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A RURAL PERSPECTIVE ON THE MANAGEMENT OF PHALANGEAL & METACARPAL FRACTURES USING MINI EXTERNAL FIXATORS/JESS - A PROSPECTIVE STUDY

Dr Venkatesh V[1*], Dr Ravi G R[2]

[1*]Assistant professor, Department of orthopedics, East point medical College & hospital , Bengaluru
[2]Assistant professor, Department of orthopedics, BGS medical College & hospital, Bengaluru

***Corresponding author:** Dr Venkatesh V
*E-mail: venkatesha.2007@gmail.com

Abstract

Hand fractures, including phalangeal and metacarpal injuries, are among the most prevalent yet often overlooked skeletal injuries. This study evaluates the use of mini-external fixators/ JESS for stabilizing such fractures, focusing on functional outcomes in a rural tertiary care setting. A prospective, non-randomized study involving 34 patients highlights the effectiveness of these devices in achieving stable fracture fixation and promoting early mobilization.

Introduction: The human hand, with its unparalleled functionality, is vulnerable to a variety of injuries, especially in rural environments where agricultural and occupational hazards are common. Fractures of the metacarpals and phalanges constitute 13 %- 15% of hand injuries, often necessitating surgical intervention for complex cases. External fixation offers minimal surgical trauma, preservation of fracture hematoma, and simplified post-operative care, making it a viable option for rural healthcare setups.

Materials and Methods: This eight month study (in the year August 2023 - April 2024) involved 34 patients aged 18–40 with phalangeal and metacarpal fractures. The study was conducted after ethical clearance, patients were included into them study depending on the inclusion & Exclusion criteria. The fractures were stabilized using threaded K-wires, clamps, and connecting rods, with reductions achieved under C-arm guidance. Post-operative follow-ups were conducted to monitor infection, alignment, and functional outcomes.

Results: Of the 34 patients, 23 were male and 11 female. Most injuries (63%) were open fractures, with agricultural accidents being the leading cause. Fractures included 43% proximal phalanx, 25% metacarpals, and 32% middle phalanx. Union was achieved in 79% of cases, while delayed union occurred in 21%, primarily due to infection or bone loss. Outcome assessments revealed 49% excellent, 27% good, 17% average, and 6% poor results. Complications included pin tract infections and fracture angulation, which were managed with appropriate interventions.

Discussion: External fixation proved particularly effective for extra-articular fractures, which showed better functional outcomes compared to intra-articular fractures. The use of threaded K-wires and mini-external fixators/ JESS allowed early joint mobilization, crucial for restoring hand function. However, intra-articular fractures often led to joint stiffness, affecting recovery. Comparisons with previous studies validate these findings, emphasizing the method's simplicity and efficacy.

Conclusion: Mini-external fixators/JESS offer a practical, efficient solution for managing phalangeal & metacarpal fractures in rural settings. They ensure stable fixation, promote soft tissue healing, and allow early mobilization, yielding favorable functional outcomes despite minor complications. The technique is cost-effective, with a short learning curve, making it ideal for resource-constrained environments.

Keywords: Mini external fixator, JESS, hand fractures, phalanx fractures, metacarpal fractures, rural healthcare.

Introduction:

The human hand, with its unparalleled functionality evolved into an organ of exceptional prehensile function capable of highly complex movements and manipulation. The human hand, with its unparalleled functionality, is vulnerable to a variety of injuries, especially in rural environments where agricultural and occupational hazards are common. Fractures of the metacarpals and phalanges constitute 13% - 15% of hand injuries, often necessitating surgical intervention for complex cases. It is an organ both for powerful grasp as in lifting heavy objects as well as delicate pinch and hook functions. Hand injury is extremely common and accounts for about 17% of the attendance at accidents and emergency departments [1, 2].

Phalangeal and metacarpal fractures, either closed or open, are common injuries of the hand. These injuries are encountered every day. They can be treated conservatively or operatively depending on the nature of injuries, fracture pattern and the fracture stability [3].

