ORIGINAL ARTICLE

Criss-Cross Wires versus Blocking Wires in Management of Metaphyseal Fractures of the Hand (Comparative Study)

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Abstract

Background: ***Fractures of the hand are prevalent and constitute 10% of all fractures. While some authors suggest that extra-articular fractures with less than thirty percent angular displacement can be treated by splinting and closed reduction, most advocate for surgical fixation due to the risk of displacement. Various techniques, including locked plates, percutaneous K-wire fixation, and open screw fixation, have been described. The latter, introduced 50 years ago, remains popular for minimizing adhesions of the extensor apparatus. Kirschner wires have long been utilized for hand fracture fixation and are still considered one of the best methods.***

Aim of the Work: ***This investigation aims to compare the effect of two distinction techniques for fixing extra-articular hand fractures: crisscross wires with splinting and blocking wires without splinting.***

Patients and Methods: ***The study involved a comparative analysis of two groups. The first group received crisscross wire fixation with splinting, while the second group received blocking wire fixation without splinting, where the K-wires were connected outside and kept under tension to provide more stability and allow early range of movement.***

Results: ***There were no insignificant distinctions among the groups regarding gender, age, risk factors (smoking, DM, HTN), side, mechanism of trauma (RTA, FFH, twisting, direct), displacement, and time before surgery. Both groups demonstrated insignificant distinctions in anesthesia type, operative time, and time to union. However, the blocking group demonstrated a statistically significant decrease in DASH scores and a significant increase in TAM scores at 12 weeks compared to the crossing group. There was an insignificant distinction in TAM scores for the 1st MCB in 12 weeks, but a significant elevation in TAM scores without the 1st MCB was observed in the blocking group. The VAS score at 3 months postoperatively showed a slight increase in the crossing group. Additionally, grip strength measured using a sphygmomanometer at 3 months was significantly different between the groups.***

Conclusion: ***While both techniques showed significant differences in most aspects, the blocking technique demonstrated a statistically significant advantage in terms of functional recovery, as evidenced by improved DASH and TAM scores at 12 weeks.***

Keywords: Hand fractures, extra-articular fractures; Kirschner wires; crisscross wires; blocking wires; DASH score

1. Introduction

Metacarpal and phalangeal fractures are the 2nd most prevalent upper limb fractures following fractures of the distal radius, representing forty percent of all upper extremity fractures .[1]

Regarding some authors, extra-articular fractures with less than thirty percent angular displacement can be managed by reduction and splinting. Conversely, for most authors, all extra-articular fractures, even with minimal displacement, warrant surgical fixation due to the possibility of displacement .[2]

Several procedures have been described, involving locked plates [3], open screw fixation [4], and percutaneous K-wire fixation .[5] The percutaneous techniques described 50 years ago are the most widely utilized since they reduce adhesions of the extensor apparatus .[6] Kirschner wires have been utilized for hand fracture fixation for many years and are still considered one of the best methods .[7]

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Various techniques of K-wire fixation have been utilized for the operative management of hand fractures, like intramedullary K-wire, transverse K-wire, crossing wires, locked K-wire, and intra-osseous wiring .[8]

Closed percutaneous wire fixation of hand fractures frequently necessitates protection with external splintage. This splinting elevates the possibility of prolonged recovery time and joint stiffness, and increases therapy input .[9]

In our comparative study, we use fixation of extra-articular hand fractures by two different techniques. The first one is using crisscross wires with splinting, and the second one is using blocking wires without splinting, where the K-wires are connected to each other outside and kept under tension, which will give more stability and an early range of movement to avoid stiffness.

Study aimed to evaluate the radiological, functional, and clinical outcomes of both crisscross wires with splinting and blocking wires without splinting in the surgical fixation of extra-articular metaphyseal fractures of the hand.

2. Patients and methods

All cases participating in this prospective comparative randomized investigation have been treated and monitored at the orthopedic emergency and outpatient clinic for hand, tumor, and microsurgery at Al-Azhar University Hospitals, Cairo, Egypt. The Ethical Research Committee of Al-Azhar University discussed and approved the protocol for clinical investigation, and written informed consent has been obtained. All cases were advised of their pathology, the recommended treatment based on their diagnosis, and the potential risks.

All patients have been assessed over the period from December 2023 to June 2024 and were monitored for a minimum period of twelve weeks; the maximum period of follow-up was twenty-four weeks, with an average period of sixteen weeks.

