Functional Outcome after Surgical Fixation of Metacarpal and Phalangeal Fractures using K Wire

Alaa A. Dawood, FICMS

Orthopedic Department, Basrah University Hospital

الخلاصة :

كسور العظام السلاميات ومشط اليد من الكسور الشائعة , اغلب هذه الكسور ثابتة ويمكن ان تعالج بدون تداخل جراحي. لكن الكسور الغير ثابتة او بمعنى اخر الكسور التي تحتوي قصراو كسور مزاحة او كسور متزاوية او كسور ملتوية اوتحتوي على فقدان عظمي تحتاج الى تداخل جراحي لتثبيت هذه الكسور.أجريت دراسة أحتمالية لتقييم النتائج الوظيفية لتثبيت هذة الكسور جراحيا بواسطة سلك كريشنر باستخدام تقنيات مختلفة.

المرضى والطرق :

ما بين كانون الاول 2010 و تشرين الثاني 2012 دراسة احتماليه اجريت على سبعه عشر مريض لديهم 21 كسر غير مستقر في عظام سلاميات ومشط اليد والتي تم علاجها بواسطة التداخل الجراحي بأستخدام سلك كيرشنر بتقنيات مختلفة. استبعدت من هذه الدراسة كسور السلاميات الطرفية وكسور الابهام .

فترة متابعة المرضى مدة 3 اشهر كحد ادنى للمتابعة . وتم تقييم جميع المرضى سريرياً وشعاعيا لتقييم النتائج, وقد قيمت النتائج النهائية حسب معايير بليسكي .

النتائج :

جميع الكسور التحمت بصورة جيدة وبمعدل 8.5 اسابيع, لم تحدث مضاعفات مثل الالتهابات,تأخير التحام, عدم التحام الكسر,و لكن تيبس المفصل حدث في 4(19%) من الكسور المثبتة و التحام مشوه في 2 (10%) من الكسور المثبتة

النتائج المصنفة حسب معايير بليسكي من ممتاز الى جيد كانت 17 (81%) من الكسور المثبتة والنتائج المصنفة من متوسط الى ضعيف كانت 4 (19%) الكسور المثبتة.اظهر تثبيت كسور الامشاط نتائج وظيفية أفضل حيث كانت النتائج من ممتاز الى جيد في(85%) من الحالات مقارنة مع نتائج تثبيت كسور السلاميات حيث كانت جيدة في (75%) من الحالات.وكذلك اظهرت النتائج الوظيفية لتثبيت الكسورالبسيطة نسبة ممتاز في(93%) من الحالات مقابل جيد في (50%) من حالات تثبيت الكسور المركبة.

الاستنتاج :

التثبيت بواسطة سلك كيرشنر هي طريقة سليمة في تثبيت الكسور الغير مستقرة لأمشاط الكف و السلاميات والتي بامكانها ان تعطي نتائج جيدة بالنسبة الى التحام الكسر والنتيجة الوظيفية مع نسبة مضاعفات منخفضة . وكانت النتائج الوظيفية في حالات تثبيت كسور الامشاط و الكسور البسيطة افضل من مثيلاتها لكسور السلاميات و الكسور المركبة .

Abstract:

Background:
Metacarpal and phalangeal fractures are commonly encountered fractures, majority of them are stable and can be treated by non-operative means, however, unstable fractures i.e. those with shortening, displacement, angulation, rotational deformity or segmental fractures need surgical intervention. This prospective study was undertaken to evaluate the functional outcome after surgical stabilization of these fractures by K-wire using different techniques.

Materials and Methods:
A prospective study was conducted between December 2010 and October 2012. Seventeen patients with 21 unstable metacarpal and phalangeal fractures were treated by surgical stabilization using K-wire with different techniques. Fractures of the thumb and distal phalanx were excluded. All the patients were followed up for a minimum of three months. They were assessed radiologically and clinically. The evaluation of the functional outcome was measured according to Belsky's criteria.