The majority of metacarpal & phalangeal fractures are closed injuries amenable to conservative management, whereas external fixation is used when there is a complex soft tissue injury [4]. Management Principles involves restoration of articular congruity, fixation of Fractures with external fixation devices [5].Near normal Anatomical reduction and stable fixation followed by early mobilization stays the key elements. [6, 7] External fixation offers an effective treatment modality in the treatment of these difficult fractures & act through distraction mobilization through capsulo – ligamentotaxis[6]. Advantages provided by this modality of fixation are minimal surgical trauma, preservation of fracture hematoma, shortened operative time, and minimal anesthetic complications & also removal is simple. In this current study we are estimating the following outcomes such as Range of motion, soft tissue healing, fracture healing & functional morbidity through this prospective study.

Materials & Methods

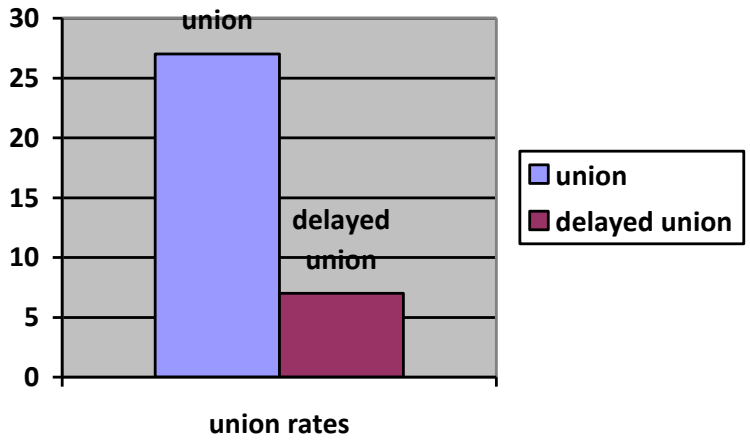
In our current prospective, non-randomized study we included patients depending on inclusion criteria's i.e., Age between 18- 40 years, Intra & extra-articular fractures, Fractures of phalanx, metacarpal fracture Closed & open fractures. And excluded Patients with other fractures like carpals fracture distal end radius fracture both bone forearm fractures phalanx or metacarpal fractures with vascular compromise. This prospective study is done in a tertiary care rural hospital from August 2023 - April 2024 for a patient population of 34. After the pre - op 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 followed by distal fragment which was also inserted with 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, which are further connected using a thicker k wire as connecting rod. Open fractures were debrided and thorough wash was given with simple stay sutures application. Patients were regularly followed up every week for wound examination, and every 2 weeks for fracture status {like change in alignment, loss of reduction etc.}, In case of any implant loosening it was tightened and alignment checked depending on X rays.

External fixator was removed after 6 weeks of duration with signs of callus formation seen on x rays. Patients where followed up for a duration of 8 months. Patients from all the mechanism of

injury was included in the study like RTA, Agricultural, and Occupational related trauma. Fractures of all patterns were included like Intra & Extra- Articular fractures.

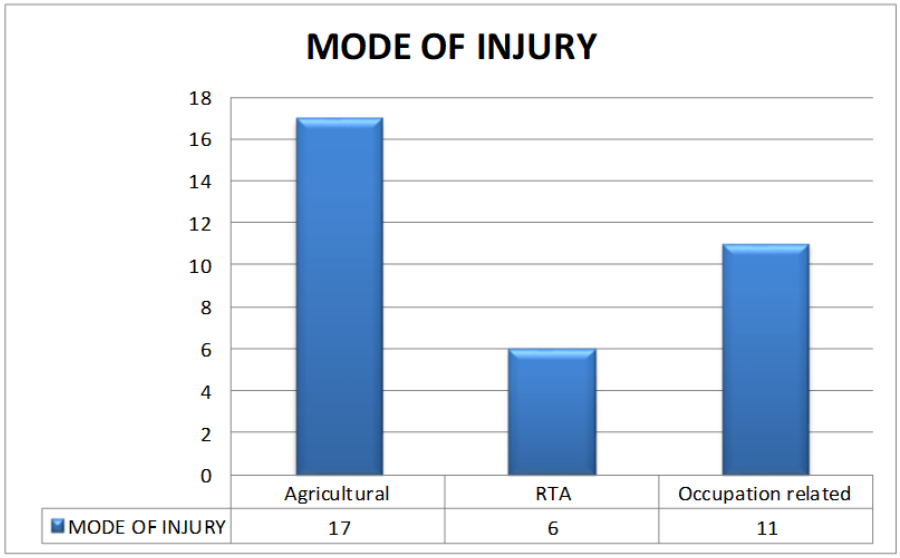
RESULTS :

According to our study which was conducted for 34 patients **UNION** was seen in 27(79%) patients, Remaining 7(21%) cases had a delayed union due to infection & bone loss.



