OUTCOME OF INTERNAL FIXATION OF METACARPAL FRACTURES OF HAND AT A TERTIARY CARE HOSPITAL, KATHMANDU

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ABSTRACT

Hand fractures are different from other fractures elsewhere in the body. Functional impairment of hand leads to a prominent issue to the patient. We have a common practice of treatment of hand fractures by using kirschner wire(s). The internal fixation using plates and screws for metacarpal fractures of the hand is technically demanding but it is beneficial to the patients as it permits early mobilization and better pain relief. We studied the outcome of this type of internal fixation of the metacarpal fractures at Nepal Medical College. We included 26 patients above 18years with isolated extraarticular, closed and open Swanson I metacarpal fractures of the hand. Fractures with rotation of the digit and unacceptable angulation, shortening and unstable fractures were included. Pain was evaluated by visual analogue scale and function using American Society for Surgery of hand Total Active Flexion (ASSHTAF) score. The mean pain score (VAS) was 0.27 at 12 weeks. The ASSHTAF score showed excellent results in 92.3% patients at 12 weeks. At the final follow up 92.3% patients had excellent results, 3.8% had good and 3.8% had poor results. Fracture union was seen in all patients at final follow up. The study shows that internal fixation of unstable metacarpal fractures gives significant pain relief to the patient and an excellent functional outcome.

KEYWORDS

Functional outcome, internal fixation, metacarpal fractures

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INTRODUCTION

Hand fractures differ from fractures elsewhere in the body due to peculiar anatomy and function of the hand. Functional impairment may follow seemingly minor trauma from resultant sensory loss, motion restriction and weakness.[1] The principles of management of hand fractures include the attainment of anatomical (or near-anatomical) position, adequate stability to allow both fracture-healing and early active digital motion.[2] Fracture fixation needs to be strong enough to immobilize the fracture until the strength of the healing callus surpasses that of the fixation. Early mobilization helps to prevent adjacent tendon and joint adhesions, stiffness and achieve desired range of movement at the joint. Anatomical reduction and stable fixation help to control and minimize pain and are instrumental in permitting the early active range-of-motion exercises that are the cornerstone of rehabilitation and recovery.

Prolonged immobilization leads to joint stiffness and dystrophy of soft tissues. The potential progression towards serious functional limitation (due to pain, instability or stiffness in hand) and the resulting significant socio-economic repercussions must be at the forefront of a surgeon's mind early on during the initial care of any finger or hand trauma.[3]

Ultimate functional outcome is more important than just fracture healing.[4] The goal of treatment is to return patient's hand function to pre-injury level.[5] For many non-displaced fractures and fractures that can be stably reduced, immobilization by buddy taping, splinting, plaster casting and molded orthoplast splints (with foam and metal) are the preferred method of treatment.[6,7] But in complex injuries, it may not be suitable. Prolonged immobilization may be necessary for healing. Unfortunately, more than 3 weeks of immobilization can cause finger stiffness and tendon adhesions. While many factors outside the doctor's control, such as the amount of soft tissue and bone injury, also contribute to stiffness, every effort should be made to allow movement by 3-4 weeks after injury.[8]

Surgical options for fracture reduction include Krischner wires, intramedullary nailing, compression screws, external fixation, and plate and screw fixation. Compression screws and plate fixation techniques offer the greatest potential advantage for rigid fixation, allowing for earlier resumption of range of motion.[9] As per Dr. Alfred Swanson, "Hand fractures can be complicated by deformity from no treatment, stiffness from over treatment and both deformity and stiffness from poor treatment."

In spite of early mobilization, stiffness is the most frequently encountered complication, followed by wound infection, nonunion and reflex sympathetic dystrophy.[10] Although, today's technology (anaesthesia, antibiotics, technologically advanced implants) allows considerable freedom in treating these injuries, still a number of patients suffer a complicated course of events and experience stiffness, nonunion, malunion, and chronic pain following hand fractures.[11]

Most metacarpal fractures, in our settings are inadequately treated. It has been proven by various studies conducted in developed countries that miniplates and screw fixation offers the best functional outcome. This study was conducted to evaluate the outcome of this treatment modality in our settings, which can change our clinical practice.

