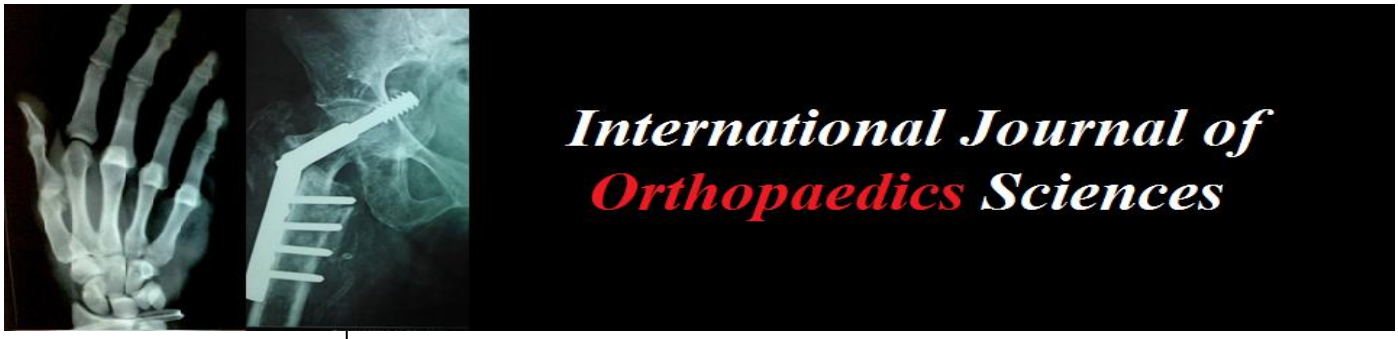

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Functional outcome of mini- external fixator for hand in a rural tertiary care hospital

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Abstract
Introduction: Human hand has evolved into an organ of exceptional function which is capable of complex movements & manipulation. Varieties of functions vary widely from pinch grip, hook function to powerful grip for lifting heavy weights. 15% of hand injuries are of Metacarpals and phalanges. Phalangeal fractures either closed or open are the most common injuries of the hand. These injuries can be treated conservatively or operatively depending on nature of injuries, fracture pattern & fracture stability.
Principle management involves restoration of articular congruity, fixation of Fractures with external fixation devices.
Materials and Methods: We did a prospective, non randomized study for a duration 6 months for a patient population of 17 who had phalangeal & metacarpal fractures. After ethical clearance & consent they were included in the study. Fractures were stabilized by threaded k wires, link joints and connecting rods. Reduction was achieved under c-arm guidance. Patient were followed up periodically for pin tract infection, loosening of k wires & link joint loosening.
Excellent results were achieved in majority of patients and with few patients in average & poor results.
Results: Out of 17 patients 10 were males & 7 were females, most of the injuries are due to agricultural accidents, 76% of patients had good union with 24% had delayed union,65% were open fractures & 35% closed injuries, 11 were extra- articular & 6 were intra-articular fractures, The majority fractures were of proximal phalanx followed by metacarpals, 47% patients had excellent outcomes, 29% with good results, 18% average results & 6% poor results these were due to the pin tract infection, loosening, collapse of fracture, angulation & side to side translation.
Conclusion: Our study showed that extra-articular fractures gave a better results, whereas intra- articular fractures gave average results due to stiffness of joints. And at the same time external fixator gave a better outcome.

Keywords: Mini external fixator JESS phalanx fractures metacarpal fractures

Introduction
Human hand has evolved into an organ of exceptional function which is capable of complex movements & manipulation. Variety of functions vary widely from pinch grip, hook function to powerful grip for lifting heavy weights. 15% of hand injuries are of Metacarpals and phalanges [1, 2] Phalangeal fractures either closed or open are the most common injuries of the hand. These injuries are encountered every day [3]. These injuries can be treated conservatively or operatively depending on nature of injuries, fracture pattern & fracture stability [4]. The majority of metacarpal fractures are closed injuries amenable to conservative management, whereas external fixation is used when there is a complex soft tissue injury [5]. Principle management involves restoration of articular congruity, fixation of Fractures with external fixation devices [6].
Anatomical reduction and stable fixation followed by early mobilization represents the key treatment [7, 8]. External fixation offers an effective treatment options in the management of these difficult fractures & act through distraction mobilization through capsule-ligamentotaxis [7]. Advantages provided by the External fixation are minimal Surgical trauma, preserves fracture hematoma, short operative time, minimal anesthetic complications & also removal is simple. In our study we are estimating the functional outcome in view of Range of motion, soft tissue healing, fracture healing & functional morbidity through this prospective study.

