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Dr. Prakash Samant
Professor, Department of
Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

Dr. Arpit R Rajpurohit
Post Graduate, Department of
Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

Dr. Sachin Y Kale
Professor, Department of
Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

Dr. Gaurav Kanade
Assistant Professor, Department
of Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

Dr. Shikhar Singh
Assistant Professor, Department
of Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

Corresponding Author:
Dr. Arpit R Rajpurohit
Post Graduate, Department of
Orthopaedics, D.Y. Patil
Hospital and Research Centre,
Nerul, Navi Mumbai,
Maharashtra, India

A comparative study to assess the effect of conservative versus operative management on functional outcome in patients with metacarpal fractures

Dr. Prakash Samant, Dr. Arpit R Rajpurohit, Dr. Sachin Y Kale, Dr. Gaurav Kanade and Dr. Shikhar Singh

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Abstract

Aims and Objectives: The primary objective of this study is to evaluate and assess healing, functional outcomes and complications of conservatively versus operatively managed metacarpal fractures.

Materials: Our study was conducted in a total of 50 patients with sixty-eight metacarpal fractures of the hand in patients aged 18 to 65 years conducted during the period of 2016 to 2018. Unstable metacarpal fractures, intra-articular fractures, avulsion fractures were included in this study. Fracture dislocations, open fractures with severe soft tissue injury, tendon injury, neurovascular injury and pathological fractures were excluded. Primary outcomes were assessed using the Quick DASH score and Michigan Hand Questionnaire

Results and Observations: Out of 50 patients, 72% were males and 28% females with the male to female ratio being almost 2.5:1. Almost 80% of patients fell in the category of 20-40 years. The 3rd and 5th metacarpal fractures were the most common, having an incidence of 20.6% and 32.4% respectively. The average time taken to union in study was approximately 6.5 weeks with age being more of a factor than treatment protocol as both conservatively managed and operatively managed fractures began to show union as early as 3 weeks. According to the study, 5 complications were found, with stiffness and superficial infection being the most common.

Conclusion: Functional outcome is of paramount importance and restoration to maximum hand function and is the primary expectation of the patient. Conservative management and operative management, both have their merits and demerits and should be chosen as per surgeon experience, preference and patient expectation. Physical therapy and mobilization are key in managing these fractures and should not be neglected and should rather form an integral path to recovery.

Keywords: metacarpal, conservative, operative management, functional outcome

1. Introduction

The hand is essential in humans for physical manipulation of their surrounding environment. Allowing the ability to grasp, the main functions include both fine and gross motor skills as well as being a key tool for sensing and understanding the immediate surroundings^[1].

With the hand being involved in day to day activities, it is one of the most vulnerable parts of the body prone to suffering injuries in a variety of ways especially in domestic, industrial and agricultural sectors. The increase in industrialization and moving vehicles on the road have also compounded the injuries that are suffered and can often lead to a litany of complications like open wounds, intra-articular fractures, comminuted fractures and at worst, mutilation.

Hand fractures are the most common fractures presenting at both accident and emergency and within orthopedic clinics and metacarpal fractures comprise between 18-44% of all hand fractures^[2]. Fractures of the metacarpal bone either involve the proximal base, the shaft, neck, or the distal head. The neck and shaft are more commonly injured in contradiction to the first metacarpal where the base is most often involved.

Metacarpal fractures are isolated injuries and are often simple, closed, and stable which leads to them being treated as minor injuries but can often lead to major disabilities^[3] and this has never held more true now than it was first described by Dr. P.R. Lipscomb in 1963.

The functional outcome and result of the management of a hand fracture is of predominant

importance; rather than fracture healing being the only isolated goal [4].

Patients present with dorsal swelling, tenderness and in some cases, ecchymosis over the fractured metacarpal. On examination, there may be loss of knuckle contour from shortening and more proximal dorsal bony prominence secondary to excessive angulation. Shortening is potentially problematic as the extensor mechanism is attached at the level of the metacarpal head, through the sagittal bands, and therefore, the shortening will create a tendon imbalance resulting in an extension lag. Every 2 mm of shortening will result in 7° of extension lag [5]. As the MCP (metacarpophalangeal) joints naturally hyperextend by about 20°, shortening of up to 6 mm is tolerable with neutral MCP extension.

