ORIGINAL ARTICLE

Early return to play after minimally invasive treatment of metacarpal fractures in elite football players

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ABSTRACT

BACKGROUND: To evaluate the clinical outcomes of closed reduction and crossed retrograde intramedullary Kirschner wire (K-wire) fixation in professional football players with metacarpal fractures, specifically focusing on return to play and complication rates.

METHODS: A total of 27 elite professional football athletes with metacarpal fractures were treated using closed reduction and crossed retrograde K-wire fixation. All surgeries were performed by the same orthopedic surgeon. Postoperative rehabilitation included a standardized protocol and individualized braces designed by a single hand therapist. Clinical and functional outcomes were assessed using range of motion (ROM), grip strength, Visual Analog Scale (VAS) for pain, Disabilities of the Arm, Shoulder, and Hand (DASH) scores, time to return to training and competition, and radiographic healing.

RESULTS: The mean age of the cohort was 24 years. The fifth metacarpal was the most commonly affected site, and falling onto the pitch was the predominant injury mechanism. Mean return to training was 3.16 weeks, to competition 4.12 weeks, and to radiographic union 4.88 weeks. Mean DASH scores improved from 67.5 to 12.8, VAS from 5.78 to 0.75, MCP joint ROM from 66.75° to 89.25°, and grip strength from 44.87% to 95.55%.

CONCLUSION: Closed reduction and crossed retrograde K-wire fixation, with personalized postoperative care, appears to be a safe, reliable, and minimally invasive method in elite football athletes, enabling early return to play with excellent functional outcomes.

Keywords: Early return to play; functional outcomes; K-wire fixation; metacarpal fracture; professional football players.

INTRODUCTION

Metacarpal fractures are one of the most common upper extremity injuries in athletes.[1] Although this rate is low in football players compared to contact sports in which the hand is used, it has been reported that metacarpal fractures constitute 15% of hand injuries among Northern European football players.[2] The mechanism of injury in contact sports occurs by direct impact or falling onto a clenched fist.[3] For treatment planning, the performed sport, the position of the athlete, and whether the injury occurs during the in-season are as important as the characteristics of the fracture.

Most metacarpal fractures are stable and are successfully treated with non-surgical methods. Significant angulation, rotation, instability, shortening, intra-articular fracture, open fracture, and multiple metacarpal fractures require surgical treatment.[4] The rate of conservative treatment after metacarpal fractures in American National Football League (NFL) athletes has been reported as 60%, which differs from the management of

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metacarpal fractures in the general population.[5] While the majority of metacarpal fractures are stable and can be managed nonoperatively, a more aggressive approach becomes necessary to expedite the return of athletes to play within a reasonable timeframe. Both the athlete's career and the financial investments of teams or organizations contribute to the strong desire for the earliest possible return following injury, which in turn influences the choice of treatment strategies.

In surgical treatment, closed reduction with K-wire or intramedullary cannulated screw fixation, and open reduction with plate and screw or lag screw fixation, are commonly preferred methods. For elite athletes engaged in high-demand sports, the chosen fixation method for metacarpal fractures should facilitate early mobilization, restore proper grip strength, regain rotation and range of motion, and address any angulation issues. Fixation with K-wires offers advantages such as being rapid, easily applicable, accessible, and minimally invasive; however, it is also associated with disadvantages, including insufficient stability and the risk of pin tract infection. Although open reduction with plate and screw fixation provides rigid stabilization, it is associated with higher complication rates and prolonged soft tissue healing time.[6]