Forty (n=40) patients with different extra-articular metaphyseal fractures of the hand have been classified into two groups: the 1st group (group A) (n=20) was treated with crisscrossing wires with splinting, and the 2nd group (group B) (n=20) were treated with blocking wires.

Sex: There was no distinction among both groups regarding gender, with 14 (70.0%) men and 6 (30.0%) women in the blocking group and 14 (70.0 percent) men and 6 (30.0 percent) women in the crossing group.

Age: The age of both groups varied from 19 to 58 years, with a mean of 36.40 ± 13.36 years in the blocking group and a mean of 38.60 ± 11.61 years in the crossing group.

Mode of trauma (MOT): Direct trauma was the most common cause of trauma. It represents half of the cases, while the rest of the cases were due to route traffic accidents, falling from high, or twisting trauma.

Selection criteria

Inclusion criteria: both mature sex >17 years old, isolated closed fractures, open fracture Gustilo (I) and (II), moderate to severe deformity, unstable fractures, and failed non-operative treatment.

Exclusion criteria: intra-articular fractures, cases delayed more than two weeks, comminuted fractures with more than three fragments, pathological fractures, patients presenting with neurovascular injury, and multiple injuries.

Diagnosis:

History taking: In the form of the case's name, gender, hand dominance, age, medical disorders, and special habits of medical importance, such as smoking and drug abuse. As well as the history of the trauma in the form of the mode of trauma, the time passed since the trauma was documented, and hand function after trauma.

Clinical Examination:

General examination: The case was fully examined systematically for any other related injuries.

Local examination: Checking the initial deformity (rotational malformation, angulation, and translation), the rest of the skin condition, the hand skeleton, the intensity of the edema all over the hand, and associated motor incompetence, sensory deficit, or vascular insufficiency was thoroughly examined and documented in the affected hand.

Radiographic evaluation: Standard anteroposterior (AP), oblique, and lateral X-rays were done. An X-ray was done to assess displacement, shortening, angulation, and rotation.

Investigations:

Laboratory data: Complete blood count (CBC), prothrombin concentration (PC), INR, prothrombin time (PT), kidney function tests, and liver function tests were done for all patients preoperatively.

Management

Preoperative evaluation: Written informed consent, including operative details and complications, was obtained from all patients.

Intraoperative management:

Position: All cases have been treated while lying in a supine position with the injured upper limb located on a radiolucent table positioned perpendicular to the case's body.

Anesthesia: The operation was carried out on all patients under brachial plexus block, ring block, or general anesthesia. Prophylactic intravenous antibiotics (amoxicillin/sulbactam 150 mg/kg) were given preoperatively at the induction of anesthesia.

Preparation: Both dorsal and ventral sides of the forearm and hand will be cleaned by antiseptic solutions, a sterile drape sheet will be located on the side table or the fluoroscopic device, and a mixture of sterile towels and sheets will be performed, leaving only the hand and distal forearm exposed.

Intraoperative fluoroscopy: Intraoperative imaging was a prerequisite and has been utilized for all cases throughout the procedure.

Operation time: The Operation time was approximately twenty to thirty minutes.

Operative details

Group 1 (Crisscross wires with splinting):

Surgical technique: Longitudinal traction will be placed on the affected finger, and reduction by clamp will be obtained and confirmed by fluoroscopy; then a skin incision of 0.5 centimeter is made at the site of K-wire insertion, and then dissection is done till reaching the bone.

Two K-wires will be placed, one from the radial side and the other from the ulnar side of the base or the head of the metaphyseal fragment, according to the fracture site. After the first wire location is thought to be satisfactory, the fracture will be diminished, and the wire will be drilled into the intramedullary canal of the distal fragment to find purchase in the corresponding cortex; then the second wire is placed in a crossing manner with the first wire, thereby obtaining biocritical fixation. A final check of the fracture reduction and location of the K-wire in both anteroposterior, oblique, and lateral views was done. The Kirschner wires will be bent and left outside the skin. Cases will be immobilized in a splint in the functional position.

Blocking wires without splinting:

Surgical technique:

Step 1: Longitudinal traction and closed reduction are obtained for the affected finger and then confirmed by fluoroscopy. Two K-wires are placed against the displacement pattern on the same side, the ulnar or radial side.