Fractures of the metacarpal shaft are less forgiving and require surgical management or conservative management is based on the apex dorsal angulation. There is also an inverse variance noted in the same. Due to the mobility of the carpometacarpal (CMC) joints, ring and small fingers can tolerate much greater dorsal angulation than the index and middle finger. Although the MCP joint can hyperextend to accommodate flexion deformity in the metacarpal, this compensation can result in inadequate force at the proximal interphalangeal (PIP) joint, leading to extensor lag, a phenomenon known as pseudo clawing.

Intra-articular fractures deserve special consideration. A step off of >1 mm or involvement of more than 25% of the articular surface are indications for operative fixation to align the joint and minimize the risk of subsequent arthrosis [3].

With a wide range of complications in mind and the importance of the hand in day to day activities compounded with the paucity of literature regarding management and lack of an established algorithm of management of metacarpal fractures, the aim of this study is to assess pain relief, fracture healing, union, and functional outcome for metacarpal fractures that are treated conservatively as some emerging trends in management of metacarpal fractures have shown no significant difference between operative and non-operative patients in terms of hand grip, aesthetical deformity and quality of life as compared to surgical intervention

2. Materials and Methodology

This study was carried in the selected group of 50 patients treated for various fractures of the metacarpals by either offering conservative or operative management in the Department of Orthopaedics, Pad. Dr. D.Y. Patil Hospital and Research Centre. All patients presenting to Trauma centre were given first aid in form of splint age, supportive care, analgesics and routine relevant investigations. Basic radiological investigations pertaining to nature of fracture of sustained were carried out.

Inclusion criteria

- Age 18 years to 70 and above of either sex
- Closed fractures
- Consenting patients
- Extra-articular metacarpal shaft fractures
- Intra-articular fractures

Exclusion criteria

- Fracture dislocations
- Open fractures with severe soft tissue injury, tendon injury
- Neurovascular injury

- Pathological fractures

Clinical examination

It will be both subjective and objective

Subjective: A detailed questionnaire was completed for each patient to evaluate subjective factors such as pain, functional limitations and occupational considerations.

Objective: Objective examination of each patient was included with regards to inspection of the hand for deformity, tenderness, abnormal mobility of the affected joint, measurement of range of movements of the joint.

Radiological examination

The radiographic evaluation included assessment of joint space, evidence of bony deformity, degree of displacement, angulation and CT scan if required for further evaluation

Methodology

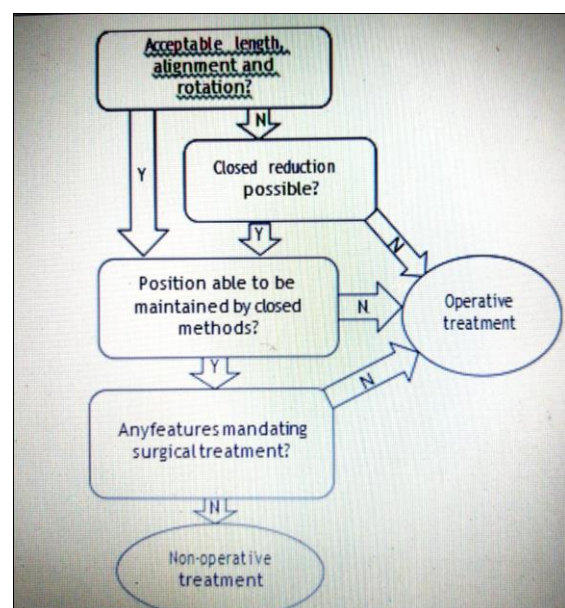


Fig 1: Flow chart to aid in assessment of operative and non-operative assessment [44, 1]

2.1 Post management protocols

If the patient received conservative management in the form of a radial or ulnar gutter splint, he was evaluated every week for 3 weeks for finger swelling, pain, paraesthesia while daily movements and routine activities in the unaffected fingers were encouraged. At 3 weeks, after removal of splint, a dynamic splint was given and movements in fractured fingers and grip exercises were started.