In many sports, such as American football, basketball, baseball, Australian football, and lacrosse, there are few studies evaluating the success of treatment and the time to return to sports after metacarpal fractures.[6-10] It is seen that these studies usually include athletes from different levels or different sports branches. While many of these studies are based on the hypothesis that surgical treatment facilitates a faster return to sports, a greater number of studies have reported a shorter return-to-sport time following conservative management. The fact that surgical treatment was performed in more complex fracture types is seen as the main reason for this inference. In addition, soft tissue edema due to open surgery and prolongation of movement limitation are seen as another reason. In the systematic review reporting the treatment of 184 metacarpal fractures of athletes across many different sports branches and competitive levels, it was reported that 78 of them received surgical treatment and only 2 were treated with K-wire.[11] It was reported that the mean time to return to sports after surgical treatment and conservative treatment was 28.5 and 22 days, respectively.[11]

The study aimed to report the effect of closed reduction and minimally invasive cross-intramedullary fixation of metacarpal fractures with K-wire on the time to return to sport and post-treatment athletic performance in elite football players. Although there are studies evaluating the return to sports and performance of metacarpal fractures after surgery in elite athletes, to the best of our knowledge, this is the first study to report the results of surgical treatment of metacarpal fractures in elite football players.

MATERIALS AND METHODS

Following the approval of the ethics committee, we retrospectively analyzed elite professional football players who underwent surgery for metacarpal fractures between 2011 and 2023. In the evaluation, it was observed that 36 football players had surgery for metacarpal fractures. A total of 27 patients who met the inclusion criteria were included in the study after the removal of patients with a follow-up period of less than one year, those with open fractures, intra-articular fractures, or who underwent a surgical method other than closed reduction and fixation with K-wire. This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Procedures were performed under general anesthesia by the senior orthopedic surgeon (Yİ), who has expertise in sports-related injuries. Fluoroscopy guidance was employed to assess the fracture site. At the beginning of the procedure, closed reduction of the fracture was performed through traction. If the fracture was reducible, K-wire placement was performed; if it was not reducible, open reduction and plate fixation were decided by the surgeon. K-wire placements were done in a retrograde fashion, with crossed insertion of two percutaneous K-wires of appropriate diameters through a small skin incision at the base of the affected metacarpal bone via the intramedullary canal. Surgical fracture reduction was performed by manipulating the inserted intramedullary K-wires. The stability and position of the K-wires were assessed under fluoroscopy. Subsequently, the K-wire was bent and cut, and the patients were immobilized with a customized brace for eight weeks (Figure 1).

The union of the fracture was monitored through repeated X-rays during weekly follow-up visits post-surgery. Range of motion exercises for the phalanges were initiated three days after surgery. Physical therapy, conducted on an outpatient basis with the assistance of a specialized hand physiotherapist, was initiated ten days after the operation. Athletes were not allowed to participate in contact training until three weeks postoperatively; they then started using a special soft brace during contact training and official matches (Figure 2).

Upon radiographic confirmation of fracture union, the K-wires were removed in the sixth postoperative week, and patients continued wearing the customized brace (Figure 1). Regular follow-up visits were scheduled until full union was achieved. Assessment measures, including range of motion (ROM), grip strength (expressed in comparison with the contralateral hand, with 100 being the best), Visual Analog Scale (VAS) for pain, and Disabilities of the Arm, Shoulder, and Hand (DASH) scoring, were performed for all patients. Anteroposterior and oblique X-rays were taken to evaluate complete bony healing and detect any incidence of deformity.

Statistical Analysis

Descriptive statistics were conducted using the SPSS 21.0 program (SPSS Inc., Chicago, IL, USA). Paired t-test, post-hoc