Step 2: The first K-wire is placed at the small metaphyseal fragment, which is fixed, while the second wire is located at the other fragment of the fracture in a crossing manner, which is malleable.

Step 3: The two K wires are bent away 0.5 cm from the skin toward each other, and then the free end of the first wire is bent in a sling shape, which is fixed, and then the K wire of the displaced segment will be bound over the 1st K wire so that the second wire is malleable and maintains reduction.

Step 4: Dressing well is placed, and mobilization is immediately smooth.

Postoperative measures and follow-up:

Group A was secured within a precisely contoured dorsal short arm splint in the intrinsic plus position, which preserved the wrist in an extension of roughly thirty degrees, the metacarpophalangeal joint flexed at roughly seventy degrees, and the interphalangeal joints fully extended.

The splint was removed three weeks post-surgery, after which patients were permitted to perform daily activities as tolerated. All cases had early physical therapy following the removal of the splint. All cases have been instructed to refrain from physical activity for two months following surgery.

Group B: were kept without a splint to start movement immediately postoperative to avoid stiffness; dressing is placed at the K-wire exit in blocking wire cases with betadine every 3 days.

Discharge the patient the next day and take the analgesic. Antiedematous and prophylactic intravenous antibiotic (amoxicillin/sulbactam 150 mg/kg) for 5 days, then continue with oral antibiotics.

The case has been studied in one week, then at 2-, 4-, and 6-weeks intervals with radiographic assessment for 2nd displacement.

Removal of the K wires: K wires have been removed in the clinic from (6-8) weeks in metacarpal fracture and (4-5) weeks in phalangeal fracture postoperatively, and force grip has been allowed at eight weeks.

Clinical evaluation: pain, deformity, and swelling, range of motion, grip assessment, and complications.

Pain evaluation: Pain is evaluated regarding the fracture site, pain tract infection, and loosening of K-wires. The subjective assessment involved documenting pain utilizing a visual analogue scale.

Visual analogue scale (VAS): It is a clinical evaluation for the intensity of the residual pain, where 0 signifies no pain and 10 signifies maximum imaginable pain.

Deformity and swelling: Any apparent deformity, such as rotation or angulation, should be evaluated clinically and radiologically.

ROM: The range of motion of PIP, MCP, and DIP joints will be assessed with a standard hand goniometer for both hands, and the amount of loss has been measured in degrees.

Radiological evaluation: At three weeks, six weeks, and three months postoperative, plain

radiographs included: anteroposterior (AP) view, oblique and lateral views, follow up with x-ray to assess: Type of union (primary or secondary), time of union regarding sex, age, type of fracture, screw length & number of fractures, type of healing regarding age, sex, type of fracture, screw length & number of fractures, number of fractures and healing process, and uprising complications identification and management.

Radiographic evidence of nonunion is typically inadequate, as fractured lines could persist on radiographs for up to fourteen months' post-fracture. Clinical evidence of pain is unreliable, as numerous fractures are linked to nerve injury and stiffness, which may lead to pain. A combination of clinical and radiological signs is the most effective method for diagnosing nonunion.

Delayed union is usually considered when there is no evidence of bony union at 3-6 months postoperatively.

Functional evaluation:

Quick DASH score: It is the debilities of the shoulder, arm, and hand. A score is a questionnaire that asks about symptoms as well as the ability to perform certain activities. Increasing the score means that the disability increases.

It consists of eleven items, each graded from one to five, and it gives a score of 100. The higher the score, the greater the disability.

The grip strength of the hand: The grip strength of the hand has been measured three months after surgery with a comparison with the other normal side by sphygmomanometer. Testing grip strength, we pump a blood pressure cuff to twenty mmHg and request the case to squeeze it together as tightly as possible. Cases with natural hand function should attain a value of two hundred mmHg or more in comparison to the normal hand.