The hand of the operated patients was kept elevated for a period of 24 to 48 hours. Active finger movements were started immediately to prevent swelling and stiffness.

Intravenous antibiotics were given for 2 days and oral antibiotics for 7 days. Pin tract was inspected every weekly for up to 4 weeks. K wires were removed between 3-6 weeks and active assisted range of motion exercises were started.

2.2 Functional outcomes

To help assess the functional outcome after fracture treatment,

¹ Credit to University of Michigan for Michigan Hand Questionnaire and Royal College of Surgeons, England for Flow Chart used in assessment of hand injuries

three main evaluative parameters were used: Total Active Range of Motion (TAM), Quick DASH score and Michigan Hand Questionnaire.

Total active range of motion is calculated by adding the active flexion at metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints, after subtracting the sum of extension deficit at these three joints. Recovery is calculated as percent- regained motion compared to normal range of digital motion (260°) According to this, patients with 85-100% of movement are classified as excellent, 70-84% as good, 50-69% as fair and less than 50% as poor.

Quick DASH score is a questionnaire designed to ask about symptoms as well as your ability to perform certain activities. Scaling was ranked from 0 indicating least disability to 100 indicating most disability. It was administered at 12 weeks and/or 24 weeks

Michigan hand questionnaire is a hand-specific outcomes instrument which measures the health outcomes of patients with chronic hand conditions. The MHQ contains six distinct scales (1) overall hand function, (2) activities of daily living (ADLs), (3) pain, (4) work performance, (5) aesthetics, and (6) patient satisfaction with hand function. The raw scale score for each of the six scales is the sum of the responses of each scale item. For the Pain scale, a higher score indicates more pain. For the other five scales, higher scores indicate better hand performance. An overall MHQ score can be obtained by summing the scores for all six scales after reversing the pain scale (pain=100-pain score) and then dividing by six. It was administered at 12 and 24 weeks.

3. Results and observations

A total of 50 patients with metacarpal fractures were treated and the following observations were noted:-

Table 1: Age wise distribution of patients

Age	No. of patients	Percent
<20	2	4
20-29	19	38
30-39	17	34
>40	12	24
Total	50	100

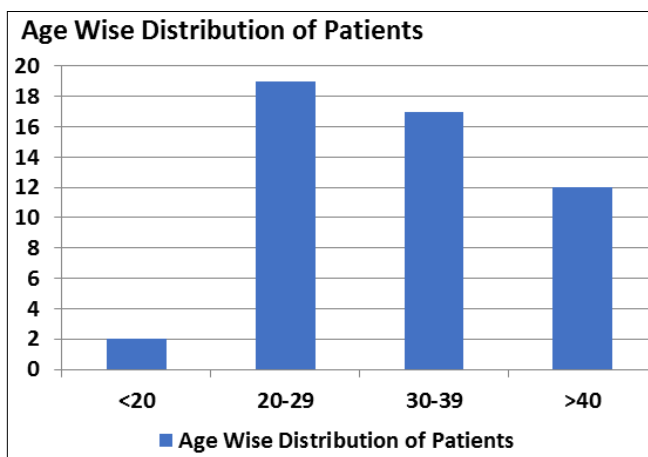


Fig 2: Graph showing predominance of injuries in 20-40 age group

Table 2: Sex wise distribution of patients

Sex	No. of patients	Percent
Male	36	72
Female	14	28
Total	50	100

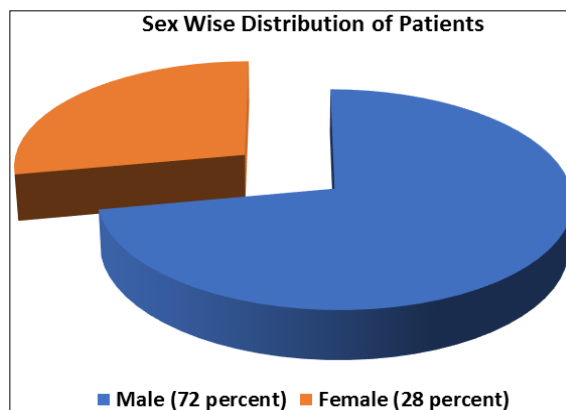


Fig 3: Pie chart showing male preponderance (2.5:1)

