

Original Research Article

Circumosseous wire fixation for metacarpal fractures: an old method revisited

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ABSTRACT

Background: Different methods are in use for fixation of metacarpal fractures. Krischener wire and titanium miniplates are most commonly used methods. Both these methods require special & sophisticated instruments. In this study, we have used a dental wire in circumosseous fashion to fix the metacarpal fractures.

Methods: In the study, we included all the fracture of metacarpals with operative indication. K-wire, miniplate system and circumosseous dental wire methods were used randomly.

Results: The results were compared in term of immediate post-operative complications & functional recovery in form of ability of fist formation at 06 weeks. All the three methods were found comparable, in fact in this study the results of fractures treated with circumosseous wiring were appreciable and significantly better.

Conclusions: Circumosseous use of dental wire can be an alternate method of metacarpal fracture fixation.

Keywords: Metacarpal, Fracture, Circumosseous wiring

INTRODUCTION

Metacarpal fractures comprise around 18-44% of all hand fractures and fifth metacarpal fracture being most commonly involved.^{1,2} Metacarpal fractures may be open or closed, intra or extra-articular. Fracture lines may be oblique, transverse, spiral or comminuted.³

Minimally displaced, with no rotational deformity metacarpal fractures are generally managed conservatively.⁴ Simple fractures with significant rotational deformity or displacement are managed with various fixation methods like percutaneous K-wire fixation (longitudinal or transverse) or one of the various open fixation methods available such as plates and screws, lag screws, K-wires, interosseous or circumosseous dental wires, combination of K-wires and dental loop wires.⁴⁻¹⁴ Complex metacarpal fractures are generally

managed with external fixation or rigid internal fixation.^{15,16}

Gropper et al about 36 years ago had described a simple technique using dental wires in circumosseous fixation for spiral and oblique fractures of metacarpal shaft. This technique did not gain popularity as authors believed that bone always had to be scored to prevent wire from migrating and this weakened the already fractured bone. Secondly it was believed that fixation was not rigid.

In the present study 128 cases of metacarpal shaft fractures were treated with one of the methods K-wire fixation, plates and screws, circumosseous dental wiring. The results of all three methods were compared for fracture healing and functional outcome.

METHODS

Study design

It was a prospective cohort study from the period 2015 to 2019. In the present study a total of 128 cases of metacarpal shaft fractures were surgically treated with one of the methods 1) K-wire fixation 2) plates and screws 3) circumosseous dental wiring

Study place

It was carried at a tertiary care super speciality health care facility.

Inclusion criteria

Metacarpal fracture with rotational deformity and significant angulation of fracture fragments. (acceptable dorsal angulation was 0 degree in index and middle finger, 25 degree in ring and 30 degree in little finger.

Exclusion criteria

Metacarpal fractures which were functionally and radiologically stable.

Sample size and sampling procedure

In this study all patients presenting with metacarpal fracture with rotational deformity and significant angulation of fracture fragments satisfying our inclusion criteria from the period 2015 to 2019 were included. They were surgically treated by internal fixation by either K-wire fixation (n=37), plate and screws (n=37), or circumosseous wiring (n=54) based on purposive sampling technique.

Data collection

Demographic data and aetiology of injury, metacarpal involved, type of fracture, method used for fixation etc were recorded. Follow up done with record of pain, residual swelling and stiffness at end of 4 weeks post op and fist formation at six weeks.

Procedure

Procedure was carried out under Supraclavicular/axillary block or General anaesthesia. Perioperative prophylactic antibiotic was given to all patients as per hospital

antibiotic policy. Lazy S dorsal was over the fractured metacarpal and fracture site exposed. The periosteum was reflected, fracture reduced and then fixed either by circumosseous wiring, K-wire or screws and plates.

