ORIGINAL ARTICLE

Early movement does not cause loss of reduction in surgically treated boxer fractures

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ABSTRACT

BACKGROUND: The surgical treatment of fifth metacarpal fractures, especially using Kirschner (K) wire techniques, has recently become popular because it provides for early hand movement. Successful anatomical reduction of the fracture is often achieved with surgery; however, an anatomical reduction cannot always be achieved and, according to 30° oblique radiography, the fracture is fixed with an apex dorsal angulation below 40°. The aim of this study was to evaluate the stability of such fractures postoperatively and compare the two different angulation options that provide early movement of the hand and wrist.

METHODS: Thirty consecutive cases of neck fractures of the fifth metacarpal were treated intramedullarly with one K wire. Cases were divided into two groups: One fixed with anatomical reduction (Group 1) and the other (Group 2) fixed in apex dorsal angulation below 40°, according to 30° oblique radiography. Angulation, shortening, and functional outcome as Quick DASH scores and grip strengths were evaluated at 6 months.

RESULTS: The mean correction angle was 56.6° (between 30° and 110°) for Group 1 and the residual angle was 0°. The mean correction angle was 42.4° (between 20° and 75°) for group 2 (Figs. 4 and 5) and the residual angle was 23.6° (between 10° and 45°). The mean Quick DASH scores were 1.9 (SD: 1.7) for Group 1 and 5.67 (SD: 2.93) for Group 2 ($p<0.05$). Grip strength values were similar for both groups. All the patients returned to their previous occupations without any limitations in an average of 4 weeks (SD: 1.4) (range 2–6 weeks). No complications such as correction loosening or shortening were detected. Rotation was not detected during physical examination.

CONCLUSION: Our investigation revealed no risk of shortening or rotation of the fracture; the patients were able to return quickly to their everyday activities.

Keywords: Antegrade intramedullary pinning; boxer fracture; fifth metacarpal neck; K wire; outcomes.

INTRODUCTION

A fifth metacarpal neck fracture is known as a boxer fracture. It is often seen as a palmar angulation and is seldom comminuted.[1] Successful results can be achieved with conservative treatment, as reported in the literature; however, impatient or restless patients with this kind of injury can find it difficult to live with a cast and cause unintentional self-harm.[2,3] Patients sometimes attempt to remove the cast themselves within a few days of their treatment, which causes worse displacement of the fracture and can result in esthetic sequelae and lack of extension at the metacarpophalangeal (MCP) joint. Thus, our hospital recommends surgical treatment to avoid these problems. If the patient accepts surgical treatment, we treat the fracture with antigrade nailing using the Kirschner (K) wire technique. Anatomical reduction is often achieved in surgery and the bone is fixed in its correct anatomical position; however, in some cases, this cannot be achieved due to comminution, inadequate evaluation in C-arm fluoroscopy during surgery, or neglect of the reduction that has caused the bone to remain in a non-anatomical position. The purpose of the present study is to evaluate the stability of such

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fractures and compare the two different treatment options that allow for early movement of the limb.

MATERIALS AND METHODS

The first 30 consecutive cases between 2017 and 2019 of displaced apex dorsal angulation >40°, according to 30° oblique radiography, were selected; neck fractures of the fifth metacarpal were treated intramedullarly with one K wire. The patients' mean age was 45 (39–50). All of the patients were male. All of the cases were admitted to our hospital complaining of hand pain after hitting a hand on something. All of the operations were carried out by two senior surgeons within 10 days of the injury. Any patients who had an additional hand injury at the same time, multiple injuries, or open fractures were excluded from the study. Fractures were categorized according to the AO classification system, and only metacarpal fractures described as a 77.5.3. A were included in the study.[4] Cases were divided into two groups according to 30° oblique radiography: fixed with anatomical reduction (Group 1) (Fig. 1b) and fixed with apex dorsal angulation below 40° (group 2) (Fig. 2a). All cases were evaluated. Patient satisfaction and the presence of pain were recorded. Shortening and loss of dorsal angulation was evaluated by Ap X-ray and subtle rotation was evaluated by examining the patient's fist or semi-flexed fingers.[5] Active ROM was measured at the MP joint using a finger goniometer. Grip strength was measured with a Jamar hydraulic hand dynamometer (Sammons Preston/Ability One, Germantown, Wisc.). Informed consent was obtained before the data collection, and ethical committee approval is not required.

