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DISPLACED METACARPAL SHAFT FRACTURES: A COMPARATIVE STUDY BETWEEN SURGICAL TREATMENT WITH MINI-PLATES AND PERCUTANEOUS K-WIRE FIXATION

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ABSTRACT

Introduction: Percutaneous intramedullary K. wires fixation and mini-plates fixation are reasonable options for treating unstable metacarpal fractures as they provide anatomical reduction and rigid fixation, which is adequate to permit early mobilization. The aim is to compare between mini-plates and Kirschner wires in management of unstable metacarpal shaft fractures in adults. **Patients and Methods:** All patients (n=36) included in this retrospective comparative study were managed and followed up at Lattakia University Hospital from January 2023 to January 2025. Thirty-six patients with fracture of shaft metacarpal were divided into 2 groups: group A (n=21) were managed by percutaneous intramedullary K-wires and group B (n=15) were managed by mini-plates. **Results:** Thirty-two patients were males and 4 were females. All patients had a complete union between 7-10 weeks for group A with average of 8.5 weeks and 6-9 weeks for group B with average of 7.7 weeks. The total result according to Quick DASH score was excellent in 12 cases, good in 6 cases, fair in 1 case and poor in 2 cases in group A, while group B was excellent in 8 cases, good in 6 cases, fair in 1 case. **Conclusion:** Both techniques are highly effective for fixation of metacarpal shaft fractures. Mini-plate fixation provides rapid recovery of hand function and K-wire fixation is cheaper and allows soft tissue preservation.

KEYWORDS: K-wire;Mini-plates;metacarpal fractures.

INTRODUCTION

Metacarpal fractures are common injuries, accounting for approximately 36% of all hand and wrist fractures, occurring at an incidence rate of 13.6 fractures per 100,000 person-years.[1-3] It has been estimated that metacarpal and phalangeal fractures contribute to approximately 40% of emergency room and urgent care facility visits.[4,5]

Metacarpal fractures may be complicated by deformity from neglection of treatment, stiffness from overtreatment, and both deformity and stiffness from mal-treatment.[6] The goals of treatment include early diagnosis, anatomical reduction correcting the rotational and deformities, preservation of soft tissue, preservation of the longitudinal and transverse arches, and maintaining length of the metacarpus because shortening of more than 3 mm will lead to an imbalance between the extrinsic and intrinsic hand muscles.[7]

Over the last 25 years, treatment of metacarpal fractures has greatly expanded.[8] It can be treated by closed reduction and splinting[9] which have the disadvantage of difficulty to preserve joint mobility to avoid stiffness,[10] Kirschner wires fixation, intraosseous wiring, and screw fixation with or without plating having the advantage of early active motion but carry the disadvantage of wide surgical exposure and soft tissue injury.[11]

The purpose of this comparative study was to assess Q.DASH score and union time to determine which fixation method (mini plates or K wires) provides a better functional outcome for the treatment of metacarpal shaft fractures.

PATIENTS AND METHODS

All patients included in this retrospective comparative study were managed and followed up at Lattakia University Hospital. All patients were selected from the orthopedic outpatient clinic of Lattakia University Hospitals, Lattakia, Syria. The protocol was discussed and approved for clinical study by the Ethical Research Committee of Lattakia University and written informed consent was obtained. All patients were evaluated over the period from January 2023 to January 2025. All patients were followed up for 6 months.

Thirty-six (n=36) patients with fracture of shaft metacarpal bone were divided into 2 groups: group A (n=21) were managed by closed reduction and percutaneous intramedullary Kwires fixation, and group B (n=15) were managed by ORIF by mini-plates and screws.

The inclusion criteria comprised adult patients (≥18 years old) with recent closed fractures of shaft of any medial four metacarpal bones (Transverse, oblique, contaminated and spiral fractures) with angulation of more than 30o or with a shorting of more than 2 mm or rotational deformity and we excluded pathological fractures fractures with bone loss, thumb metacarpal fractures, stable undisplaced fractures, old fractures and fractures with Intra-articular extension. Clinical assessment was based on the history taking in the form of the patient's name, age, gender, medical diseases, special habits of medical importance, and complaints of the patients (Pain. Swelling. Limited range of movement. Paraesthesia). The patient was fully examined systematically for any other associated injuries and locally for checking the initial deformity (angulation, rotational malformation), the rest of the hand skeleton, skin condition, the intensity of the edema and neurovascular examination. Below elbow extended slab was done for all patients.

Radiographic evaluation: Anteroposterior view, Lateral view, and Oblique view.

Statistical analysis

Data were analyzed by the Statistical Program for Social Science (SPSS) version 24. Expression of quantitative data was as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage and The following tests were done:

Independent-samples t-test of significance used when comparing two means, Mann–Whitney U test used when comparing two means (for abnormally distributed data), Chi-square test was used when comparing non-parametric data and probability (P-value): P-value < 0.05 was considered significant and P-value > 0.05 was considered insignificant.

