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Surgical Outcomes after Metacarpal Shaft Fractures Management at Zagazig University Hospitals

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Metacarpal fractures are among the most prevalent injuries evaluated in the emergency setting, comprising about 30% of all hand fractures and 18% of all below-elbow fractures. Unfortunately, these fractures are often neglected or regarded as trivial injuries. Incorrect diagnosis and management of metacarpal and phalangeal fractures can have catastrophic consequences for patients, as much morbidity and disability can be prevented by establishing proper management at initial evaluation.This study is aimed to evaluate the outcome of the surgical management of metacarpal shaft fractures as regarding functional, radiological outcomes and complications. A prospective study were operated on 18 consecutive patients presented by metacarpal shaft fractures and associated 3 phalangeal fractures were managed by two methods of surgical fixation; percutaneous pinning (PCP) by different techniques and open reduction internal fixation (ORIF) using mini-plates and mini-screws. They were followed up for a mean period of 6.8±1.1 (SD) months; range (6-9) months. There is statistically insignificant difference between clinical and radiological outcome as regarding type of operation among studied patients. The percent of excellent level of TAM score in close fracture was 53.8% while none of open fracture patients had excellent level of TAM score, the difference is statistically significant $p<0.05$. The mean of DASH score in closed fracture was 2.4, while in open fracture was 15.5, the difference is statistically significant $p<0.05$ i.e. DASH score was better in closed than open fractures. Open metacarpal fractures had an unsatisfactory functional outcome. This could be attributed to the severity of soft tissue injury and increased possibility of associated injuries as cut extensor tendons compromising both wound healing and tendon gliding mechanism, thus delaying finger movement and affecting the grip strength. Prolonged postoperative immobilization should be avoided and patients must start active movement as early as possible to avoid stiffness.

Keywords: metacarpals, mini-screws, mini-plates and fractures

INTRODUCTION

The metacarpals represent the most proximal long bones of the hand, and provide a stable platform for the phalanges and palmar neurovascular structures, forming a volar concave arc along their length, with flares at the bases and the necks (Chin et al. 2008).The metacarpal base articulates with the distal carpal row. The metacarpal head is cam-shaped, and articulates with the base of the proximal phalanx as a condylar joint that permits flexion, extension, and radial and ulnar motion.Metacarpal fractures are among the most prevalent injuries evaluated in the emergency setting, comprising about 30% of all hand fractures and 18% of all below-elbow fractures (Van Onselen et al. 2003 ; Aitken et al. 2008).The majority (70%) occur within the second and third decades of life (Stanton et al.

2007).Most fractures are due to either accidental falls or direct blows to another object or individual, with small-finger neck fractures (Boxer's fractures) and ring -finger shaft fractures among the most common metacarpal fractures (Soong et al.2010). Metacarpal shaft fractures can result from axial loading, torsion, or a direct blow, and typically present as transverse, oblique or comminuted fractures. The primary goals of treatment of metacarpal fractures are to achieve acceptable alignment, stable reduction, strong bony union, and unrestricted hand motion with avoidance of hand stiffness and early return of normal daily activities (Rafael et al.2013).

Fractures that are displaced or minimally displaced, without significant angulation, rotational deformity, or shortening, can be managed conservatively with immobilization. Angulation is better tolerated among the ulnar digits than in the index or middle finger. However, the presence of pseudoclawing, rotational deformity, or significant metacarpal shortening or prominent dorsal deformity should prompt consideration of operative intervention. Although closed reduction may be attempted for displaced transverse metacarpal shaft fractures, many of these injuries will require operative fixation (Rafael et al.2013). A variety of techniques are available for fracture fixation, including pins, wiring techniques, intramedullary fixation, plate fixation, and interfragmentary compression screws. Although some fracture patterns are ideally suited to specific techniques, the choice for fixation is largely directed by fracture pattern and surgeon preference. Each surgical technique has its advantages as well as drawbacks (Blazar and Leven, 2010; Yaffe et al. 2011). However, complications may include pin-site infection, impaired healing of extensor tendon, and non-union caused by over distraction (Dailianaet al.2009). Therefore, this study is aimed to evaluate the outcome of the surgical management of metacarpal shaft fractures as regarding functional, radiological outcomes and complications.