Graph 1 : Union rates

Mechanism of injury :

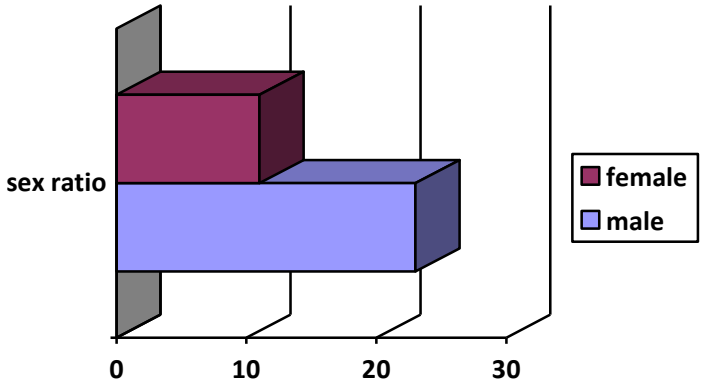


Graph 2 : Mode of Injury

As depicted in the table that the agricultural injuries have the highest rate of occurrences followed by occupation related injuries, 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 :

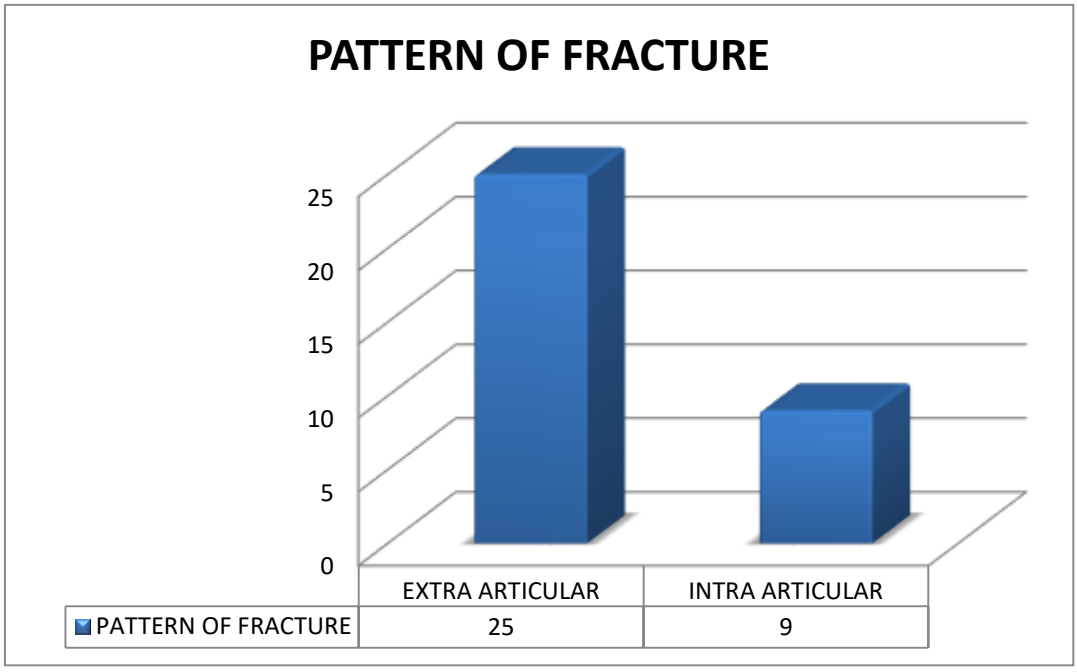
In the study conducted we found that there was a Male predominance of fracture occurrence of (23)68% and remaining female population of (11)32%.