Results:
All fractures achieved union with a mean of 8.5 weeks, no delayed union or nonunion or infection was reported, but stiffness has happened in 4(19%) fractures and mal-union in 2(10%) cases. Overall functional results were excellent to good in 17(81%) of cases and fair to poor in 4(19%) of cases .A better functional outcome was achieved in metacarpal fractures with excellent - good in (85%) as compared with phalangeal fractures with good results in (75%), Closed fractures (93%) excellent - good as compared to compound fractures with (50%) good results

Conclusion:
K-wire is a sound method of fixation for unstable metacarpal and phalangeal fractures that could give good results, regarding fracture union, functional outcome, with low complication rate. Metacarpal and closed fractures show a better functional outcome than phalangeal& compound fractures.
Key words: Metacarpal fractures, Phalangeal fractures, K- wire fixation.

Introduction

Hand fractures are common presentation in Emergency Department[1] and are the most common fractures of the human skeleton[2] .These injuries are commonly encountered in our daily practice. A study conducted in Norway for distribution and relative incidence of hand fractures showed that metacarpal fractures accounted for 36%, phalanges 46%, fracture of neck of 5th metacarpal 9.7% and Bennett's fracture 1.4% of the total [3]. Disability from hand injury may result in loss of sensation, loss of strength and loss of flexibility, which are the chief functions of the hand. Prevention of disability from hand injuries is the primary goal of treatment. Maintenance of function rather than cosmoses is of paramount concern in the management of hand injuries.

Much morbidity and disability can be prevented by proper management of these fractures. Hand fractures can be complicated by deformity from no treatment, stiffness from over-treatment and both deformity and stiffness from poor treatment [4].

More extensive dissections that permit the placement of rigid fixation may result in excellent correction of deformity, but may create adhesions that limit motion and hinder overall patient outcome. On the contrary, lack of appropriate fixation may maintain adequate joint motion but fail to correct deformity. It is this fine balance between bony stability and motion that affects the surgeon's decision-making process when treating fractures of the hand[5, 6].

Fractures of hands need early recognition and treatment. Majority of them are treated by closed method. These injuries need prompt attention and appropriate surgical technique to prevent many of the complications associated with this frequently encountered problem.

The aim of the study

To evaluate K-wire fixation (using different techniques) for metacarpal and phalangeal fractures that require operative management and to assess the results, complications and functional outcome.

Patients and Methods

This is a prospective study that was conducted from December 2010 to October 2012,at Orthopedic Department of Al-Basrah General University Hospital.

Twenty one metacarpal and phalangeal fractures in 17 patients (4 patients had 2 fractures) were surgically stabilized by K-wire.

Displaced, unstable, irreducible, compound metacarpal &phalangeal fractures and cases with failed conservative treatment were included in this study while fractures of the thumb, distal phalanges, and fractures associated with neurovascular injuries, were excluded from this study.

All patients were evaluated clinically by history, clinical examination and radiological evaluation by standard posterioanterior and lateral views. Fifteen fractures were closed and 6 were open.

All cases were managed by open reduction and internal fixation using K-wire with different techniques according to the shape and site of the fracture. Seven fractures were fixed by crossed wires, nine by single intramedullary, two by intramedullary plus oblique, one by intramedullary plus transverse ,one by intramedullary plus circulage wire and two fractures were fixed by two oblique wires. All cases were operated within 7 days.

A cortico cancellous bone graft from proximal tibia was used to fill 1.5 centimeter defect in 4^{th} metacarpal in one case.

The operative time ranged from 30 to 60 minutes (mean 45 minutes).

Postoperatively palmar slab which maintains 30 degree wrist extension, the metatarsophalangeal (MP) joint at 70-90 degree flexion, full extension of interphalangeal (IP) joints were used in all cases. All patients were given proper prophylactic antibiotics. Patients were discharged at day of operation or one day after with instruction for limb elevation.

All patients were assessed two weeks post-operatively. The stitches were removed and pin site inspected for any infection. Three weeks post-operatively the slab was removed followed by a course of gentle passive and active movements. Six weeks post-operatively, all patients were assessed clinically and radiologically for signs of union, then at 2 weekly intervals. Pin was removed after signs of union are seen. Unrestricted hand activity was gradually allowed and thorough physiotherapy was encouraged to regain good range of movement. Follow up ranges from three to twelve months (mean 4 months) and no patient was missed from follow up.

The functional outcome was assessed according to Belsky's criteria[7] and graded as:

1- Excellent- pain-free union/no deformity/total active motion (TAM) > 215 degree, proximal interphalangeal (PIP) joint motion > 100 degree.
2- Good - pain-free union/ minimal deformity/ TAM > 180 degree, (PIP)joint motion >80 degree.