Techniques

All the patients were treated under general anesthesia without a tourniquet. Antibiotic prophylaxy was given systematically with first generation cephalosporin 30 min before surgery. A blunt K wire was prepared according to the metacarpal length before procedure; the distal part was bent at a 30° angle, while the proximal part was bent at 90° and twisted clockwise. After closed reduction using the Jahss maneuver, the entry point was made percutaneously with a 2.0 mm K wire under fluoroscopic control; next, contrary to the literature, a skin incision was made dorsal to the metacarpal. The prepared 1.2–1.6 mm K wire was advanced through the corticotomy until it reached the distal head cortex of the metacarpal, and then was rotated to the head of the fourth metacarpal bone. Skin closure was made with a 3/0 Monocryl suture. A simple wrist splint was placed for 4 weeks. Radiologic controls were imposed on the 1st post-operative day, then after 6 weeks, 3 months, 6 months, and 12 months, and then annually. Active motion of the MCP and IP joints began in the immediate post-operative period. Simple wrist support was removed at the end of the 4th week. Full active motion was recommended for all hand and wrist joints. During the healing period, the same follow-up protocol was applied to all of the patients in both groups. Group 2 patients, who received the non-anatomic fix, did not delay movement of the hand. Instead of postponing the initial movement of the limb to a few weeks after surgery to prevent displacement of the fracture, we tried to encourage active movement of the hand — especially the fifth finger — by all of the patients. Clinical controls were imposed after the surgical procedure at 3 months, 6 months, 12 months, and then once a year. To prevent complaints regarding discomfort due to the wire, we recommended its removal after 3 months depend of based of complaints. During the final controls, each patient was evaluated by radiographic and clinical assessment and asked for complaints. The occurrence of complications was investigated.

Statistical Analysis

Data were gathered and analyzed on Microsoft Excel (Microsoft Corporation).

Statistical analysis was performed using SPSS version 12 (SPSS Inc., Chicago, IL, USA). The T test and Mann–Whitney test were used to analyze the relationships between quantitative variables. Correlation was classified and the threshold for significance was set at $p<0.05$. $P=0.05$ was used as the cutoff for establishing statistical significance.

RESULTS

One K wire was used for each patient. The mean follow-up period was 21 months (12–40 months). All patients reached union within 6 weeks. The mean correction angle was 56.6° (between 30° and 110°) for Group 1 (Fig. 1a and b) and the residual angle was 0° (Fig. 1c). The mean correction angle was 42.4° (between 20° and 75°) for Group 2 (Fig. 2a and b) and the residual angle was 23.6° (between 10° and 45°) (Fig. 2c and Table 1). At the time of application, the t-value was −0.89351 between Group 1 and Group 2, and the result was not statistically significant at $p<0.05$. The t-value among the groups after reduction and fixation was 8.8776 and the result was significant at $p<0.05$. The mean Quick DASH score was 1.9 (SD: 1.7) for Group 1 and 5.67 (SD: 2.93) for Group 2. The difference was not statistically significant ($p=2.57$) (Table 2). When grip strengths were evaluated, the average grip strength was 92.9 (SD: 18.9) for Group 188.4 (SD: 15.36) for Group 2, and similar between the groups. Mean MCP flexion and extension were recorded as 99–8° for Group 1 and 87–4° for Group 2. Metacarpal shortness was found only in Group 2, with an average of 1.38 mm.