3. Results

Table 1. Showing time before surgery of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
TIME BEFORE SURGERY (HOURS)	Min. – Max.	6.00 – 144.0	6.00 – 192.0	186.50	0.718
	Mean ± SD.	42.00 ± 41.20	43.80 ± 54.34		
	Median (IQR)	24.00 (12.0 – 72.0)	12.00 (12.0 – 72.0)		

Table 2. Showing operative time of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	T	P VALUE
OPERATIVE TIME	Min. – Max.	20.0 – 31.0	19.0 – 33.0	0.151	0.881
	Mean ± SD.	27.65 ± 2.68	27.80 ± 3.53		
	Median (IQR)	28.50 (25.50 – 30.0)	29.0 (26.50 – 30.0)		

Table 3. Showing time to union of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
TIME TO UNION (WEEKS)	Min. – Max.	6.00 – 8.50	6.00 – 9.00	180.0	0.602
	Mean ± SD.	7.20 ± 1.03	7.40 ± 0.99		
	Median (IQR)	7.50 (6.0 – 8.0)	7.75 (6.50 – 8.0)		

Table 4. Showing Dash score at 3 months of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
Q DASH SCORE AFTER 3 MONTHS	Min. – Max.	5.00 – 10.00	6.00 – 12.00	28.500*	<0.001*
	Mean ± SD.	5.93 ± 1.12	8.10 ± 1.44		
	Median (IQR)	5.75 (5.50 – 6.0)	8.00 (7.0 – 8.0)		

Table 5. Showing TAM at 12 weeks of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
TAM 12 WEEKS	Min. – Max.	130.0 – 260.0	125.0 – 250.0	37.50*	<0.001*
	Mean ± SD.	245.05 ± 38.64	220.50 ± 33.12		
	Median (IQR)	259.50()	230.0 (222.50 – 235.5)		

Table 6. Showing TAM at 12 weeks for 1st MCB of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
TAM 12 WEEKS FOR 1ST MCB	Mean ± SD.	132.50 ± 3.54	127.50 ± 3.54	0.500	0.333
	Median (Min. – Max)	132.50 (130.0 – 135.0)	127.50 (125.0 – 130.0)		

Table 7. Showing TAM at 12 weeks (without 1st MCB) of the examined groups

		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
TAM 12 WEEKS	Mean ± SD.	257.56 ± 3.45	230.83 ± 9.72	1.000*	<0.001*
	Median (Min. – Max)	260.0 (250.0 – 260.0)	230.0 (210.0 – 250.0)		

Table 8. Showing VAS score of the studied groups at 12weeks.

VAS		BLOCKING (N = 20)	CROSSING (N = 20)	U	P VALUE
PRE	Min. – Max.	5.0 – 9.0	6.0 – 9.0	135.0	0.081
	Mean ± SD.	7.60 ± 1.43	8.30 ± 0.98		
	Median (IQR)	8.0 (7.50 – 8.50)	9.0 (8.0 – 9.0)		
POST	Min. – Max.	4.0 – 6.0	4.0 – 7.0	150.0	0.183
	Mean ± SD.	5.30 ± 0.66	5.80 ± 1.11		
	Median (IQR)	5.0 (5.0 – 6.0)	5.50 (5.0 – 7.0)		
3 MONTHS	Min. – Max.	0.0 – 1.0	0.0 – 1.0	120.0	0.03
	Mean ± SD.	0.05 ± 0.22	0.45 ± 0.51		
	Median (IQR)	0.0 (0.0 – 0.0)	0.0 (0.0 – 1)		

Table 9. Showing hand Grib strength by sphygmomanometer after 3 months of the studied groups

		BLOCKING (N = 20)	CROSSING (N = 20)	T	P VALUE
GRIB STRENGTH	Min. – Max.	83.0 – 98.0	80.0 – 95.0	119	0.028
	Mean ± SD.	90.35 ± 4.39	87.25 ± 5.45		
	Median (IQR)	90.0 (88.0 – 93.0)	85.0 (80.0 – 92.0)		

Table 100. Showing comparative analysis among the two examined groups according to complication

	BLOCKING (N = 20)		CROSSING (N = 20)		χ^2	FEP
	No.	%	No.	%		
PAIN TRACT INFECTION	2	10.0	2	10.0	0.0	1.000
STIFFNESS	0	0.0	2	10.0	2.105	0.487
NEUROLOGICAL (NUMBNESS)	1	5.0	2	10.0	0.360	1.000

Case presentation

Case 1

History: A forty-year-old male patient worker presented with pain, swelling, and limitation of movement of the thumb after twisting trauma.

Radiology: Anteroposterior and lateral views of the thumb were done, showing the first metacarpal fracture base.

Treatment: Closed reduction has been done, and fixation with blocking wires without a splint to start early range of motion.