Patients andMETHODS

A prospective study were managed and followed up at Zagazig University Hospital(ZUH) in the period from January 2019 to January 2020. The patients were informed by the surgical intervention and written consents were obtained.

A sum of 18 consecutive patients presented by a total of 29 metacarpal shaft fractures and associated 3 phalangeal fractures were managed by two methods of surgical fixation; percutaneous pinning (PCP) by different techniques and open reduction internal fixation (ORIF) using mini-plates and mini-screws. They were followed up for a mean period of 6.8±1.1(SD) months ;range (6-9) months.

The inclusion criteria was unstable metacarpal shaft 4222 ractures (irreducible fractures ,unstable fractures after closed reduction, multiple metacarpal shaft fractures, shaft fractures with significant rotational deformity, Pseudoclawing and those with significant metacarpal shortening i.e.>5 mm) , Adult Patients any gender with ages between 18 and 60 years. Poly-traumatized patients with recent Metacarpal fractures less than 10 days and both closed and open fractures with different shapes (transverse, spiral, oblique, or comminuted) either isolated or associated with other hand injuries.

Exclusion criteria was stable metacarpal shaft fractures or Patients aged below 18 and more than 60 years old, Pathological fractures(non-traumatic), Fractures more than 10 days after injury. For Diagnosis, full personal history was taken and systematic examination for other injuries and local examination of the affected hand were done.

Routine plain radiographic images include anteroposterior (AP) and oblique views of the hand and pronation oblique views and X ray images were obtained.

All patients in this study were operated within seven days from their trauma. Mean time lag between the trauma and the surgical procedure was 1.56±1.85 (range 0-7) days. This surgical operation was carried out under general anesthesia for 14 patients (77.8%) and regional anesthesia for 4 patients (22.2%) by suprascapular nerve block. Intraoperative fluoroscopy was used to confirm reduction and fixation of the fractures during surgery. Percutaneous pinning by Kirschnerwire(k-wire) by different techniques and Open reduction internal fixation (ORIF) by mini-plates and mini-screws were used to fixation of these fractures.

Statistical analysis:

Data analysis was performed using the software SPS version 20. Quantitative variables were described using their means and standard deviations. Categorical variables were described using their absolute frequencies and percentages. To compare means of two groups, Independent sample t test (for normally distributed data) was used. Pearson and Spearman correlation efficient

were used to assess correlation between two continuous or categoral variables respectively. The level statistical significance was set at 5% (P < 0.05). Highly significant difference was present if p ≤ 0.001.

RESULTSAND DISCUSSION

The attainable results showed that, there is statistically insignificant difference between clinical and radiological outcome regard type of operation among studied patients (Table 1). There is statistically insignificant difference between clinical wound pin tract" healing and socio-demographic characteristics of studied patients (Table 2). The defined percent of wound" pin tract" healing in close fracture was 76.9% , while none of open fracture well healed difference is statistically significant p<0.05. One other hand percent of wound "pin tract" healing among patients without Ipsilateral lesion was 75% while 16.7% among patients with Ipsilateral lesion with difference is statistically significant p<0.05 (Table 3). The percent of excellent level of TAM score in closed fracture was 53.8% while none of open fracture patients had excellent level of TAM score, the difference is statistically significant p<0.05 (Table 4). The mean of DASH score in closed fracture was 2.4, while in open fracture was 15.5, the difference is statistically significant p<0.05 i.e. DASH score was better in closed than open fractures (Table 5).

Fractures of metacarpals and phalanges are the most common among upper limb bony injuries and contribute to about 10% of total fractures among them. It is well recognized that both soft tissue healing with fracture healing must be kept in mind during treatment of hand and metacarpal fractures because successful outcomes require the return of functional integrity to both the tissues (Kamath et al. 2011).