All the patients returned to their previous occupations without any limitations in an average of 4 weeks ([SD: 1.4] [range, 2–6 weeks]). Rotation was not detected at semi-flexed positions during physical examinations (Fig. 3a). No complications such as correction loosening or shortening were detected. K wire migration was detected in one patient; the wire rested on the cortex, but it did not protrude from the bone (Fig. 3b).

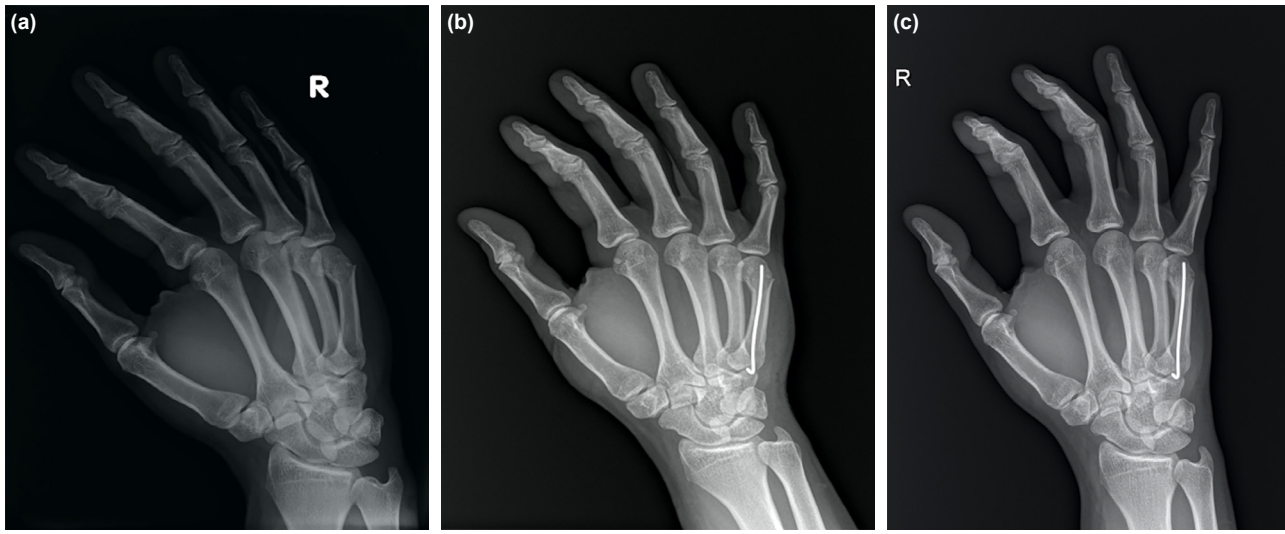

Figure 1. (a) X-ray of the case sample with fifth metacarpal neck fracture. **(b)** X-ray of the case sample showing that anatomical reduction and fixation can be achieved. **(c)** Final follow-up control X-ray of the patient sample showing that anatomical reduction can be achieved.