Standard procedure was followed in K-wire and screws and plate fixation. In the fractures fixed with circumosseous dental wiring two loops of wire were made around metacarpal so that it is secured and does not slip after twisting and tightening. After tightening the wire, ends were turned laterally and buried, so that they do not impinge on the extensor tendon. The periosteum was closed and then rest of the wound. Splint was given to keep wrist in 20-30-degree extension, leaving MCP and IP joints free for early post op mobilization. Sutures were removed on 14th day. Splint were kept for 2-3 weeks. Patient was advised not to lift weight for eight weeks.

Ethical approval was obtained from Institutional ethical committee

Statistical analysis

Data was first coded and entered into excel sheet. Double checking was done to ensure data quality. Discrete data has been presented as proportions while continuous variables (such as age) is expressed as mean±standard deviation. Statistical significance has been set at P and It; 0.05%. Appropriate graphical representation has been made.

RESULTS

Total of 128 patients were included in the study. There were 113 male and 15 female patients with age ranging from 14 years to 66 year (Table 1). Mode of injury was fall of heavy object (n=25), road traffic accident (n=64), slip and fall (n=6), sports injury (n=33) (Table 2).

Table 1: Demographic data.

Age (years)	Sex	
	Female (count)	Male (count)
10-20	0	5
21-30	8	63
31-40	2	31
41-50	2	10
51-60	1	1
61-70	1	4

Table 2: Mode of injury and type of fracture.

Mode of injury		Type of Fracture		
		Comminuted	Oblique	Transverse
Mode of injury	Fall of heavy object	9	5	11
	RTA	8	36	20
	slipped and fall	2	2	2
	Sports	0	16	17

The various types of fracture noted were comminuted (n=19), oblique (n=59) and transverse (n=50) (Table 2). Circumosseous wiring was done in 54 patients (comminuted-18, oblique-36, transverse-0), K-wire

fixation was done in 37 patients (comminuted-0, oblique 20, transverse fracture-17), screws and plating in 37 patients (comminuted-1, oblique-3, transverse-33,) (Table 3).

Table 3: Type of fracture and method of fixation.

	Type of fracture	Method of fixation			Total
		Circumosseous wire	K-wire	plating	
	Comminuted	18	0	1	19
	Oblique	36	20	3	59
	Transverse	0	17	33	50
	Total	54	37	37	128

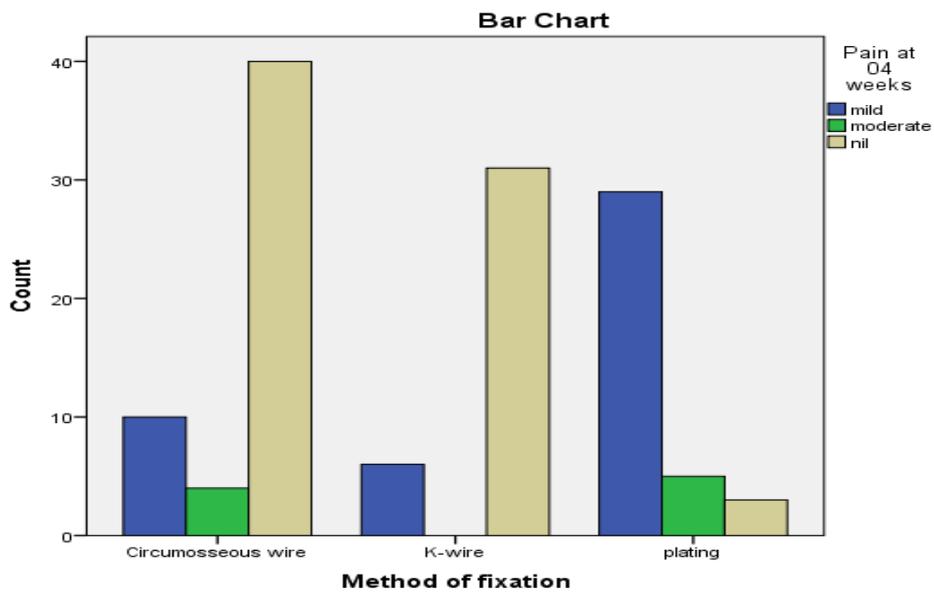


Figure 1: Method of fixation and pain at four weeks.