Table 3: Side of injury

Side of Injury	No. of Patients	Percent
Left	23	46
Right	27	54
Total	50	100

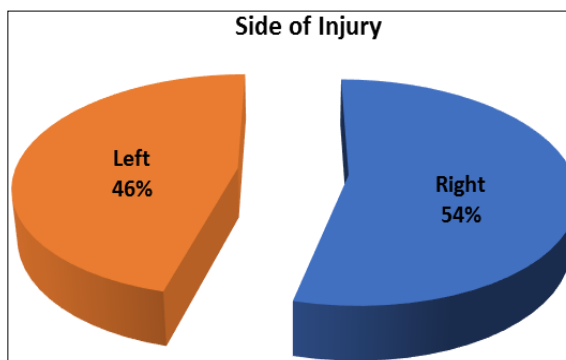


Fig 4: Pie chart showing near equal incidence of injury with regards to site of injury

Table 4: Mode of injuries

Mode of injury	No. of patients	Percent
Blunt Trauma	18	36
Fall	13	26
Road Traffic Accident	19	38
Total	50	100

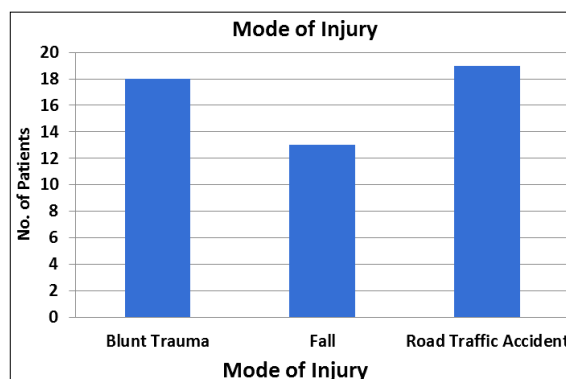


Fig 5: Graph showing road traffic accidents and blunt trauma being most common mode of injury

Table 5: Site of fracture

Fracture	No. of patients	Percent
1 st MC	8	11.8
2 nd MC	12	17.6
3 rd MC	14	20.6
4 th MC	12	17.6
5 th MC	22	32.4
Total	68	100

Table 6: Duration of union in weeks

Union (wks)	No. of patients	Percent
Less than 5 weeks	2	4
5	16	32
6	12	24
7	10	20
8	8	16
9	2	4
Total	50	100

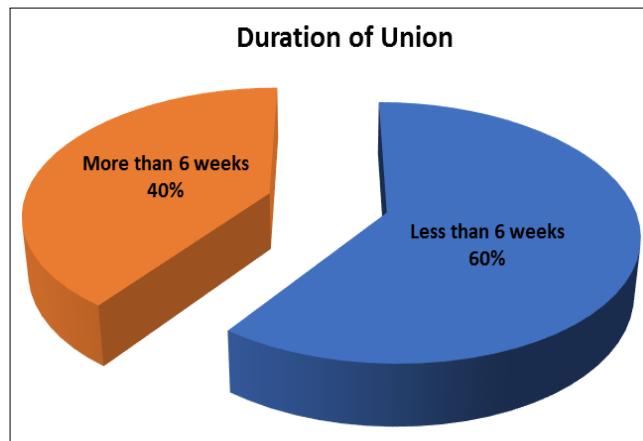
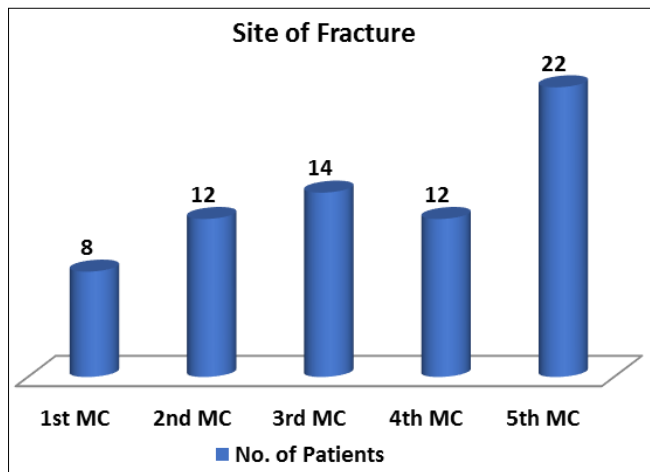