3) Poor- pain or non-union/ deformity affecting function or cosmoses/ TAM <180 degree, (PIP) joint motion <80 degree.

Calculating total active range of motion (TAM) was done by adding the active flexion at (MP), (PIP) and distal (IP) joints, after subtracting the sum of extension deficit at these three joints

Results

Seventeen patients with 21 metacarpal and phalangeal fractures were included in this study; the male to female ratio was 16:1.The age distribution ranges between 18 to 45 years (mean 29 years). Four (24%) cases were below the age of 20 years , 10 (58%) cases were between age of 21 to 40 years and only 3 (18%) cases were above the age of 40 (Table1).

Table (1) Age and sex distribution.

Age of patient	Male	Female	Total (%)
< 20	4	0	4(24)
20-30	4	1	5(29)
31-40	5	0	5(29)
>40	3	0	3(18)
Total	16	1	17(100)

There were 15 (71%) closed fractures and 6 (29%) open fractures . Eight (38%) fractures were transverse, 6 (29%)were oblique, 6(29%) were comminuted, and 1 (4%) fracture with bone loss (Table 2).

Table (2) Fracture type and personality.

Fracture personality	closed	open	Total(%)
Transverse	5	3	8 (38)
Oblique	6	0	6 (29)
Comminuted	4	2	6 (29)
Bone loss	0	1	1 (4)
Total	15	6	21(100)

The metacarpal fractures were 13 (62%), proximal phalangeal fractures were 6 (29%) and middle phalangeal fractures were 2 (9%).The shaft

fractures were 14 (66%) followed by base and neck fractures 3 (14%) for each, and one fracture (4%) was intra-articular (Table 3).

Table (3) Fracture site.

Fracture site	Metacarpal	Proximal Phalanx	Middle Phalanx	Total (%)
Shaft	**10**	**2**	**2**	**14 (66)**
Base	**2**	**1**	**0**	**3 (14)**
Neck	**1**	**2**	**0**	**3(14)**
Intra articular	**0**	**1**	**0**	**1(4)**
Total	**13**	**6**	**2**	**21(100)**

All fractures were fixed by Kirschner wire, using different techniques. Single longitudinal were 9(43%), Crossed were 7 (33%), Longitudinal plus oblique were 2 (9%), Longitudinal plus transverse was1(5%), Longitudinal plus circulage wire was 1(5%) and two oblique were 1(5%).(Table 4).

Table (4) Kirschner wire fixation techniques.

K Wire Technique	Number (%)
Single intramedullary wire	9 (43)
Crossed wires	7(33)
Intramedullary +oblique wire	2(9)
Intramedullary +transverse wire	1(5)
Intramedullary+circulage wire	1(5)
Two oblique wires	1(5)
Total	21(100)

The time of union ranges from 6-16 weeks (mean 8.5 weeks), four (19%) fractures united at 6 weeks, 15 (71%) fractures united at 8-10 weeks, 1(5%) fracture united at 12 weeks and 1(5%) fracture united at 16 weeks. (Table 5).

Table (5) Fractures union time

Union time in week	Number of fractures(%)
6	**4**(19)
8	**11**(52)
10	**4**(19)
12	**1**(5)
16	**1**(5)
Total	**21(100)**

All fractures achieved union, no delayed union, nonunion or infection was reported. Stiffness occurred in 4(19%) fractures and mal-union in 2(10%) fractures.

The functional outcome was assessed according Belsky's criteria. Overall functional results were excellent to good in 17(81%);6 (29%)were excellent and 11(52%) were good , and fair to poor in 4(19%) of fractures (Table 6).

Table (6) the overall functional outcome according to Belsky's criteria:

Results	No.(%)
Excellent	**6 (29)**
Good	**11(52)**
Fair to poor	**4(19)**
Total	**21(100)**

Functional outcome in metacarpal fractures was 6 (46%) excellent, 5(39%) good, and 2(15%) fair to poor results, which is better than that of phalangeal fractures which had 6(75%) good and 2(25%) poor results(Table 7).