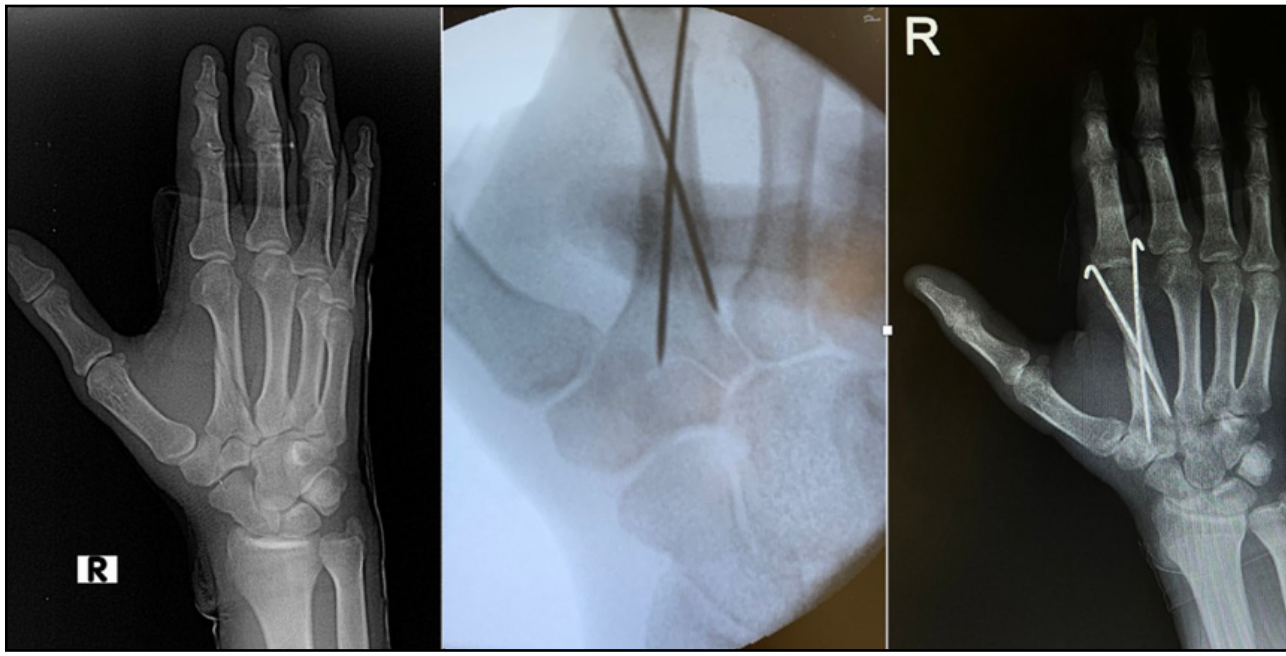

Figure 1. Preoperative, intraoperative, and immediate postoperative photographs of a male patient who is 21 years old at the time of the injury.

Figure 2. Preparation of a customized soft brace, which allows for use during official matches.

test, and Kruskal-Wallis test were performed to show the significance of differences for related variables. A statistical significance level of <0.05 was considered indicative of a significant correlation between variables.

RESULTS

A total of 27 athletes were included in the study, with a mean age of 24±3.64 years and a mean follow-up duration of

Table 1. Demographics, means of return to sport, and healing

n: 27	m±sd
Age (y)	24±3.64
Follow up (m)	18±4.80
Return to sport (w)	3.16±0.72
Return to competition (w)	4.12±1.26
Radiological healing (w)	4.88±0.58

n: number, y: years, m: months, w: weeks, m: mean, sd: standard deviation.

Table 2. Comparison of pre- and post-operative clinical parameters

Parameter	Pre-op±sd	Post-op±sd	p
DASH	67.5±8.98	12.8±5.48	p<0.05
VAS	5.78±0.96	0.75±1.55	p<0.05
MCP-ROM	66.75±6.25	89.25±2.35	p<0.05
Grip strength (%)	44.87±9.14	95.55±6.23	p<0.05

sd: standard deviation; p: probability-statistical significance; DASH: Disabilities of the arm; shoulder, and hand score; VAS: Visual analog scale; MCP-ROM: Metacarpophalangeal joint range of motion.

18±4.80 months. The mean return to sports was 3.16±0.72 weeks, while the return to competition occurred at 4.12±1.26 weeks. Radiological healing was observed at 4.88±0.58 weeks (Table 1).