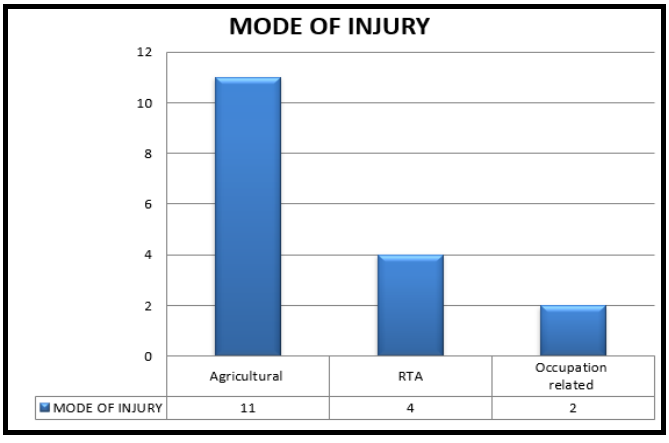
Materials & Methods

In our prospective, Non randomized study we included patients depending on inclusion & exclusion criteria. i.e., Age between 18- 40 years, Intra & extra-articular fractures,
Fractures of phalanx, metacarpals Closed & open fractures.
Patients with other fractures like carpals fracture distal end radius fracture Both bone forearm fractures phalanx or metacarpal fractures with vascular compromise were excluded. This prospective study is done in a tertiary care rural hospital from July 2019 – December 2019 for a patient population of 17.
After the preoperative evaluation patients were surgically managed under regional or local anesthesia. Fractures were reduced under C arm guidance, initially the proximal fragment was inserted with a threaded k wire followingly distal fragment was also applied threaded k wire, fracture was reduced under c- arm guidance, rotation, alignment & angulation was maintained.
These threaded k wires were transfixed with JESS fixator clamps for small bones, intern these were connected using a thicker k wire as connecting rod. Open fractures were debrided and thorough wash given with simple stay sutures application. Patients were regularly followed up every week for wound status, and every 2 weeks for fracture status, In case of any implant loosening it was tightened and alignment checked depending on x rays. External fixator was removed after 4-6 weeks of reduction with signs of callus formation seen on x rays. Patients from all the mechanism of injury was included in the study like RTA, Agricultural, Occupational related trauma. Fractures of all patterns were included like Intra & Extra- Articular fractures.

Results

According to the study conducted out of 17 patients UNION was seen in 13(76%) patients, Remaining 4(24%) cases had a delayed union due to infection & bone loss.

Mechanism of injury



Graph 1: Mode of Injury

As shown in the above table that the agricultural accidents have the highest rate of occurrence, As the study was conducted in rural tertiary care center.
On an average the duration for treatment was less than 24 hours from the time of admission.

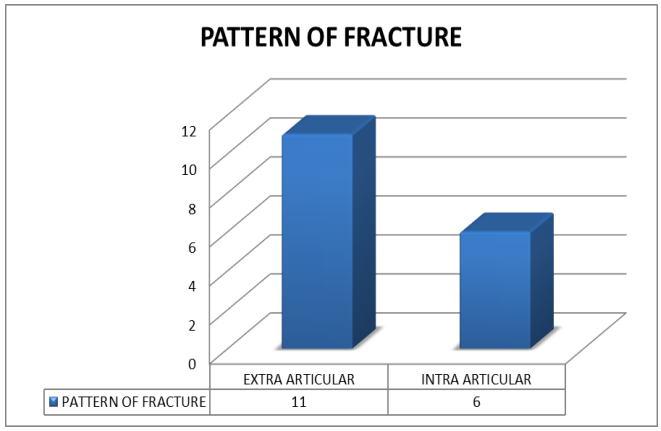
Sex ratio

In our study we found that there was a Male preponderance of fracture occurrence of (10)58% and remaining female population of (7)42%.