MATERIALS AND METHODS

This study was a prospective observational study. It was carried out in department of Orthopedics of Nepal Medical College Teaching Hospital. The study period was from April 2017 to September 2018. Twenty-six patients presenting to the emergency and outpatient department were included in the study. Patients above 18 years of age, with isolated extraarticular fractures of metacarpals, Swanson's type I open fractures were included in the study. Fractures with rotation of the digit and unacceptable angulation, shortening and unstable fractures were included. Patients with multiple fractures, fingers with amputated digits, Swanson's type II open fractures, thumb fractures, preexisting deformities of hand and medical contraindications to surgery were excluded from this study.

All pre-operative work-up were done, written and informed consent was obtained from the patients regarding surgery and their inclusion in this study. The required information was recorded in the proforma. Patients were taken for surgery as soon as possible. Surgeries were performed in a standard manner and plates were applied on the dorsal surface of the bone.

The hand was elevated on a sling for 24–48 hours to control pain and swelling. The wound was inspected after 48 hours. The hand was mobilized actively thereafter. Post-operative check x-ray was done. Active finger movement was encouraged within the limits of pain and patient was discharged.

Follow up of the patients were done at 2 weeks, 6 weeks and 12 weeks. Stitches were removed at 2 weeks follow up. Fracture union was monitored by clinical and radiological criteria on each follow up. Absence of pain on movement of adjacent joints; and absence of tenderness over the fracture site on palpation was considered clinical criteria for union. Radiological union was considered when the fracture line was obliterated in three of the four cortices.[12,13]

Clinical progress in terms of range of movement, relief of pain (Visual Analog Scale) and complications was recorded at each outpatient visit. The final range of motion of operated finger was noted in degrees.

ASSHTAF (American Society for Surgery of Hand Total Active Flexion) score was calculated. This was done

by adding the active flexion at metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints, after subtracting the sum of extension deficit at these three joints. The normal range of digital motion is 260°.[14] The ASSHTAF score grades the results as: excellent (flexion ≥220°); good (flexion 120°–80°); poor (flexion ≤80°).

RESULTS

The mean age of our patients was 28.12 years (range 19-38 years). It was 27.4 years for males and 29.6 years for females. Forty-six of the patients (n=12) were farmers. The most common mechanism of injury was road traffic accident (42.3%), followed by physical assaults and accidents at workplace (Table-1). Twenty-two (84.6%) were closed injuries. Second and fourth metacarpals (Fig. 1) were the most commonly fractured metacarpals in our series with 34.6% (n=9) in each (Table-1). Twenty-three (88.4%) patients had fracture on the dominant side.

Table-1: Characteristics of the study population and the procedure

Particulars	Number (%)
Sex	
Male	19 (73.1)
Female	07 (26.9)
Mechanism of injury	
Road Traffic Accident	11 (42.3)
Industrial/domestic accidents	05 (19.2)
Fall from height	03 (11.5)
Sports	02 (7.7)
Physical assault	05 (19.2)
Fractured side	
Right	15 (57.7)
Left	11 (42.3)
Fractured Metacarpal	
Second	09 (34.6)
Third	04 (15.4)
Fourth	09 (34.6)
Fifth	04 (15.4)
Type of injury	
Closed	22 (84.4)
Open	04 (15.4)
Type of fracture	
Transverse	12 (46.2)
Oblique	06 (23.1)
Spiral	07 (26.9)
Comminuted	01 (3.8)
ASSHTAF score at 12 weeks	
Excellent	24 (92.3)
Good	01 (3.8)
Poor	01 (3.8)
Fracture union at 12 weeks	
United	26 (100)
Non-union	00 (0)

Morphologically, transverse fractures were most common (46.2%) followed by spiral and oblique. (Table-1). Surgical site infection was seen in 11.5% (n=3) cases. The mean pain score (VAS) was 6.12 at 2 weeks, which dropped to 2.12 at 6 weeks and 0.27 at 12 weeks. The ASSHTAF score showed excellent results in 23.1% at 2 weeks, in 73.1% at 6 weeks and in 92.3% at 12 weeks. At the final follow up 92.3% patients had excellent results, 3.8% had good and 3.8% had poor results. Fracture union was seen in all patients at final follow up (Table-1). The improvement in ASSHTAF score seen at 12 weeks in comparison to the score at 2 weeks was statistically significant ($p<0.05$) as shown by Wilcoxon Signed Ranks Test.