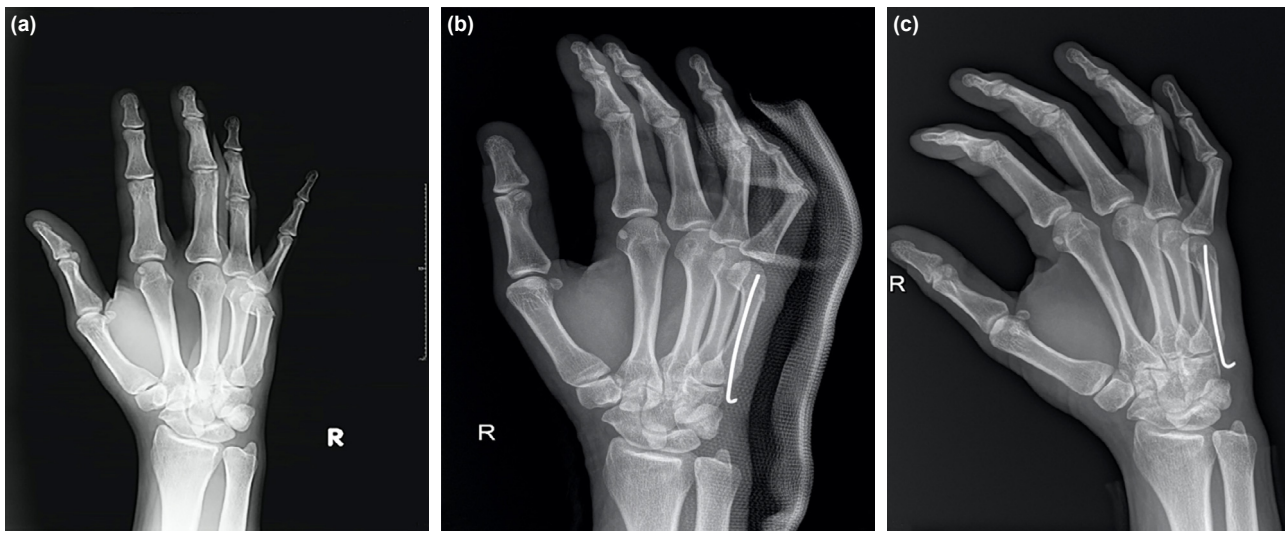

Figure 2. (a) X-ray of the case sample with fifth metacarpal neck fracture. **(b)** X-ray of the case sample showing that anatomical reduction and fixation can be achieved. **(c)** Final follow-up control X-ray of the patient sample in whom anatomical reduction could not be achieved.

DISCUSSION

Successful surgical results of the boxer fracture through antigrade one K wire techniques with early movement between 2 and 6 weeks after surgery have been reported. Kim, one of the reporters of these results, recommended this technique in particular for athletes who need their hand to function as soon as possible.[6] At present, surgery has become one of the most popular treatment modalities due to contemporary working styles for office jobs.[3,7] Early hand function is critical for white-collar workers — in the work context, "time is money." In this study, we present the radiological results of surgically treated boxer fractures using antigrade one K wire techniques and discuss the effect of early movement on postoperative fracture displacements.

All of the operations were performed by two senior surgeons. Anatomical reduction of the fracture was attempt-

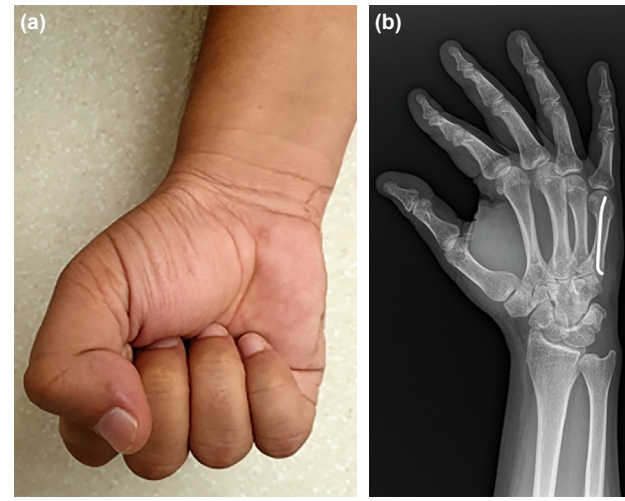

Figure 3. (a) Clinical image of the hand at flex position. **(b)** X-ray of the case with K wire migration.