Fig 6: Graph showing increased volume of 5th metacarpal injury

Fig 6.1

Table 7: Complications in patients

Complications	No. of cases	Percent
K- wire loosening	1	1.5
Malunion/Malrotation	3	4.4
Stiffness/Grip weakness	3	4.4
Superficial Infection	2	2.9
Aesthetic(dorsal prominence)	2	2.9
None	57	83.8
Total	68	100

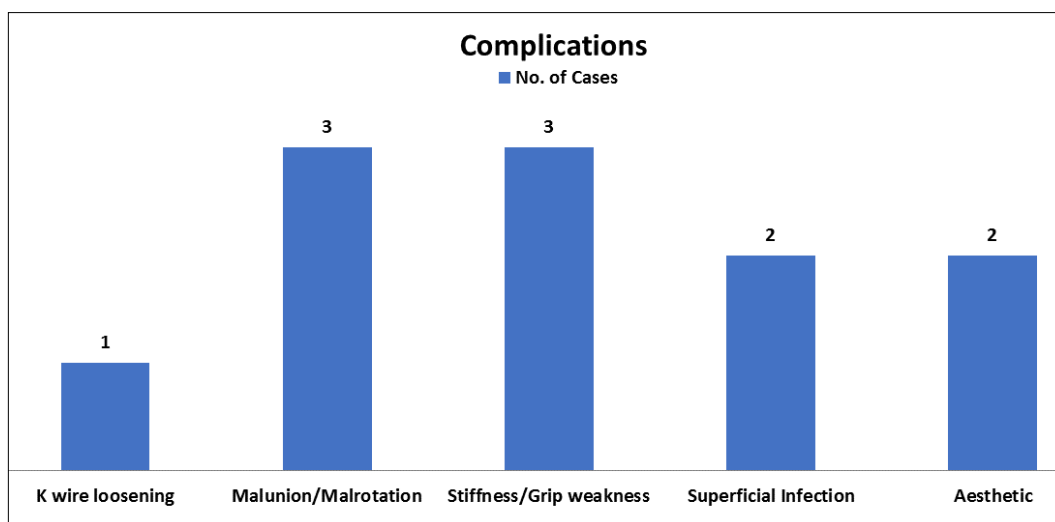


Fig 7: showing complications associated with both treatment protocols

Table 8: age wise union in fractures

Age	Union in 6 weeks	
	Yes	No
<20	2	0
20-29	12	7
30-39	10	7
>40	5	7

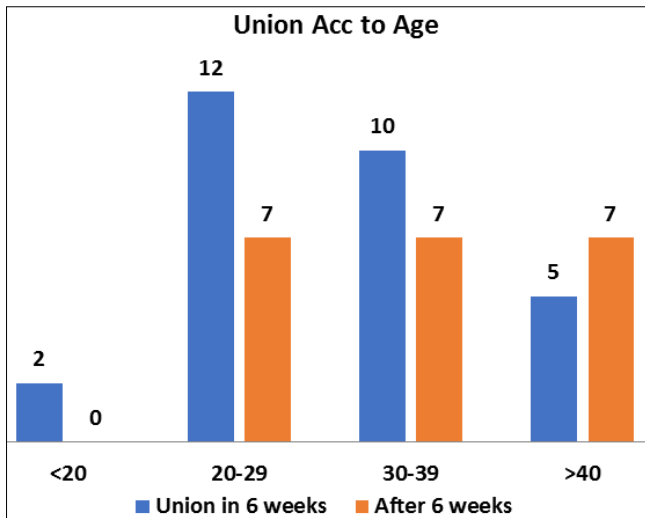


Fig 8: Figure showing young age being a significant factor in time to union

Table 9: Quick DASH score at follow up*

*Lower score indicating less disability and more patient satisfaction

Quick DASH Score	No. of patients	Percentage
<20	2	4
21-25	28	56
26-30	16	32
>30	4	8
Total	50	100