In the current study, a total number of 18 patients were included. These patients presented by a sum of 29 unstable fractured metacarpals and associated 3 phalangeal fractures in 3 patients. Comparing outcomes in this study with the other literature, it was detected that hand grip of fracture side ranged from 22-30 with mean±SD of 27±2.3, wound 'pin tract "healing was good among 55.6% of studied patients. DASH score ranged between 0 to 24 with mean ±SD 6.02±7.97, in addition,38.9% of studied patients had excellent TAM score and same percent of them (38.9%) had good TAM score i.e.77.8% of all the series had satisfactory results. Only 22.2 of the patients had fair results without any of them having bad results. It was obvious that 11 patients;78.6%(of the total 14 patients operated by K-wire technique) had excellent results, while 3 patients;75%(of the total 4 patients operated by open reduction internal fixation technique) had excellent results, but these results were not statistically significant (p value>0.15).

Table 1: Comparison between clinical and radiological outcome regarding type of operation.

Items	Type operation				Test sig	p-value
	K-wire n=14		Miniplate and screw n=4			
	No	%	no	%		
Wound healing						
Good (n=10)	7	50	3	75	f	0.59
Delayed(n=8)	7	50	1	25		
Hand grip Fracture side						
Mean ± SD	27±2.4		27.5±2.1		t=0.37	0.72
Median(range)	26.5(22-30)		27.5(25-30)			
DASH Score						
Mean ± SD	6.1±7.7		5.8±10		MW =0.48	0.628
Median(range)	3.35(0-24.2)		12.5(0-20.8)			
TAM score						
Excellent(n=7)	4	28.6	3	75		
Good(n=7)	7	50	0	0.0	4.7	0.15
Fair(n=4)	3	21.4	1	25		
Bone union						
Yes(n=16)	12	85.7	4	100	f	0.99
Delayed (n=2)	2	14.3	0	0		
Time of union (week)						
Mean ± SD	5.9±3.1		4.3±0.5		MW=1.5	0.128
Median(range)	5(4-16)		4(4-5)			

MW =Mann whitnney test of significant t= student t test f=Fisher exact test p≥0.05 non-significant.

Table (2): Association between clinical wound pin tract healing and socio demographic characteristics of studied patients.

Items	Wound				Number	Test of sig	p-value
	Proper healed		Delayed healing				
Age Mean ± SD Median(range)	36.6±9.5 38.5(18-50)		33±13.1 30.5(19-52)			MW= 0.72	0.76
Sex	no	%	No	%			
Male	8	50	8	50	16	f	0.48
Female	2	100	0	0	2		
Smoking							
Smoker	4	44.4	5	55.6	9	f	0.64
Non -smoker	6	66.7	3	33.3	9		
Residence							
Rural	6	54.5	5	45.5	11	f	0.99
Urban	4	57.1	3	42.9	7		
Occupation							
Driver	1	100	0	0.0	1	χ^2 =	
Doctor	1	100	0	0.0	1		
Framer	3	75	1	25	4	7.1	0.31
House wives	2	100	0	0.0	2		
Manual worker	2	28.6	5	71.4	7		
Student	0	0.0	1	100	1		
Teacher	1	50	1	50	2		

MW =Mann whitnney test of significant t= student t test f=Fisher exact test p≥0.05 non-significant.

Table(3):Association between wound "pin-tract" healing of metacarpal fractured patients and fracture characteristic:

Items	Wound "pin tract" healing				number	Test of sig	p-value
	Proper healing		Delayed healing				
Fracture open or close							
Close	10	76.9	3	23.1	13	F	**0.007(S)**
Open	0	0	5	100	5		
Fracture side							
Right	7	58.3	5	41.7	12	F	0.99
Left	3	50	3	50	6		
Causes of fracture							
Animal	0	0	1	100	1		
Direct trauma	2	50	2	50	4	$\chi 2$ =1.6	0.65
Fall	1	50	1	50	2		
Road	7	63.6	4	36.4	11		
Type of fracture							
Comminuted	1	33.3	2	66.7	3		
Oblique	4	57.1	3	42.9	7	$\chi 2$ =0.93	0.82
Spiral	1	50	1	50	2		
Transverse	4	66.7	2	33.3	6		
Number of metacarpal bone fracture							
One	6	10	4	40	10		
Two	2	40	3	60	5	$\chi 2$ =0.72	0.69
Three	2	66.7	1	33.3	3		
Ipsilateral lesion							
Yes	1	16.7	5	83.3	6	F	**0.043(S)**
No	9	75	3	25	12		