Table 1. Demographic characteristics and dorsal angulation changing of patients with surgery according to 30° oblique radiography

Patient	Follow-up	Age	Preop. angle	Postop. angle	Last control angle
BK	96 m	51	50	0	0
HŞ	36 m	30	68	0	0
NGK	61 m	44	42	0	0
SD	23 m	43	57	0	0
SHH	17 m	44	40	0	0
YK	36 m	62	74	0	0
ÖE	118 m	56	110	0	0
OA	9 m	38	82	0	0
CA	8 m	42	92	0	0
DK	94 m	31	30	0	0
CÖ	58 m	24	42	0	0
FÖG	66 m	24	52	0	0
MŞ	112 m	23	63	0	0
RO	120 m	18	50	0	0
EÖ	75 m	36	48	0	0
SHY	16 m	44	45	20	20
VTK	72 m	58	85	10	10
HM	71 m	51	50	30	30
KG	12 m	39	75	45	45
GGG	15 m	35	57	37	37
AT	36 m	42	75	30	30
BK	113 m	51	45	10	10
LMO	88 m	49	71	17	17
MMB	98 m	37	47	19	19
AÇ	68 m	37	71	30	30
GEY	85 m	23	66	22	22
MK	77 m	32	58	15	15
AM	36 m	55	85	40	40
CŞ	30 m	44	76	20	20
HMK	84 m	36	85	10	10

Preop.: Preoperative; Postop.: Postoperative.

ed, but the surgeons sometimes had to opt for a non-anatomical fix due to comminution or inadequate evaluation of the C-arm fluoroscopy during surgery — the latter fix was acceptable as long as the dorsal angulation was below 40° according to an oblique X-ray. Even though many authors have reported successful clinical results with angles of between 30° and 70° according to oblique radiographs, Michel reviewed the neck fractures and revealed that 45° angulation can lead to important shortening of muscle resting length.[3,8] Therefore, we decided in our study to limit the angle to 40°.

Antigrade fixation of the fracture initially included two or more K wires in a bouquet technique; nonetheless, there has recently been a switch to using one K wire, which has been reported to yield successful clinical and radiological results.[9,10] Despite these successful results, Heo et al. reported that, even though early joint motion did not cause a shift in the angulation, changes in the length of the metacarpal and the position of the distal tip of the K wire were observed radiologically.[11] Like Heo et al.,[12] Rowland stated that the fractures were unstable due to comminution. Heo et al. believed that the instability could be prevented by the K wire but the shortening could not because it should be attributed to comminution of the metaphyseal. Contradicting Heo et al.,[12] Khan and Giddins[13] reported that DTML could prevent the shortening of the metacarpal. Mirza et al.[14] reported on the incidence of shortening of the metacarpal in fractures treated with one K wire and found the technique to be unsuccessful. Although miniplates have become popular in terms of preventing shortness and loss of function in metacarpal fractures and Aykut et al.[15] reported successful results, it has not been a preferred treatment for metacarpal neck fractures due to high complication rates.[16] In addition, Zeng et al.[10] reported shortening when an elastic nail was used, even noting that when two elastic nails were used, there was less shortness; but he also stated that his calculations may not be very accurate due to the difficulty of standard acquisition of oblique radiographs. Although the instability and shortening debates have not been resolved, we encountered neither of those complications in our study. K wire migration was detected in one patient; the wire rested on the cortex, but it did not come out of the bone. The migration was attributed to insuf-

Table 2. Clinical outcomes of both groups

	Group 1	Group 2	Statistic	P	SD	
					Group1	Group 2
Quick Dash Score	1.9±1.7/100	5.67±2.93/100	2,57	0.05	1.7	2.93
Grip Strength	92.9±18.97	88.4±15.36	-1.53	0.05	18.97	15.36
MCP extension	8±3	4±4	2.5	0.01	3	4
MCP flexion	99	87	2.5	0.01		
Metacarpal shortening	0	1.38±1.51				

SD: Standard deviation; MCP: Metacarpophalangeal.

ficient bending of the proximal part of the K wire, which was left to rest on the cortex. Although Zeng et al. recommended using elastic nail, he did not mention migration in his work; we preferred K wire over elastic nails because of its blunt tip. Migration can be expected with blunt-tip wire, but penetration into the joint is a less expected complication.