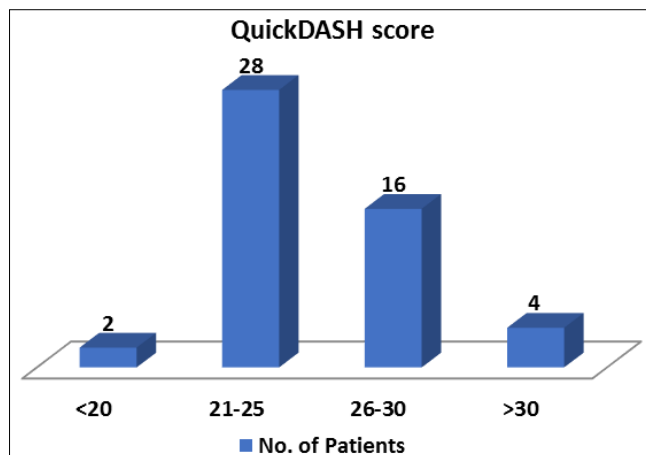


Fig 9

Table 10: Michigan Hand Questionnaire [Overall] Score at final follow up

MHQ score	No. of patients	Percentage
55-60	2	4
61-65	2	4
66-70	6	12
71-75	17	34
76-80	16	32
81-85	6	12
85-90	1	2

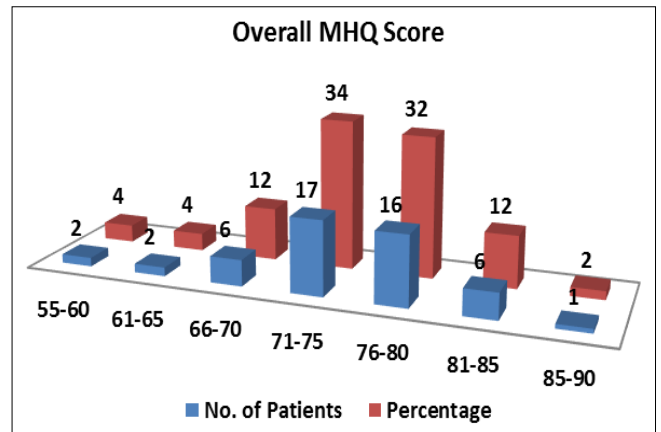


Fig 10

3.10: X-rays and Clinical Evaluation



Fig 11: Radiographs of Left Hand AP and Lateral views showing fracture of the first metacarpal



Fig 12: Post-operative radiographs of Left Hand AP and Lateral views showing fixation of fracture with K wires.



Fig 13: Radiographs of left-hand AP and Lateral views showing fracture of shaft of fifth metacarpal



Fig 16: showing post-operative radiographs with management by “Bouquet” technique of metacarpal fractures.



Fig 14: Fracture being treated conservatively with ulnar gutter splint.



Fig 15: Showing radiographs of left-hand involving fractures of the shaft of the fourth and fifth metacarpal with marked displacement and angulation.



Fig 17: Radiographs of right-hand AP and oblique views showing fractures of the base of the fourth and fifth metacarpals.