RESULTS

Twenty-one were managed by K wire, and 15 were managed by mini-plate. Non-patients involved in the study were diabetic, hypertensive nor having other debilitating diseases. Summary of the demographic data is detailed in Table 1 and assessment was done according to Q. DASH score.

Results as regards Quick DASH Score

The Q DASH score was excellent and good for most patients in both groups (32 patients). P = 0.747. There was no significant statistical difference between the two groups regarding the index value. The Q DASH value was poor in two patients in the Kirschner group.

Results as regards union time

Although all fractures eventually healed, the plate fixation group had a shorter time for radiological union (6 – 9 weeks) when compared with the Kirschner wires group (9 – 10 weeks).

Result as regards operative time

Percutaneous K. wire fixation under fluoroscopic imaging (despite its radiological hazards) had a shorter operative duration than with ORIF by mini-plates with highly statistically significant difference (p-value < 0.001) between studied groups.

Results as regards complication

There was no statistically significant difference between studied groups as regard complications.

Table 1: Summary of Demographic Data.

		K wire group	Plate screw group
Age, years(range)		(18-67)	(18-68)
sex	Male	18	14
	Female	3	1
Shape of fracture	Transverse	17	15
	Oblique	6	1
	Contaminated	3	2
	Spiral	4	-

Table 2: Comparison between studied groups as regard Quick DASH score.

		K wire group	Plate screw group	p-value
Quick DASH score	Median	3	4	0.747 NS
	IQR	2-6	3-8	

Table 3: comparison between studied groups as regard union time.

		K wire group	Plate screw group	p-value
Union time (weeks)	Median	8.5	7.7	0.00 S
	IQR	7-10	6-9	

Table 4: comparison between studied groups as regard operative time.

		K wire group	Plate screw group	p-value
operative time(min)	Median	6.9	9.7	0.002 HS
	IQR	(45-20)	(70-40)	

Table 5: comparison between studied groups as regard complications.

		K wire group	Plate screw group	p-value
Complication	Stiffness	3	5	0.565 NS
	Soudik.syn	3	2	
	Sym. Hardware	2	1	
	malunion	2	-	

Table 6: comparison between studied groups as regard total result.

		K wire group	Plate screw group	p-value
Total results	Excellent	12	8	0.565 NS
	Good	6	6	
	Fair	1	1	
	Poor	2	-	

DISCUSSION

Metacarpal fractures are common and can be stabilized in multiple ways.[11] In treating these fractures conservatively, James and Wright reported less good results[12], while Goodman and Pfenninghaus reported 66% satisfactory results.[13]

In the present study, ORIF with mini-plates and screws of metacarpal bones had higher satisfactory results than percutaneous fixation with K. wires but without statistical significance.

It was also found that percutaneous pinning had a shorter operative time, easier operative techniques, and cosmetically better results. But it had less rigid fixation. While open reduction and internal fixation with mini-set plates and screws was a technically demanding operation, longer operative time, and a higher risk of soft tissue adhesions.

Although the time of operation was shorter in the intramedullary K wire group than in the mini-plate group, the incidences of loss of reduction, penetration of metacarpal head were much higher in the K wire group. The same results were found in our study. These clinical findings are similar to those reported by the other authors.[14,15]

In this study, transverse and spiral metacarpal fractures gave a higher proportion of excellent results than oblique fractures. These findings are similar to those reported by other authors.[16,17,18]

In the treatment of hand fractures with closed reduction and percutaneous fixation by intramedullary Kirschner wire, Elmaraghy and coworkers reported 76% of cases with satisfactory results, 19 while Eaton et al. 20reported satisfactory results in 90% of cases. Gingrass et al, reported 70% satisfactory results after intraosseous wire fixation.[21]

In the treatment of hand fractures with plate and screws, Kilbourne and Paul reported 53.3% satisfactory results,[22] Crawford reported 95.2% excellent results,[23] Segmuller and Weber reported complications in 15.1% of cases,[24] Stern et al, reported 42% complications[25] and Berman et al, reported 25% complications.[26]

Rigid internal fixation of the metacarpal fractures allowed early active hand motion. Motion after two weeks postoperatively showed a higher incidence of satisfactory results than after one month.

Diwaker and Stothard reported better results after rigid fixation of metacarpal and phalangeal fractures. 27 They concluded that this fixation allowed earlier mobilization.

CONCLUSION

Percutaneous intramedullary K. wires and open reduction and internal fixation by mini-plates and are reasonable options for treating unstable metacarpal fractures where mini-plates fixation provides a rigid internal fixation that permits an early active range of motion and early good results but Percutaneous K-wire fixation has the advantages of soft tissue preservation with short operative time and short hospital stay.

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