensifier is mandatory. 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 1.2mm to 1.5mm were inserted into the phalanx and frames were made using the smallest link joint (2 x 2) and 2mm connecting rods; whereas, 1.5mm K-wires were used for metacarpals to make frames with the

medium link joint (3 x 3) 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, however, aim was to insert two K-wires into each fracture fragment. This assures stability of the frame and thus stability of the fracture fixation. 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. Across I.P. joints connecting rod is maintained in extension, means connecting rod is straight. Fractures involving Metacarpo Phalangeal joints, fixator has to be in position of function that is Metacarpo Phalangeal joints at 90 degrees of flexion. All wires must be trimmed and only 4-5mm wire should be protruding beyond the link joints and capping of the protruding wires with plastic tubing is done. The limb should be kept elevated above the level of heart to facilitate gravitation of body fluids into the circulation and should be advised full range of movements of adjacent joints. Postoperatively Pin tract dressing done in the form of gauze soaked in betadine with excess betadine squeezed out was applied around the pin tracts. No other form of dressing or bandage was applied unless required as in case of open fractures to ensure freedom of movement. Mobilisation of every joint, which is not involved in the frame should start from the very first day. Patients were encouraged to move the affected digits and was also taught passive and active motion exercises of the affected joint. At 4 weeks, radiological examination and clinical assessment of fracture union done by removal of connecting rods and clinically fracture site tested for abnormal mobility and excessive tenderness. 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 et al¹⁶ scoring. This adds the active flexion of metacarpophalangeal, Proximal interphalangeal and distal interphalangeal joints, then subtracting the sum of extension deficits of these three joints. Functional assessment based on total active range of movements in degrees of each injured finger separately according to Duncan et al¹⁷

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

All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

Results

The mean age of the patients was 35.33 years. Majority of patients accounting for 86.7% were males and 13.3% of cases were females. Majority of the patients accounting to 60.0% had sustained injury to the injured at right hand and around 40.0% of patients had injured their left hand. Out of 30 patients, Metacarpal bones were involved in 46.7% of patients, Proximal phalanx fracture seen in 40.0% of patients and 13.3% patient's had involved middle phalanx. In 46.7% of cases had transverse fracture pattern, in 43.3% of cases

communited fracture pattern seen and in 10.0% of cases fracture pattern was oblique fracture type. The mean duration for removal of external fixator was 30.97 days. In this study majority of patients accounting to 60% of cases had no complications, in 16.6% of patients had the complication of partial stiffness, 2 patients (6.7%) had the complication of pin tract infection and pin loosening respectively. 2 patients (6.7%) had malunion and one patient had stiffness. Our Study revealed that 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. Out of 30 cases, in 15 patients (50.0%) fracture union was seen in the range of 0—8 weeks, in 10 patients (33.4%) fracture union was seen in the range of 9—12 weeks. In 2 patients (3.3%) fracture union seen in 12-20 weeks range.

Table No 1: Complications

Complications	Number of cases	Percentage
No complications	18	60.0
Partial stiffness	5	16.6
Pin tract infection	2	6.7
Pin loosening	2	6.7
Malunion	2	6.7
Stiffness	1	3.3
Total	30	100.0

Table No 2: Study outcome

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

Table No 3: Distribution based on fracture healing

Fracture union in weeks	Number of cases	Percentage
0—8 weeks	15	50.0
9—12 weeks	10	33.4
13—16 weeks	4	13.3
17—20 weeks	2	3.3
Total	30	100.0

Discussion

JESS external fixator is applied to all types of fractures, both closed and compound fractures of hand 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.¹⁵⁻¹⁷

In our study, injury was seen more in males than in females. This is comparable to other studies. A study by Raj Kumar et al¹⁸ had reported that males were commonly affected than females. The average age group was 35.33 years in our study, whereas in Parson et al¹⁹ 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.

Fracture healing occurred in most of the cases within 12 weeks totalling to 83.3%. Healing took more than 20 weeks in case which had multiple fractures and open injuries. The mean fracture healing in our study was 13 weeks. In the study conducted by Dr. KV Dhanwantary Naidu, he observed majority of fixators were removed within 6 weeks and in 68% wounds were healed at that time of fixator removal. In our study 90% of JESS FIXATORS removed within 5 weeks. A delay in one or two weeks of frame removal in cases with comminuted fractures with open wounds to give sufficient time to wound healing and fracture union.¹⁵ In a study done by L. E Claes, J.L. Cunningham²⁰ showed that the healing time of fracture is actually earlier than that suggested by radiographic assessments and that the strength of fracture callus is not in correlation with that of the radiographic picture. Hence, in our study, we tried to keep the time for frame removal to be minimum and balancing between early active mobilization and stability of the fracture.

In our study most of the cases had no complications. In our study 5 cases (4 partial and 1 total) developed joint stiffness. Most of the cases which went for stiffness were open injuries, cases reported late, multiple fractures or intra-articular comminuted fractures. Reviewing the Drenth & Klasen studies²¹, 11 fractures out of 36 had developed partial or total stiffness. We had 2 fractures which developed pin loosening which did not effect the healing of the fractures. All the cases of pin loosening have occurred after 3 weeks. The other most common complication was pin tract infection in about 2 fractures. In our study most of the fractures were superficial infections. The pin tract infections healed promptly by antibiotics.

Recent studies by Johnson et al., El-Shaer et al., Yaseen et al are all in favor of use of mini external fixator for metacarpal and phalangeal fractures of hand based on the excellent-to-good functional outcomes derived in their studies.²²⁻²⁴

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 and 13.3% of patients were fairly recovered. There is good functional outcome in patients undergoing JESS fixation in fractures of the metacarpal and phalanges. In the study conducted by Darshil Shah et al= 38% patients had excellent, 32% Good and 26% Fair Functional outcome at the end of 6 weeks.²⁵ Based on observations in the current study we can confidently say that metacarpal and phalangeal fractures especially open type, comminuted fractures and intra articular fractures can be effectively managed with JESS EXTERNAL FIXATOR

Conclusion

Patients with comminuted fractures, open fractures, intra-articular fractures require operative reduction and stabilization 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, intraarticular, comminuted. JESS outcome also depends on severity of accompanying injuries like open fractures and comminuted fracture pattern. Without proper physiotherapy and delay in mobilization of fingers there is risk of stiffness.

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