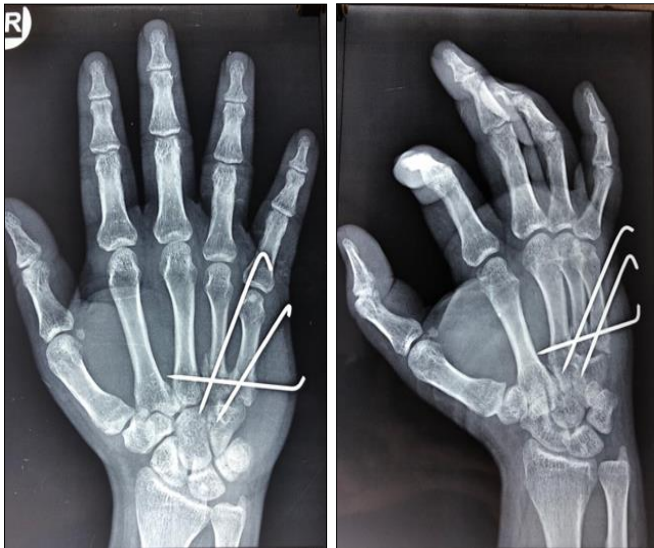


Fig 18: Radiographs of right-hand AP and oblique views showing fixation with transverse percutaneous K wires



Fig 19: Post-operative clinical photograph at 3 weeks following removal of K wires from their entry points.



Fig 20: Clinical photograph showing fingers pointing towards the region of scaphoid (above) and maximum flexion at MCP joint (below) at 3 weeks.

4. Discussion

Hand and upper extremity injuries are one of the most common injuries treated in the emergency departments. Fractures of the phalanges and metacarpals account for 10% of all fractures which comprise at least 41% of all fractures of the upper extremity. Early techniques of splint immobilization work well for simple hand fractures and can also be used for cases in which patients are hesitant to undergo operation. Accurate reduction and maintenance of fracture fragments can be controlled with good results. However, these measures fall short in more complex injuries. Conservative or operative management, whichever technique be used, principles of fracture management remain the same with the goal being to restore full hand function. As a general rule, this can be accomplished through anatomic reduction and obtaining adequate stability to allow early range of motion.

Almost 80% of patients fell in the category of 20-40 years. Higher incidence in this age group have economic impact which is directly proportional to time of immobilization. Speedy recovery and early return to work assumes paramount importance as this is most productive period/span of their lives. Higher incidence in this age group was also reported by Onselen and this study found the right side being slightly more affected as compared to the left [46]. Rapid industrialization and increased vehicular traffic have caused unfortunate incidents to occur at any given time on any given side and blunt trauma and road traffic accidents accounted for approximately 70% of the injuries. The 3rd and 5th metacarpal fractures were the most common, having an incidence of 20.6% and 32.4% respectively. The average time taken to union in the study was approximately 6.5 weeks with age being more of a factor than treatment protocol as both conservatively managed and operatively managed fractures began to show union as early as 3 weeks. 5 complications were found, with stiffness and superficial infection being the most common. Superficial infections were resolved with oral antibiotics and regular dressing within 2 weeks. Patients who presented with stiffness, which was attributed to longer immobilization and/or multiple fractures in the metacarpals, required a longer course of rigorous physiotherapy. A surprising finding was the patient's noticing the difference in aesthetics of the affected/injured hand as compared to the unaffected side. 2 patients (one conservative, one operative) noticed a dorsal prominence or "hump" and though it did not affect quality of life, it was a point to be considered as part of restoring full function to the hand as well as patient expectation.

Though all patients took both, Quick DASH and Michigan Hand Questionnaire, evaluation, they found the scales being somewhat relative and some parameters not what they really paid attention to or considered, suggesting that these could be further streamlined for more relevance and efficiency. The overall scores of both these evaluative parameters showed that patients who received either treatment protocol, conservative or operative, had good quality of life and restoration of hand function with return to being contributing members of society without any major disabilities within a short period of time.

5. Conclusion

Metacarpal fractures are extremely debilitating injuries and can cause significant impact on an individual's life and thus need to be treated with utmost care. It was Sir John Charnley who rightly said, "The reputation of a surgeon may stand as much in jeopardy from a fracture of the proximal phalanx of

the finger as from any fracture of the femur." Functional outcome is of paramount importance and restoration to maximum hand function is the primary expectation of patients. Physical therapy and mobilization are key in managing these fractures and form an integral path to recovery. Further studies are required to help establish a definitive treatment algorithm without losing sight of the quality of care provided to our patient and their long term, overall satisfaction.

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