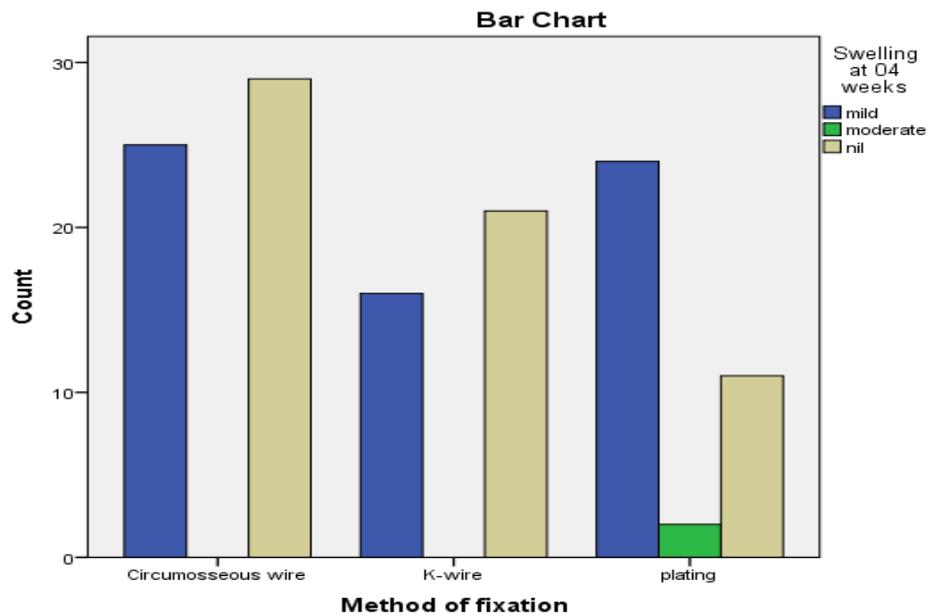


Figure 2: Method of fixation and swelling at four weeks.

There was no case of infection or nerve entrapment. No complication related to circumosseous wiring such as wire slipping or breaking, impingement on extensor tendon were noted.

Pain, swelling, stiffness at end of four weeks and fist formation at end of six weeks in various methods of fixation and their comparison are tabulated in Tables IV to VII. There was no pain in 40 cases of circumosseous wiring, 31 cases managed with K-wire fixation and 3

cases of screws and plates fixation at the end of four weeks (Figure 1). There is significant difference between the different type of fixation technique and outcome i.e pain at 4 weeks ($p < 0.000$)

There was no swelling in 29 cases of circumosseous wiring, 21 cases managed with K-wire and 11 cases managed with screws and plates fixation at end of four weeks (Figure 2). There is significant difference between the different type of fixation technique and outcome i.e swelling at 04 weeks ($p < 0.028$)

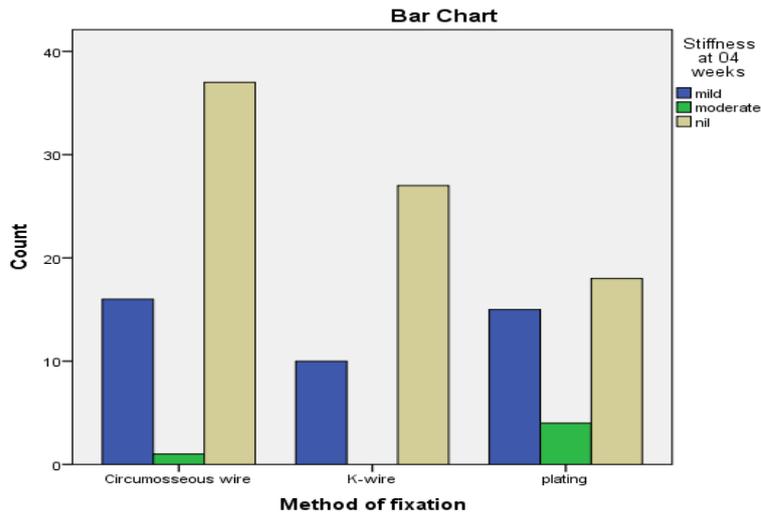


Figure 3: Method of fixation and stiffness at four at four weeks.