Graph 3 : Sex ratio

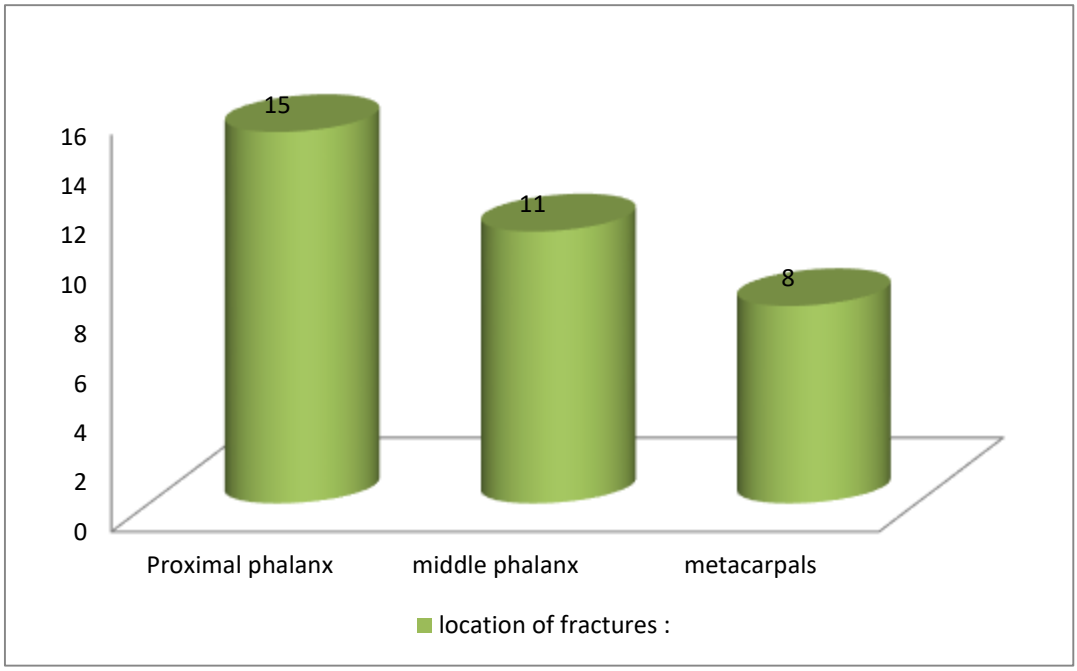
Types of Fractures :
Majority of the fractures were open fractures due to the agricultural sharp objects handling. Open fractures were of 67% & remaining 33% of closed fractures.

Pattern of fracture :