The distribution of metacarpal bone involvement revealed that the fifth metacarpal was most commonly affected (n=12, 44.4%), followed by the fourth (n=8, 29.6%).

The primary mechanism of trauma was downfall, accounting for the majority of cases (n=18, 66.6%). Direct force (n=7, 26.0%) and other causes (n=2, 7.4%) contributed to a smaller proportion of fractures.

The preoperative DASH score was 67.5±8.98, which significantly improved to 12.8±5.48 at the last follow-up (p<0.05). Similarly, the VAS score reduced from 5.78±0.96 preoperatively to 0.75±1.55 at the last follow-up (p<0.05). ROM of the MCP joint increased from 66.75±6.25° preoperatively to 89.25±2.35° at the last follow-up (p<0.05). Grip strength of the opposite side showed a substantial improvement, increasing from 44.87%±9.14 preoperatively to 95.55%±6.23 at the last follow-up (Table 2, p<0.05).

No malalignments, nonunion, or malunion were encountered. All patients returned to their competition levels prior to the injury by the end of the follow-up period.

DISCUSSION

The return to sport after metacarpal fractures treated with closed reduction and K-wire fixation in elite football players was determined to be 3 to 4 weeks, in accordance with studies in the literature. The return of all athletes to their pre-injury competitive level demonstrates the effectiveness of the treatment, with results that are comparable to or even superior to those reported for other treatment approaches. This is the first study conducted on this subject in elite football players, and a satisfactory number of patients is reported when compared to the literature, with 27 patients who received the same treatment in this specific patient group.

In a survey study conducted with surgeons treating athletes in professional football, basketball, and baseball leagues in the USA, it was reported that these elite athletes can return to sports in 3-4 weeks with protective equipment and achieve a full return to sport without a brace in 4–8 weeks.[12] Results of the current study support this survey. In professional athletes, the primary goal is to achieve a full return to sport as rapidly as possible while minimizing financial and performance losses; therefore, there has been an increasing tendency toward surgical treatment.

Yalizis et al., in their study detecting metacarpal fractures in Australian rules football players treated with open reduction and plate screws, reported that the average time to return to sports was 2 weeks. In the same study, similar improvement in DASH scores was reported compared to our study, and radiographic improvement was seen in an average of 6 weeks, similar to our study.[8]

In another study, Etier et al. reported that in high school and college American football athletes, re-accommodation to sports after fixation of metacarpal fractures with a plate and screw occurred in an average of 1 week with a protective splint.[10] The fact that the study group consisted of very young athletes may have influenced this result. In the same study, they reported that the trauma mechanism was contact collision in 60% of cases, and the fracture occurred in the middle finger in 55% of cases.[10] Compared with our study, this highlights differences in the mechanisms of metacarpal fracture formation in different sports and the differences in affected metacarpals.

In a study in which the performance of metacarpal fractures in National Basketball Association (NBA) players was followed for two years after surgical treatment, it was observed that there was no difference in the performance of athletes before and after the injury.[9] In the same study, a comparison was made between a paired control group and the athletes who did not have an injury, and it was reported that there was no difference in performance. Although the effect of hand dexterity on performance in football players is limited compared to basketball, our study supports these results.

In a study comparing surgical and conservative treatment of metacarpal fractures in 24 Major League Baseball players, Pagani et al. reported that although the nonoperatively treated group returned to sports significantly earlier, the surgically treated group showed superior results in long-term follow-up of athletic performance.[7]

Contrary to these studies, Carender et al., in their study examining metacarpal and phalanx fractures in American college athletes, reported that the rate of athletes returning to sports in the same season after surgical treatment of metacarpal fractures was significantly lower than in the conservatively treated group.[13] This study is a nationwide data study and has significant limitations because it consists of patients from different sports, different types of fractures, and treatment by different surgeons.