Table (7) total functional outcome in metacarpal and Phalangeal Fractures:

	Metacarpal No. (%)	Phalangeal No.(%)
Excellent	**6 (46)**	**0 (0)**
Good	**5 (39)**	**6 (75)**
Fair to poor	**2 (15)**	**2 (25)**

Closed fractures (n=15) show a better functional outcome with excellent to good results in 14 (93%), whereas open fractures (n=6) show good results in 3 (50%) of cases only (Table 8).

Table (8) total functional outcome in closed and open fractures:

	closed		Total No.(%)	Open		Total No.(%)
	MTC	Pha.	15(71)	MTC	Pha.	6(29)
Excellent	6	0	6 (40)	0	0	0 (0)
Good	3	5	8 (53.3)	2	1	3 (50)
Fair to poor	0	1	1 (6.6)	2	1	3 (50)

MTC=metacarpal, Pha. = phalangeal

Discussion

Metacarpal and phalangeal fractures are often treated conservatively, but in displaced, unstable fractures, those in which closed reduction fails some form of operative reduction and stabilization is required.

In this study we used K- wire as single fixation method in 21 fractures in 17 patients. Male: female ratio was 16: 1. Comparable results found in other studies[8, 9,10,11,12]. This is because males are more exposed to trauma especially in our society.

The age range from 18 to 45 year old (mean age 29) which is similar to the other studies[8, 9,10,11,12] this represent the working, active age group which are exposed to trauma.

Transverse fractures were most common 8 (38%), followed by oblique 6 (29%), comminuted 6 (29%) and bone loss 1(4%) this is similar to a study by *Amit Thakur* [13], while *Hyder Ali et al* [12] found that oblique fractures were highest, followed by transverse and comminuted fractures.

Metacarpal fractures13 (62%) were more than fractures of the proximal 6(29%) and middle phalanx 2(9%) . This resembles the results found by *Amit Thakur* [13].

Open reduction & internal fixation by K- wire was used in all cases, using different techniques according to fracture site and configuration.

Single longitudinal wire fixation was used in displaced transverse metacarpal fractures using retrograde technique ,with the wire end protruding proximally at the level of carpometacarpal joint thus leaving metacarophalangeal joint free to move .An additional transverse or oblique wires were added to longitudinal one in cases of unstable short oblique or comminuted metacarpal fractures , while crossed wire were used for phalangeal fractures ,which give a rigid fixation that prevent

rotation ,as well as other deforming forces, and allow early joint movement to prevent stiffness. All fractures achieved union, no case of nonunion or infection was reported.

The time of union range from 6-16 weeks mean 8.5 weeks, which is shorter than the study by *Somboon Wutphiriya*[14] (12 weeks), and higher than the study by *Hemant Patankar and Fayaz W Meman*[15] which is 6 weeks.

Overall functional outcome was excellent to good in 17(81%)[52%good, 29 excellent], and fair to poor in 4(19%) of cases, which is similar to results of *Amit Thakur* [13] which is good to excellent in 82% [excellent 70.45%, good 11.36%]while Belsky et al [7] found excellent to good in 90% [excellent 61%, good 29%], and fair to poor in 10%.

Metacarpal fractures show a better functional outcome ,excellent to good in 11(85%)[46% excellent,39% good], as compared to phalangeal fractures in which no excellent but good results found in 6(75%).this result is similar to those reported by,*Rakesh Gupta et al* [16].

Closed fractures had a better functional outcome ,excellent to good in 93% of cases whereas only 50% of open fractures has good results, with no excellent,and50% poor results, this agree with the result reported by *Rakesh Gupta et al* [16] .

Stiffness occurred in 4(19%) cases, 3(14%)cases were compound fractures, and 1(5%) case was intraarticular fracture , this is expected in compound fractures which takes longer time to unite because of more sever degree of bony & soft tissue injury with some degree of bony and soft tissue loss, longer period of immobilization. This also explains lower degree of functional outcome in compound fracture.

Intaarticular fracture is also associated with stiffness due to intraarticular fibrosis. This requires intensive physiotherapy to improve the joint range of movement.

Conclusion

K-wire is a sound method of fixation of unstable metacarpal and phalangeal fractures that could give good result, regarding fracture union, functional outcome, with low complication rate. A better functional outcome is achieved in metacarpal and closed fractures.

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