DISCUSSION

Most metacarpal fractures can be treated by nonoperative methods with good outcome. In the small percentage of unstable fractures, results of closed treatment are usually unsatisfactory. Indications for accurate open reduction and internal fixation in hand fractures are few, probably accounting for less than 5% of all fractures.[15] Options for fixation of metacarpal fractures include plating, lag screw fixation, percutaneous or intramedullary fixation, interosseous wiring, and external fixation.

Early mobilization is mandatory in order to prevent stiffness of capsulogenic or tendinogenic origin (caused by adhesions). Therefore, in the ideal situation, sufficient stability should be obtained for fracture healing to occur, while at the same time, a complete freedom of motion should be guaranteed for soft tissue structures in order to prevent adhesions.[16]

Open reduction and Internal fixation of metacarpal fracture with miniplates and screws is technically demanding with little margin of error, but has a role in unstable fractures. Based on the principles of AO / ASIF (association for study of internal fixation of fractures), stable fixation is possible with minimum two screws in long oblique fractures. Short oblique fractures can be fixed using 4 or 5 holed plates (mini or micro plates). Intra-articular fractures with metaphyseal extension may be fixed with condylar buttress plates.[17] This allows very early return to motion. This is of particular value when fractures are associated with tendon injuries and when fractures involve multiple fingers.[18] Furthermore, the incidence of non-union has been reported to be low with plate fixation.[19]

The demographic parameters of study population including age, sex, type of fracture and involved metacarpal were similar to other studies.[20-23] The final ASSHTAF score showed excellent outcome in 92.3%, which is slightly higher than reported by Chand *et al*[23] (81.2%) and Mumtaz *et al*[22] (73%).

In our series, 23.1% patients already had excellent outcome by 2 weeks and 73.1% by 6 weeks. This shows that more than two third of patients treated by

Fig. 1: Pre-operative and post-operative X-ray images of fracture shaft of 4th metacarpal.

open reduction and internal fixation of metacarpal fractures by miniplates can go back to their normal lifestyle even before plaster or splints were removed if treated non-operatively or with Kirschner (K) wire fixation.

With improved instrumentation and equipment, better anesthesia, better soft tissue coverage techniques and therapy, hand surgeons generally have become more aggressive in the surgical management of hand fractures; however, operative stabilization cannot always be equated with improved outcome. Apart from surgery many other factors, including patient factors (age, associated diseases, compliance), fracture factors (location, geometry, stability, soft tissue injury, and associated injuries), and management factors (diagnosis and recognition, maintenance of reduction, immobilization time, and recognition and management of complications) affect the outcome of hand fractures.[24] As noted above, most of the determinants of outcome are beyond the surgeon's control.

The incidence of surgical site infection was 11.5% in our series, which correlates with 15.4% open fractures included in the study. Complications correlate with the severity of the initial injury, with open fractures and crush injuries decreasing the potential for uneventful union.[25] If the metacarpal fracture has undergone previous surgery but resulted in nonunion, malunion, or posttraumatic arthritis, its management can be particularly challenging. These fingers are usually stiff and sometimes painful. Besides the bone injury, there are usually soft-tissue problems that complicate the reconstructive efforts.

The future of hand fracture treatment lies in improving our ability to choose and properly apply appropriate treatment for the variety of patients and fractures that present, bearing in mind that each patient's perspective of an optimal outcome is different.[11]

In conclusion, the study shows that internal fixation

of unstable metacarpal fractures gives significant pain relief to the patient and an excellent functional outcome. It provides stable fixation which permits pain free, early active range of motion of the adjacent joints. Early mobilization is important to prevent stiffness. Complications were frequent in open fractures and those presenting late. The limitation of this study was that only a few number of subjects were involved and did not have a control group. A prospective multicentric study, with a comparison group, involving large number of patients and longer duration of follow up is recommended.

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