Types of Fractures

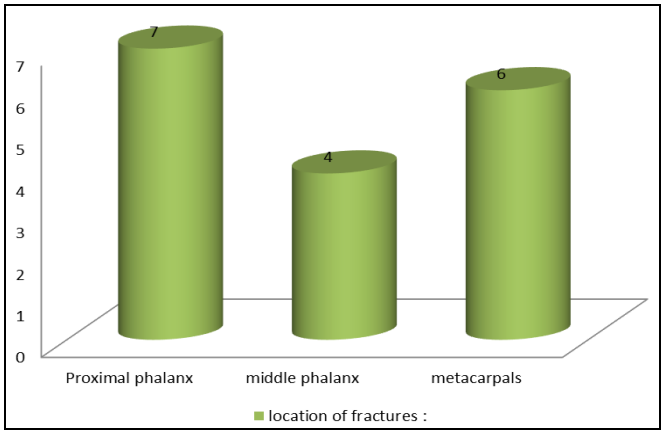
Majority of the fractures were open fractures due to the agricultural sharp objects handling.
Open fractures were of 65% & remaining 35% of closed fractures.

Pattern of fracture



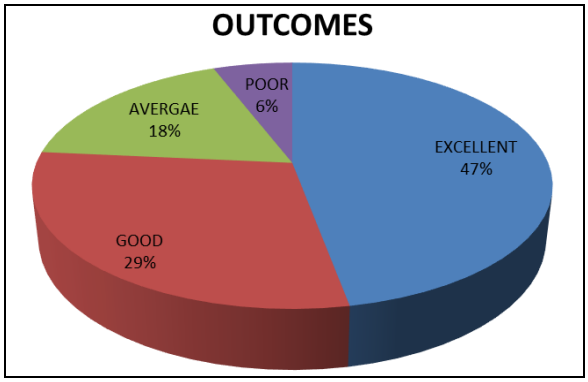
Graph 2: Pattern of fracture

Location of fractures



Graph 3: Location of fractures

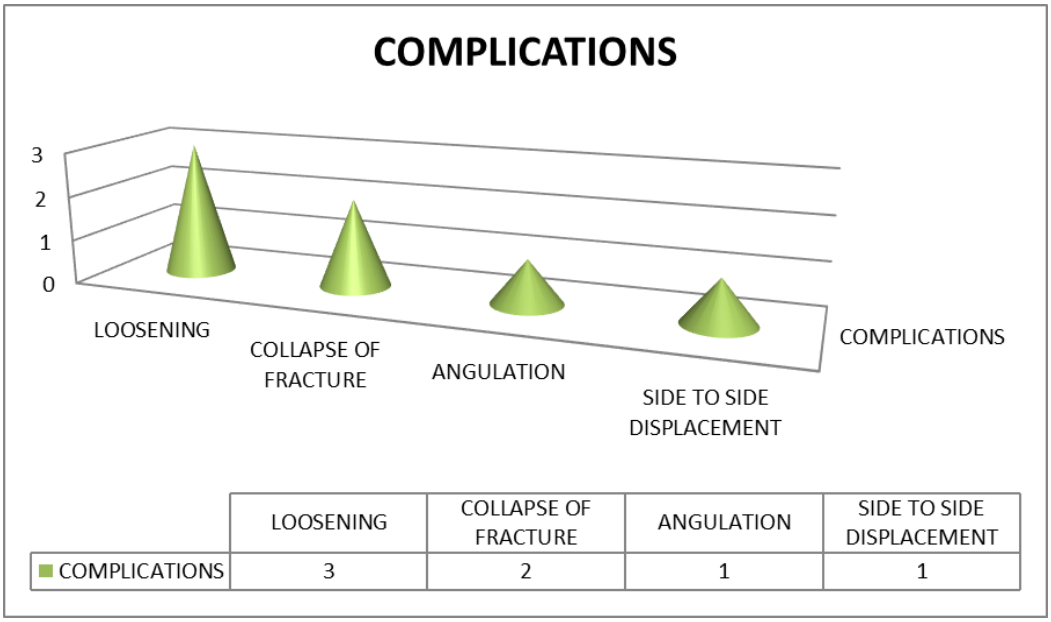
According to the above given table proximal phalanx (41%), middle phalanx (23%) & metacarpals (35%). The proximal phalanx has increased frequency of occurrence, followed by Metacarpals.