Follow up: The patient was followed up for 3 months; the case started early range of motion with satisfied range at the 3rd week, bone healing occurred at the 8th week and K-wires have been removed, and in the 12th week the case had full range of motion with TAM 145, hand grip 90%, and DASH score 8.

Preoperative x ray:

Figure 1. Plain x ray thumb (ap, lateral) show base of thumb fracture

after operative x ray

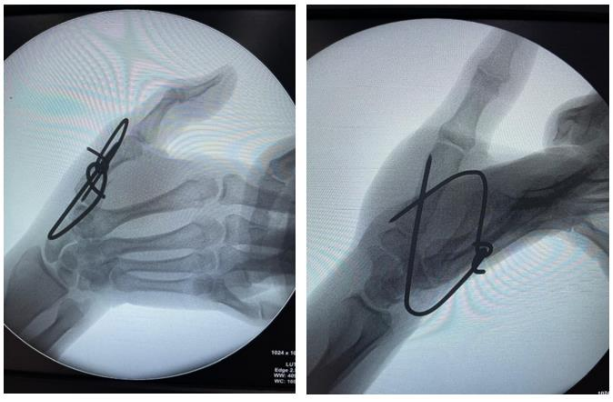

Figure 2. After operative x ray thumb (ap, lateral) show base of thumb fracture

Case 2

History: A 31-year-old male case presented with pain and swelling at the middle phalanx of the little finger after a road traffic accident. Imaging: Anteroposterior and lateral view X-ray was done and revealed a middle phalanx fracture. Treatment: Closed reduction was done, and fixation by two K wires in a crossing manner, then splitting.

Follow up: The patient followed up 3 months, splint was removed the 3th week and the patient started partial range of motion, healing was at the 5th week and k wire removal was done, the patient started physiotherapy with satisfied range of motion at the 10th week with some residual pain and at the 12th week the patient had good range of motion with TAM score 155 DASH score10 Hand grip 87%.

Pre-operative x-ray

Figure 3. Plain x ray hand (ap, oblique) showing middle phalanx
fracture of little finger

Post-operative c arm:

Figure 4. Postoperative x ray hand (ap, oblique) showing middle phalanx fracture
of little finger fixed by crossing wires

4. Discussion

One of the most frequent injuries treated in emergency rooms is hand and upper extremity injury. Ten percent of fractures are in the phalanges and metacarpals.[10]

The management of extra-articular fractures of the hand is complex and involves substantial hazards. The improvement of fibroplasia, scar tissue, and the probability of stiffness remain persistent challenges to the appropriate surgical management of hand fractures.[11]

Some examples of fixation procedures are K-wires (whether transverse, transfixing, intramedullary, or crisscross), external fixators, cerclage wires, tension band wires, mini plates and screws, lag screws, and intramedullary nail.[12]

Minimally invasive procedures using closed reduction and internal fixation (CRIF) with Kirschner wires for displaced simple extra-articular fractures are significantly less traumatic than open surgical methods. Wire fixation could reduce the possibility of fragment devascularization, periosteal injury, enlargement

of the injury area, and the development of adherent scar tissue.[11]

Transverse and short oblique fractures of the metacarpals and phalanges may be splinted using single or multiple intramedullary wires.[11]

In our study, we compare blocking without splint vs. crossing with splint techniques of percutaneous insertion of K wires, as there are no previous investigations that compare the results of this procedure.

Our blocking. A further modification of the procedure that includes transverse K-wire fixation for the treatment of extra-articular metaphyseal fractures in the hand. The highlights of our technique are that we use two K wires to prevent against displacement and the direction of force. The K-wires have been bent toward each other, and the wires have subsequently been connected. In a manner comparable to an external fixator, this straightforward operation allows the K-wires to establish a stable frame structure by crossing. A stable rectangular frame is established without the utilization of a splint, thereby facilitating early mobilization.

It was a prospective, simple, randomized comparative study that included 40 patients who were randomly allocated into two equal groups to assess the clinical, functional, and radiological outcomes of both crisscross wires with splinting and blocking wires without splinting in the surgical fixation of extra-articular metaphyseal hand fractures.

In the present study, it was found that there were no significant differences between the two groups regarding gender, age, and risk factors (smoking, DM, and HTN), with an age ranging from 19.0 to 56.0 with a median of 32.50 in blocking and ranging from 19.0 to 58.0 in crossing with a median of 38.50.