Table (4): Association between TAM score of studied patients and fracture characteristics:

Items	TAM score							χ 2	P
	Excellent		Good		Fair				
Fracture open or closed									
Close	7	53.8	5	38.4	1	7.7	13	7.1	0.028(S)
Open	0	0.0	2	40	3	60	5		
Fracture side									
Right	5	41.7	5	41.7	2	16.6	12	0.64	0.72
Left	2	33.3	2	33.3	2	33.3	6		
Causes of fracture									
Animal	0	0.0	1	100	0	0	1		
Direct trauma	1	25	2	50	1	25	4	3.7	0.72
Fall	1	50	0	0.0	1	50	2		
Road	5	45.4	4	36.4	2	18.2	11		
Type of fracture									
Comminuted	1	33.3	0	0.0	2	66.7	3		
Oblique	3	42.8	3	42.8	1	14.4	7	5	0.54
Spiral	1	50	1	50	0	0.0	2		
Transverse	2	33.3	3	50	1	16.7	6		
Number of metacarpal bone fracture									
One	4	40	5	50	1	10	10		
Two	2	40	1	20	2	40	5	2.37	0.66
Three	1	33.3	1	33.3	1	33.3	3		

Table (5): Comparison between DASH score as regarding fracture characteristics of studied patients:

Items		DASH score	MW	p-value
	No	Mean ±SD		
Type of fracture				
Closed	13	2.4±3.4	2.89	0.004
Open	5	15.5±8.9		
Number of metacarpal bone fracture				
One	10	3.34±3.6		
Two	5	10.34±11.5	KW=0.52	0.77
Three	3	7.76±11.4		
Cause of fracture				
Road	11	5.9±8.6	KW=0.68	0.58
direct trauma	4	4.4±5.1		
Fall	2	10.4±14.7		
Animal	1	*5		
Type of fracture				
Spiral	2	12.1±17		
Transverse	6	2.5±2		
Oblique	7	5.2±7.4	KW=0.59	0.9
Comminuted	3	10.8±10.4		

These findings were similar to other authors' opinion satisfactory results were reported by Elmaraghy et al. (1998) in 76% of cases, while Eaton et al. (1984) who reported satisfactory results in 90% of cases. As well, Gingrass et al.,(1980) who stated that, 70% satisfactory results after intraosseous wire fixation.

In treatment of hand fractures with plate and screws, Kilbourne and Paul (1985) who revealed 53.3% satisfactory results. According to Rios Luna et al. (2006) who concluded that, the results were

excellent for 12 out of the 20 patients (60%). Four of them (20%) had good results, one patient (5%) had a fair result and for three (15%) the result was poor, after internal fixation with mini-set plate and screws. While Mumtaz et al.(2010) who reported that good results in 78.5% of cases, fair in 19% of cases and poor in 2.5% of cases.

As regard intramedullary nailing versus plate-screw fixation of extra-articular metacarpal fractures, KaganOzer et al. (2008) who suggested that, no significant differences in the clinical outcomes using either technique. Although operative time was shorter in the intramedullary nailing group than in the plate-screw group. Similar results were found in our study.Time of operation is an important factor in the reduction of the hand fractures, the sooner it is done after injury, the easier it will be. Beyond the first week the task becomes increasingly difficult and after the second week it may be even impossible to accurately reduce some hand fractures without doing damage to the hand (Brown,2009).