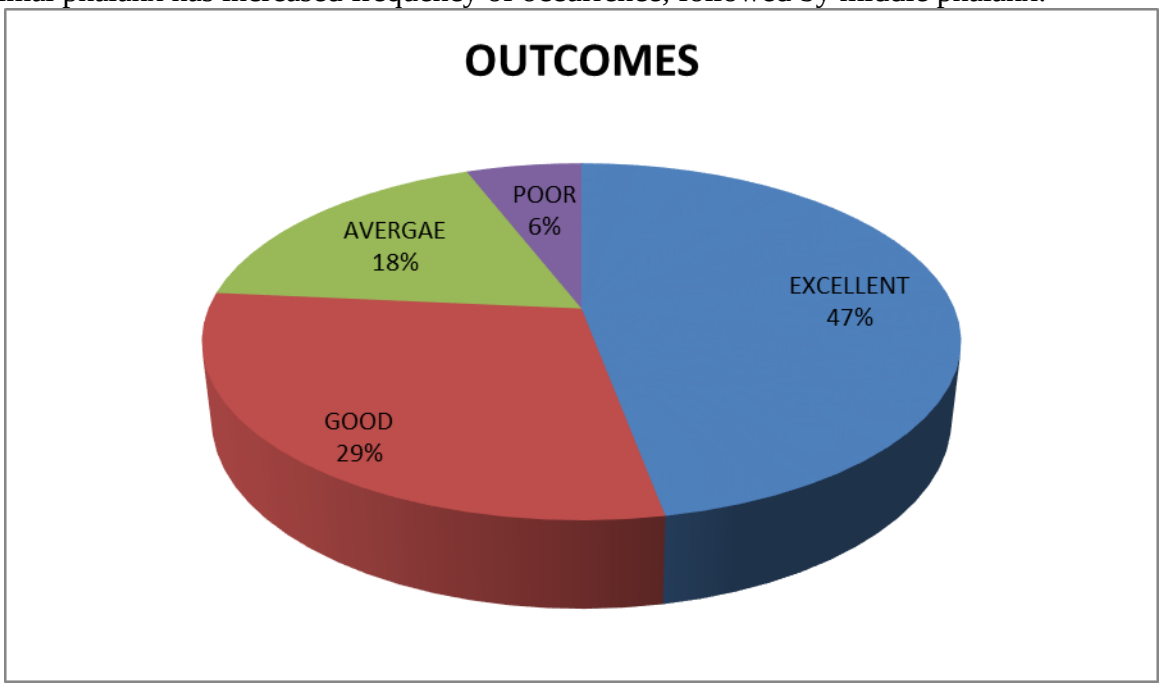
Graph 4: PATTERN OF FRACTURE

Location of fractures :



Graph 5 : LOCATION OF FRACTURES

As shown in the table proximal phalanx (43%), middle phalanx (32%) & metacarpals (25%). The proximal phalanx has increased frequency of occurrence, followed by middle phalanx.



Graph 6 : Outcomes

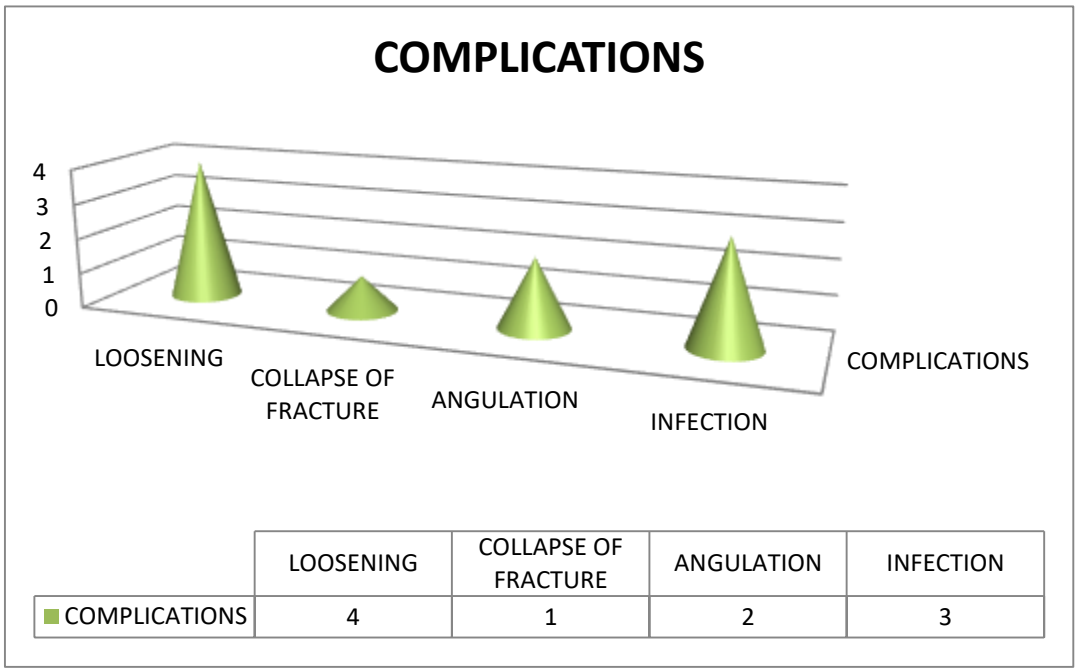
Of the 34 patients 17(50%) had excellent results, 9(27%) had good results due to the delayed healing of wounds, 6(17%) had average results due to the loosening of the link joints & pin tract infection which later on recovered on appropriate antibiotics & 2(6%) poor results who presented to us with pouring pus with implant back out .