Direct trauma was the most common cause of trauma in both groups. It represents 45% in blocking and 60% in crossing, while the remaining cases were due to route traffic accidents, falling from high, or twisting trauma.

De Jonge, J., et al. Men aged ten to twenty-nine showed the maximum frequency rate (2.5%) in a previous investigation on the cause of metacarpal fractures in the Netherlands, with an overall male/female ratio of 1.8. This investigation included a retrospective evaluation of 235,427 emergency department visits over a 23-year period, of which 3,858 were for metacarpal fractures. They observed that the most prevalent mechanism of injury for cases aged 50 was an accidental fall, while transportation mode (moped and bicycle) was a significant risk factor for all ages.[13]

Bao et al. performed a retrospective evaluation of hospital records for cases that received medical treatment for fourth and fifth carpometacarpal fracture-dislocations. The investigation involved eighty-six cases that had undergone open reduction with either plate or K-wire fixation. The findings indicated that 80 of the 86 cases were male, with a mean age of 30.2 years (range: 20–49 years). There was no significant difference between either group regarding gender or age .[14]

In our study, no significant distinction has been detected among both groups according to operative time, with a mean of 27.65 ± 2.68 min in the blocking group and a mean of 27.80 ± 3.53 min in the crossing group. In addition, both techniques have no significant difference regarding time to achieve union, with the range from 6 to 8.50 weeks in blocking and the range from 6 to 9 weeks in crossing.

Elsaeed et al. revealed that in the study, the mean time of surgery was lower in the K-wire group than in the plate group. Regarding the time to union, both groups were equal. For example, in the group of cases receiving crossing K-wire fixation for phalangeal fractures, 15 out of 20 patients achieved union in 6 weeks, while the remaining 5 cases needed 12 weeks.[15]

De Spirito et al. found that out of 53 cases, 61.1% had all their fractures healed with locked K-Wire fixation after 5 weeks, and 38.9% did so in 8.5 weeks. We could not find any reported cases of nonunion or delayed healing.[9]

In our study, the Quick DASH Score in 3 months of all studied patients in the blocking group ranged from 5 to 10 with a mean of 5.93 ± 1.12, with excellent results, while in the crossing group, it ranged from 6 to 12 with a mean of 8.10 ± 1.44.

Elsaeed et al. mentioned that the mean Quick-DASH score was 6.3, ranging from 2 to 12 in crossing wire and 6.2 (2 to 9) in plate fixation.[15]

Shemes et al. mentioned that in the fixation of the first metacarpal fracture base by the percutaneous locked K-wire technique without splint, the mean Quick DASH score was 6.9, and there was no second displacement.[16]

In the present study, the TAM score in all cases, including the first metacarpal at 12 weeks in the blocking group, ranged from 130 to 260 weeks with a mean of 245.05 ± 38.64, and that was a statistically significant increase compared to crossing, which ranged from 125 to 250 weeks with a mean of 220.50 ± 33.12 regarding TAM ($P < 0.001$). Additionally, regarding TAM 12 weeks without 1st MCB, there was a statistically significant elevation in the blocking group with a mean of 257.56 ± 3.45 weeks in contrast to the crossing group with a mean of 230.83 ± 9.72 weeks ($P < 0.001$).

Strickland et al. stated that TAM may be

reduced by immobilization for a period exceeding two weeks.[17] Lister et al. demonstrated that a TAM of 157° was achieved through K-wire fixation with immobilization for a period of three weeks. In another investigation, he recommended K-wire fixation for phalangeal fractures, which caused a TAM of 199° in his group. Belsky et al. reported sixty-nine percent exceptional, twenty-nine percent good, and ten percent poor outcomes, as per the report of a distinct technique that involved closed reduction, intramedullary fixation, and three weeks of immobilization in their investigation. TAM.[18]

Despirito et al. recorded that a full range of motion has been restored in 32.1 percent of cases within thirty-five days and in an additional 58.9 percent within sixty days. Joint stiffness has been documented in five cases (8.9 percent) during a sixty-day period, necessitating a targeted rehabilitation program. He also noted a more rapid functional recovery in cases with locked wires compared to previous experiences with free K-wire pinning, accompanied by postoperative hand immobilization. In most cases, where patients are capable of using their hands for minor tasks from an early stage, this approach to therapy is comfortable.[9]