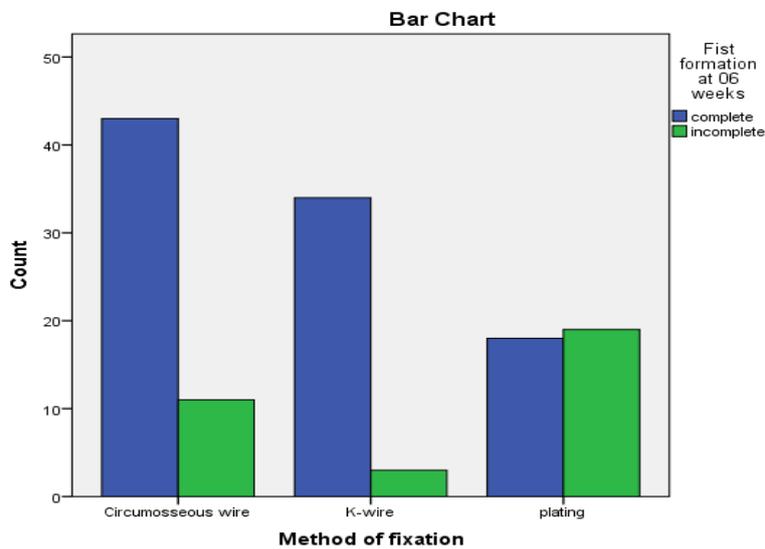


Figure 4: Method of fixation and fist formation at 06 weeks.

There was no stiffness in 37 cases managed with circumosseous wiring, 27 cases managed with with K-wire and 18 cases managed with screws and plates fixation at the end of four weeks (Figure 3). There is significant difference between the different type of fixation technique and outcome i.e stiffness at 04 weeks ($p < 0.042$). Fist formation at end of six weeks was

complete in 43cases managed with circumosseous wiring, 34 cases managed with K-wire and 18 cases managed with screws and plate (Figure 4). There is significant difference between the different type of fixation technique and outcome i.e. fist formation at 06 weeks ($p < 0.000$).

DISCUSSION

Most of the metacarpal fractures were earlier treated by simple immobilisation till Koch in 1935 explained the functional disabilities that result from immobilisation of metacarpophalangeal joints in extension.¹⁷ It was also realised that external splintage alone does not maintain the reduction satisfactorily in metacarpal fractures with significant displacement or rotational mal-alignment. Subsequently various techniques came into use. Kirschner wires were used as percutaneous longitudinal or transverse fixation intramedullary, K-wire fixation. Eventually open techniques came up providing accurate, stable and rigid fixation.¹⁸ Various implants were used which included plate and screws, intramedullary wires, clamping on screws, dental wires (as interosseous wire, cerclage, simple loops, tension band wiring. Combination of techniques.

Gropper et al 11 treated 21 spirals, long and short oblique metacarpal fractures with cerclage wires. Following open

reduction authors scored the bone with side cutting burr and then placed the cerclage wire at site of scored cortex, to prevent wire migration. The cerclage wire technique was not used much because of fear of wire migration and also the belief that this fixation was not rigid. It was also believed that scoring the already fractured metacarpal enhanced the chances of fracture on either side of the fracture site. Cerclage wires were then used in combination with unicortical interosseous loop dental wires or with K-wires by Quattan et al.¹⁹

In this study 53 patients with long oblique/spiral fracture were managed with fixation by using circumosseous wiring. The bone was not scored as done Gropper et al.¹¹ Circumosseous wiring technique was not supplemented with any other method. Double loop of the wire was made around the shaft before tightening the wire, this helped in gripping the fracture segments firmly and also prevented wire migration (Figure 5).