2mm threaded k wires were inserted either in dorso- ulanar or dorso- radial angle to prevent tendon & neurovascular complications.

We derived at 43% were proximal phalanx fracture, 25% were metacarpals fractures, 32% were middle phalanx fractures.

Drenth et al reported 28 out of 33 of their patients were satisfied with the results. In our study 95% patients were satisfied with their results & stopped follow up once they achieved the status of near normal living [7].

Complications seen during the treatment period:



Graph 5 : Complications

In order to assess the functional outcome after the removal / end of treatment period we have used Strickland- glogovac finger functional rating scale [8], which is as mentioned below :

STRICKLAND – GLOGOVAC FINGER FUNCTION RATING SCALE *:*

Results	Fingers [degrees]	Thumb[degrees]	NO OF PATIENTS
Excellent	>220	>119	17
Good	180-219	98-118	9
Fair	130-179	70-97	6
Poor	<130	<70	2

Table 1 : *STRICKLAND – GLOGOVAC FINGER FUNCTION RATING SCALE*

It is seen in our current study showed that closed fractures gave better results than comminuted / open 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 to occur at the same time the most neglected fractures in the skeletal system [9]. Due to the ease of 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, which allows soft tissue healing and at the same time for early range of movement of the joints.

In a study conducted by dialiana et al all procedures were done under Regional anesthesia except 2 patients who had polytrauma were taken for general anesthesia. [10, 11]
In our study we performed all the surgery under wrist block (regional anesthesia).
Drenth & klasen reported 41.7% excellent results 27.8% good results, 8.3% fair results & 22.2% poor results. [7]
In a study conducted by Ma et al for 28 patients who achieved fracture healing, the results were excellent in 7, good in 12, fair in 5 & poor in 4. [8,10] In our study we had Excellent 17, Good 9, average 6, poor 2 as the reason are being described in the results section.
Freeland described collapse into mild deformity after the removal of the fixator [11], whereas we did found 2 cases ended up with angulation which were insignificant to cause functional disability
Good results have been reported with devices that use small-diameter K-wires to stabilize the mini fixator construct, especially in closed metacarpal fractures, but the threaded pins in this mini fixator provide extra stability, which is necessary for the ultimate bone healing [12,13] .In our study we also observed that threaded k wires gave a better stability than smooth k wires. In addition with the usage of threaded k wires the stable construct allows early mobilization that improves the range of motion, as shown in other series, where comparable to our study as well[14].
According to Drenth the outcome of treatment depends on the severity of the accompanying soft tissue injury [7], something even which we also co-related with the results of our study series.
After comparing the studies with our study we could arrive at saying mini external fixator/ JESS gives good results in all kinds of hand injuries, hand injuries with soft tissue injury even in worse case with intra – articular extension due to the stability it provides which helps in bone & soft tissue healing.

CONCLUSIONS:

This prospective study highlights the most common hand fractures, such as phalangeal and metacarpal fractures, and investigates the use of external fixators as a treatment method. The findings suggest that external fixation is a suitable technique for stabilizing open fractures, comminuted fractures of the phalanx, and metacarpals. The technique offers a short learning curve and can be performed under a simple wrist block anaesthesia.
External fixation provides several advantages, including ease of postoperative care, enhanced soft tissue healing, and bone healing. Additionally, it allows for a good range of motion and functional outcomes. However, like all methods, it has some drawbacks, which are typically outweighed by its benefits in the appropriate clinical settings. This study reinforces the utility of external fixators as an effective treatment option for complex hand fractures.

Case 1 :

<table>
<tr><td>1A
 
Clinical Picture :</td><td> 
1B
Pre-Operative X ray :</td></tr>
<tr><td colspan="2">1C</td></tr>
</table>

Post-Operative X ray :

1D

Follow up , recovery & movement :

1E

Follow up, recovery & movement :

Following the removal of mini-external fixator:

1F :

1G :

1H :

Case 2 :

2A

Clinical pictures :

2B

Pre operative X ray :

2C

Post operative X ray :

Follow up with wound recovery & mobilization :

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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