Alseed et al. said that using percutaneous K-wires with a splint, a TAM of more than 215 was attained in just 61 percent of cases. Similarly, Pun et al. stated a TAM of higher than 210 in 60 percent of cases.[15]

Wang et al., in contrast to the fracture of the thumb alone, found that all 20 patients who received the modified locked wire without a splint were able to return to their prior employment, past activities, or interests. After one year, they have been pleased with the range of motion, strength, and symptoms of their hand. Whereas two of the ten cases that had standard fixation with K wire and splint experienced joint stiffness, preventing them from following their previous activities.[19]

Freeland et al. reported that, as a result, we feel that treatment for cases with phalangeal fractures repaired with Kirschner wires must concentrate on restoring a minimum of fifty degrees of proximal interphalangeal joint motion with as much extension as possible within these constraints through the 1st four weeks following surgery. We reported that this restriction in movement can be compared to safety in avoiding wire and fracture displacement, whereas increasing the possibility of stiffness and adhesions.[11]

Wang et al. stated that the good clinical results in the modified technique group may be connected to our change of the surgical approach by bending the K-wires and the interlocking fixation, which strengthened the stability. Thus, postoperative plaster fixation could be largely avoided (the rate of plaster use in our modified technique group was 2/20 (10%), compared with 12/25 (48%) in the report by Greeven et al.).[20]

The present study measured grip strength using a hand grip sphygmomanometer after 3 months, and it was significantly different between the two groups, ranging from 83 to 98 with a mean of 90 in the blocking group and varying from 80 to 95 with a mean of 87.

Adi et al. said that the grip strength was reported to be 91.2 percent by hand grip dynamometer in cases of first metacarpal base fractures utilizing locked K-wires fixation.[6]

Oraby et al. revealed that the average grip strength for the NLD group was 89 percent of the contralateral side (range 62 percent to 102 percent), while for the LD group it was 86 percent (range 66 percent to 114 percent). This information was found in The Treatment of Unstable Metacarpal and Phalangeal Shaft Fractures with Flexible Nonlocking and Locking Intramedullary Nails.[21]

Alashhab et al. revealed that the grip strength of the studied cases ranged from 75 to 96 percent. We used a manual dynamometer for measurement, and the percentage was measured compared to the normal hand, and the grip strength was assessed at the second and 3rd months following fixation .[12]

The present study shows a highly statistically significant (p value < 0.001) reduction in VAS 3 months after surgery (0.32 ± 0.47) when compared with postoperative VAS (4.8 ± 0.92) and preoperative VAS (8.3 ± 0.56). In addition, the VAS is slightly reduced in the blocking group than in the crossing group without a significant difference.

M. Schädel-Höpfner et al. showed in his study of antegrade intramedullary splinting or percutaneous retrograde crossed pinning for displaced neck fractures of the fifth metacarpal that a visual analogue scale (0–100) pain has been rated significantly lower (P = 0.026) in group A with antegrade splinting (range 0–30) than in group B with retrograde crossed pinning (range 0–43).[22]

In our study, two cases (10%) of the twenty cases in the crossing group had partial stiffness of the affected finger and residual pain. It was because of personal factors, as cases didn't start physiotherapy early; after one to two months of physiotherapy, the cases slightly improved. Two cases (5%) of the twenty cases in the crossing group and two cases in the blocking group had pin tract superficial infections that responded favorably to oral antibiotics for a period of one

week. Cases neglected the local cleansing of K wires because of personal factors.

Mahmoud et al. stated that three incidences of infection (an infection rate of 6.6%) were found in a comparative investigation comparing intramedullary K wires to screws and mini plates in the fixation of metacarpal shaft fractures. Two of the cases were minor pin tract infections that have been treated with antibiotics. Prophylactic wide-spectrum antibiotics and meticulous surgical techniques appeared to be the most crucial factors in preventing infection.[23]

Eberlin et al. discovered that two individuals with periarticular pinning of the base, closed reduction, and proximal phalanx shaft fractures experienced pin site infections, which were effectively resolved by oral antibiotic therapy. After the pins were removed, one of these two patients experienced a loss of fracture reduction. His result was reasonable despite this fall in value.[24]

4. Conclusion

While the blocking and crossing techniques were significantly different in most aspects, the blocking technique demonstrated a statistically significant advantage in terms of functional recovery, as evidenced by improved DASH and TAM scores at 12 weeks.

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