Many authors have reported patients returning to work and everyday activities between 4 and 28 days after the treatment.[17] Despite this wide range, we permitted and encouraged movement of the limb the 1st day after the operation. Even though a single wire was used and early movement was prescribed, we encountered no complications regarding reduction or shortening, and successful union was achieved in 6 weeks.[6] Our union time was longer than Kim's, who reported union within 3 weeks; we believe that these results are due to our lack of a follow-up protocol at the 3rd week.

Some authors recommend routine implant removals, even at the 6th week.[18] Our implant removal protocol, like Zeng's,[10] was based on complaints of the patients.

Kadlub et al. and Lundin et al.[19] drew attention to the cost of surgical treatment. However, the improvement in quality of life resulting from the positive impact of returning early to work and daily activities is invaluable for patients in a hurry. Mercan et al.[20] reported that psychological factors play an important role in the clinical sequels of intentional fifth metacarpal fractures. In light of the literature, patients should be directed toward minimally invasive surgery without any support following surgery.

Conclusion

Overall, we can achieve successful results with percutaneous antigrade single K wire techniques, and patients, especially white-collar workers, can return to their working life faster than with other surgical and more conservative treatment modalities. Our investigation revealed that the fix with the apex dorsal angulation below 40° has no more risk for shortening or rotation of the fracture than the fix with anatomical reduction — both options lead to an early return to daily activity.

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Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Cerrahi olarak tedavi edilen boksör kırıklarında, erken harekete başlamak redüksiyon kaybına neden olmaz

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AMAÇ: Beşinci metakarpal kırıkların, özellikle Kirschner teli teknikleri kullanılarak cerrahi tedavisi, erken el hareketini sağladığı için son zamanlarda popüler hale gelmiştir. Kırığın başarılı anatomik redüksiyonu genellikle cerrahi ile sağlanmakla birlikte; anatomik bir redüksiyon her zaman elde edilemez ve 30° oblik grafilerde, kırık 40°'nin altındaki dorsal açılanma ile sabitlenir. Bu çalışmanın amacı, ameliyat sonrası bu tür kırıkların stabilitesini değerlendirmek ve el ve bileğin erken hareket etmesini sağlayan iki farklı açılanma seçeneğini karşılaştırmaktı.

GEREÇ VE YÖNTEM: Beşinci metakarpal boyun kırığının 30 ardışık olgusu bir Kirschner teli ile intramedüller olarak tedavi edildi. Olgular iki gruba ayrıldı: Biri anatomik redüksiyonla sabitlendi (grup 1) ve diğeri (grup 2) 30° oblik radyografiye göre apeks dorsal açılanmada 40°'nin altında sabitlendi. Quick DASH skorları ve kavrama kuvvetleri olarak açılanma, kısalma ve fonksiyonel sonuç altıncı ayda değerlendirildi.

BULGULAR: Grup 1 için ortalama düzeltme açısı 56.6° (30° ile 110° arasında) ve rezidüel açı 0° idi. Grup 2 için ortalama düzeltme açısı 42.4° (20° ile 75° arasında) ve rezidüel açı 23.6° (10° ile 45° arasında) idi. Ortalama Quick DASH skorları grup 1 için 1.9 (SS: 1.7) ve grup 2 için 5.67 (SS: 2.93) idi ($p<0.05$). Kavrama gücü değerleri her iki grup için benzerdi. Ortalama 4. haftada (SS: 1.4) (dağılım, 2–6 hafta) tüm hastalar herhangi bir sınırlama olmaksızın önceki mesleklerine döndüler. Redüksiyon kaybı veya kısalma gibi komplikasyonlar tespit edilmedi. Fizik muayenede rotasyon tespit edilmedi.

TARTIŞMA: Araştırmamız, kırığın kısalması veya rotasyon riski olmadığını ortaya koydu; hastalar günlük aktivitelerine hızla geri dönebildi.

Anahtar sözcükler: Antegrad intramedüller çivileme; beşinci metakarpal boyun; boksör kırığı; K teli; sonuçlar.

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