In a systematic review of Level 3-4 studies, Geoghegan et al. reported that the time to return to sports after surgical treatment of metacarpal fractures was longer in athletes than after conservative treatment (28.5 days vs. 22 days).[11] Sports branches, competitive levels, treatment methods, and rehabilitation protocols differ in the included studies, and fracture types are not reported. It is important to acknowledge that fractures requiring surgical intervention are typically more complex. Furthermore, the study by Morse et al., which was included in this review, reported an extended return-to-sport duration, with a mean time of 56 days.[14]

It is worth noting that specific requirements vary within sports, with athletes in certain positions or disciplines, such as goalkeepers and basketball players, placing a higher emphasis on hand dexterity for optimal athletic performance. These considerations underscore the need for a personalized and sport-specific approach in determining the most effective treatment strategy for metacarpal fractures in athletes.

CONCLUSION

Our study has certain limitations, including its retrospective design and the relatively small sample size. Moreover, the absence of a control group treated with an alternative surgical or conservative approach limits the ability to draw comparative conclusions. Although further randomized prospective studies are warranted in this area, conducting such trials in this highly specific population of elite athletes presents considerable challenges. Nonetheless, the operative management of metacarpal fractures in professional football players using retrograde intramedullary crossed K-wires, combined with a customized brace, appears to be a reliable technique, offering favorable functional outcomes and facilitating an early return to sport.

Ethics Committee Approval: This study was approved by the Nişantaşı University Ethics Committee (Date: 01.02.2024, Decision No: 2024/02).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Elit futbolcularda metakarp kırıklarının minimal invaziv tedavisi sonrası erken spora dönüş

AMAÇ: Metakarp kırığı bulunan profesyonel futbolcularda kapalı redüksiyon ve çapraz retrograd intramedüller Kirschner teli (K-teli) tespiti yönteminin klinik sonuçlarını değerlendirmek; özellikle spora dönüş süresi ve komplikasyon oranlarına odaklanmak.

GEREÇ VE YÖNTEM: Metakarp kırığı olan toplam 27 elit profesyonel futbolcu, kapalı redüksiyon ve çapraz retrograd K-teli tespiti yöntemiyle tedavi edildi. Tüm cerrahiler aynı ortopedi cerrahı tarafından gerçekleştirildi. Ameliyat sonrası rehabilitasyon süreci, standart bir protokol ve tek bir el terapisti tarafından tasarlanan kişiye özel atelleri içeriyordu. Klinik ve fonksiyonel sonuçlar; eklem hareket açıklığı (ROM), kavrama kuvveti, Ağrı için Görsel Analog Skala (VAS), Kol, Omuz ve El Engellilik Anketi (DASH) skorları, antrenmana ve müsabakaya dönüş süresi ile radyografik kaynama açısından değerlendirildi.

BULGULAR: Çalışmaya katılan grubun ortalama yaşı 24'tü. En sık etkilenen bölge beşinci metakarptı ve saha üzerinde düşme en yaygın yaralanma mekanizmasıydı. Antrenmana ortalama dönüş süresi 3.16 hafta, müsabakaya dönüş 4.12 hafta ve radyografik kaynama 4.88 hafta olarak belirlendi. Ortalama DASH skoru 67.5'ten 12.8'e, VAS skoru 5.78'den 0.75'e, MCP eklem hareket açıklığı 66.75°'den 89.25°'ye ve kavrama kuvveti %44.87'den %95.55'e yükseldi.

SONUÇ: Kişiselleştirilmiş ameliyat sonrası bakım ile uygulanan kapalı redüksiyon ve çapraz retrograd K-teli tespiti, elit futbolcularda güvenli, etkili ve minimal invaziv bir yöntem olup, mükemmel fonksiyonel sonuçlarla erken spora dönüşü sağlamaktadır.

Anahtar sözcükler: Metakarp kırığı, K-teli tespiti, profesyonel futbolcular, erken spora dönüş, fonksiyonel sonuçlar

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