Post injury rehabilitation after metacarpal fracture is based on multiple variables including, but not limited to, the reliability of the patient, the location of the fracture, the stability of the fracture pattern, and the stability of fixation. Early motion is generally considered appropriate when there are inherently stable fracture patterns or rigid fixation, the assumption being that early motion has potential for improved outcomes (Feehan,2003 ; Praveen et al. 2017).

CONCLUSION

Open metacarpal fractures had an unsatisfactory functional outcome (none of them had excellent TAM score) unlike closed fractures, 53.8% of them had excellent TAM score and this was a statistically significant difference. This could be attributed to the severity of soft tissue injury and increased possibility of associated injuries as cut extensor tendons compromising both wound healing and tendon gliding mechanism, thus delaying finger movement and affecting the grip strength.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

All author contributed in all parts of the paper.

REFERENCES

Aitken S, Court-Brown CM: The epidemiology of sports-related fractures of the hand. Injury 2008;39(12):1377-83.

Blazar PE, Leven D: Intramedullary nail fixation for metacarpal fractures. Hand Clin 2010;26(3):321-5, v.

Brown PW. 2009.The management of phalangeal and metacarpal fractures. SurgClin North Am. 1973; 53: 1393-437.

Chin SH, Vedder NB. MOC-PSSM CME Article: metacarpal fractures. PlastReconstrSurg2008 ;121(suppl 1):1-13.

Dailiana, Z., Agorastakis, D., Varitimidis, S., Bargiotas, K., Roidis, N., &Malizos, K. N.: Use of a mini-external fixator for the treatment of hand fractures. The Journal of hand surgery2009; 34(4), 630-636.

Eaton RG, Belsky MR, Lane LB. 1984; Closed reduction and internal fixation of proximal phalangeal fractures. J Hand Surg 5A: 725-9.

Elmaraghy MW, Elmaraghy AW, Richards RS, Chinchalkar SJ, Turner R, Roth JH. 1998; Trans metacarpal intramedullary K. wire fixation of proximal phalangeal fractures. Ann PlastSurg 41(2): 125-30.

Feehan LM. Early controlled mobilization of potentially unstable extra- articular hand fractures. J Hand Ther 2003;16(2):161-70.

Gingrass RP, Fehring B, Matloub H. 1980; Intraosseous wiring of complex hand fractures. PlastReconstSurg 66: 383-94.

Kamath JB, Naik DM, Bansal A2011; Current concepts in managing fractures of metacarpal and phalanges. Indian Journal of Plastic Surgery 44(2):203-211.

Mumtaz MU, Farooq MA, Rasool AA, Kawoosa AA, Badoo AR, Dhar SA. Unstable metacarpal and phalangeal fractures: treatment by internal fixation using AO mini-fragment plates and screws. Turkish Journal of Trauma & Emergency Surgery 2010; 16(4): 334-338.

Praveen Kumar Reddy P and Dr.

VeerabhadraJavali. 2017; Metacarpal shaft fracture fixation with intramedullary k-wire: Surgical and clinical outcomes. International Journal of Orthopaedics sciences;3(2):222-225.

Rafael Diaz-Garcia, MD, Jennifer F. Waljee, MD, MS: Current management of metacarpal fractures. Hand Clin 29 (2013) 507-518.

Ríos Luna A., FahandezhSaddia H, Villanueva M. and del Cerro Gutiérrez M.. Surgical treatment of metacarpal shaft fractures. Rev OrthopTraumatol. 2006; 50: 22-9.

Soong M, Got C, Katarincic J: Ring and little finger metacarpal fractures: mechanisms, locations and radiographic parameters. J Hand Surg Am 2010;35(8):1256-9.

Stanton JS, Dias JJ, Burke FD: Fractures of the tubular bones of the hand. J Hand SurgEurVol 2007;32(6):626-36.

Van Onselen, E. B. H., Karim, R. B., Hage, J. J., &Ritt, M. J. P. F. (2003): Prevalence and distribution of hand fractures. Journal of Hand Surgery2003; 28(5), 491-495.

Yaffe MA, Saucedo JM, Kalainov DM: Non-locked and locked plating technology for hand fractures. J Hand Surg Am 2011;36(12)2052-5.