Graph 4: Outcomes

Out of 17 patients 8 had excellent results, 5 had good results due to the delayed healing of wounds, 3 had average results due to the loosening of the link joints & pin tract infection

which later on recovered on appropriate antibiotics & 1 poor results who presented to us with pouring pus with implant back out.
2mm threaded k wires were inserted either in dorso- ulanr or dorso- radial angle to prevent tendon & neurovascular complications.
We found that 42% were proximal phalanx fracture, 35% were metacarpals fractures, 23% were middle phalanx fractures.
Drenth & colleagues reported 28 out 33 patients were satisfied with their results. In our study 95% patients were satisfied with their results & stopped follow up once they achieved the status of near normal living.
Complications seen during the treatment period:



Graph 5: Complications

In order to assess the functional outcome of the fixation after removal we used Strickland- glogovac finger functional rating scale [12], as mentioned below:

Strickland – Glogovac Finger Function Rating Scale

Table 1: Strickland: Glogovac Finger Function Rating Scale

Results	Fingers [degrees]	Thumb [degrees]	No of Patients
Excellent	>220	>119	8
Good	180-219	98-118	5
Fair	130-179	70-97	3
Poor	<130	<70	1

It is seen in our study that closed fractures gave better results than comminuted fractures.
Simple / oblique fractures are better than comminuted fracture.
Extra – articular fractures are better than intra – articular fractures as the extra articular fractures gives better joint mobility than intra articular fractures which most commonly leads to joint stiffness.

Discussion
Fractures of the metacarpals & phalanges are the most common & also most neglected fractures in the skeletal system. [9] Due to the amenability to conservative management & general notion that it doesn't need any treatment. Most of them are treated conservatively but some like open fractures, unstable extra or intra articular fractures [like oblique & spiral fractures] which needs fixation and also allows soft tissue healing and at the same time for early movement of the joints.
In the study by dialiana & colleagues all procedures were done under Regional anaesthesia except 2 patients who had polytrauma so were taken for general anaesthesia [10, 11].
In our study we did all the cases under wrist block(regional anaesthesia).
Drenth & klasen reported 41.7% excellent results 27.8% good results, 8.3% fair results & 22.2% poor results [8].
In a study by Ma & colleagues for 28 patients who achieved fracture healing, the results were excellent in 7, good in 12, fair in 5 & poor in 4 [8, 11].
In our study we had Excellent 8, Good 5, average 3, poor 1 as the reason are being described in the results section.

Conclusions
In this prospective study we have presented the most common fractures of hand like phalangeal & metacarpal fractures. And the findings in this prospective study showed that external fixator is a suitable technique for stabilizing open fractures, comminuted fractures of phalanx & metacarpals. It has a short learning curve & can be performed under a good wrist block.
External fixator provides an easy post op care helps in soft tissue healing and at the same time helps in healing of bone with a good range of movement & good functional outcomes with few drawbacks.

Radiographs & Clinical Pictures
Case 1

1A: Clinical Picture:

1B Pre-Operative X ray :

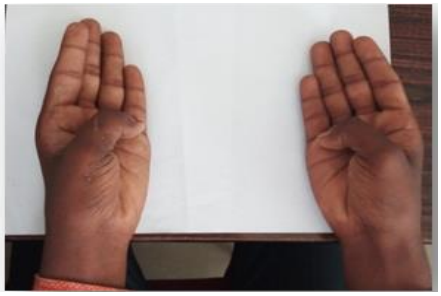
1D: Follow up, recovery & movement

1C: Post-Operative X ray

1E: Follow up, recovery & movement

1F:

1G :



1H:

Following the removal of mini-external fixator

Case 2

2A: Clinical pictures

2C: Post operative X ray

Follow up with wound recovery & mobilization

2B: Pre operative X ray

2D: Mobilization with fixator

2E: Mobilization with fixator

Following the mini external fixator removal

2F: Mobilization after frame removal

2G: Mobilization after frame removal

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