Figure 5 (A and B): Pre and post op X-ray oblique fracture IV metacarpal Rt fixed with circumosseous wire.

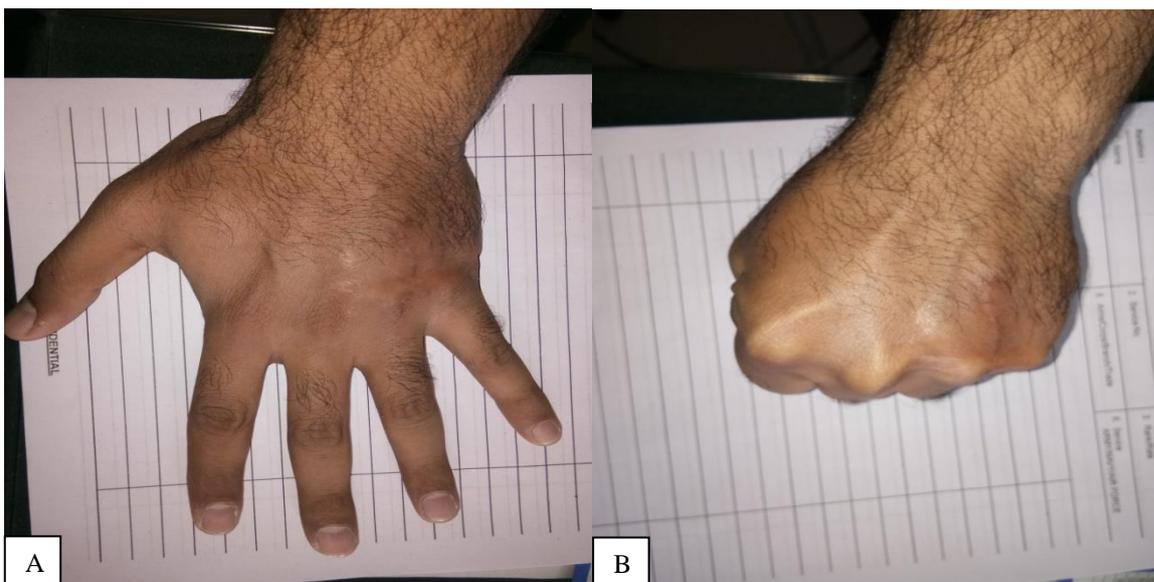


Figure 6 (A and B): Post op pic of fracture metacarpal fixed with circumosseous wire showing minimal swelling after 4 weeks and complete fist formation at 06 week.

The results of fixation by various methods (K-wire fixation, plates and screws, circumosseous wiring) in this study were compared to each other in terms of pain, swelling and stiffness at end of four weeks and fist formation at end of six weeks postoperatively. It was observed that circumosseous wiring is simple, less demanding technique which gave a satisfactory rigid fixation and its results in terms of pain, swelling, and post op hand stiffness were comparable to other standard methods, in fact in this study the results were appreciable and significantly better (Figure 6).

Limitations

The three techniques under study were done by different surgeons which may lead to bias in the study.

CONCLUSION

In metacarpal fractures requiring surgical intervention i.e open reduction and fixation the aim of treating surgeon is to have a rigid fixation, early mobilisation and minimal stiffness of hand postoperatively. Various fixation techniques are available with their advantages and disadvantages. It is treating surgeon's choice to use the best.

Circumosseous wiring technique is a simple, cheap, more forgiving and does not require implant removal later. It gives a satisfactory rigid fixation and its results are comparable to other techniques namely K-wire fixation and screw and plate fixation.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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