Minimally invasive antegrade intramedullary fixation for unstable subcapital fracture of the fifth metacarpal by single elastic nail

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Background
Fractures of the neck of the fifth metacarpal are common and mainly occur in young men. The injury often occurs through aggression, such as a fist fight or punching a hard object.
The aim of this study was to assess clinical and radiological outcomes of fifth metacarpal neck fractures using minimally invasive antegrade single intramedullary fixation prepending elastic nails in the selected patients and to explore the ideal puncture point to avoid iatrogenic ulnar nerve injury.
Patients and methods
A single elastic nail with suitable diameter was used in 24 cases of fifth metacarpal neck fractures with dorsal angulation over 45°. An initial entry point was perforated at the ulnar-dorsal base of the metacarpal. The nail was inserted in an antegrade approach. The nail was usually removed at about 8 weeks postoperatively.
Results
This study reported the results of 24 patients who were affected by closed fractures of the neck of the fifth metacarpal bone (boxer's fracture) and were treated with percutaneous single elastic intramedullary nailing to verify the effectiveness of this surgical treatment. The average follow-up period was 20.75 months. The parameters evaluated included angulation, rotational alignment, postoperative metacarpophalangeal range of motion, and time to union. At the final follow-up, no patient reported residual pain, and all fractures proceeded to bony union.
Conclusion
The authors recommend that this percutaneous single elastic intramedullary nailing was a minimally invasive and reliable fixation technique for fifth metacarpal neck fractures with good functional results and low morbidity.

Keywords:
antegrade single elastic nailing, minimal invasive, unstable subcapital fracture of the 5th metacarpal

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Introduction

Fractures of the metacarpal bones are very common injuries of the skeletal system and in ~50% of the cases involve the neck of the fifth metacarpal bone, which is called boxer fracture [1]. These fractures result from a longitudinal compression force acting on a flexed metacarpophalangeal (MCP) joint. The resultant fracture is usually unstable with volar angulation due to comminution of the volar cortex and the deforming action of the interosseus muscles [2].

Conservative treatment with reduction and immobilization was sufficient in most cases [3,4]. So, a dorsal angulation less than 45° can be treated conservatively [5]. A fracture angle greater than 45° results in significant muscle shortening, which can limit motion of the fifth digit, and surgery was usually indicated [6].

Many of the procedures had been applied, including intermetacarpal K-wire [7], intramedullary K-wire [8], and locking plate [9]. However, each of them had some drawbacks clinically. K-wires fixed with an acute angle or entry point are very close to the fracture line, and this would lead to unstable fracture reduction. Plates may induce extensive soft tissue dissection, nonunion, and wound infections [10]. Recently, elastic stable intramedullary nailing was also used for metacarpal fractures clinically with an excellent effect in children [11]. The advantages of elastic stable intramedullary nailing include faster fracture healing, excellent functional and cosmetic results, safe and reliable surgical technique, and lower complication rate [12]. In addition, it was reported that antegrade intramedullary pinning has some clinical advantages during the early recovery period over percutaneous

retrograde intramedullary pinning for the displaced fifth metacarpal neck fractures, and antegrade intramedullary pinning can be recommended for patients who require an early return of hand function [13].

Patients and methods

A total of 24 male patients (mean age: 27.2 years, range: 20–47 years) with unstable fracture of fifth metacarpal neck included in this study were managed and followed up at the authors' institute in the period between June 2014 and September 2015. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Tanta University, Egypt.

Inclusion criteria were age greater than 18 years; presence of an acute onset (0–15 days), closed, and simple fracture of the fifth metacarpal neck; and presence of an angulation of greater than 45°in oblique plane imaging. The angulation deformity of the neck of fifth metacarpal was evaluated by measuring the angulation in the continuity of the dorsal cortical line of the fifth metacarpal in a 30° oblique radiographic image.

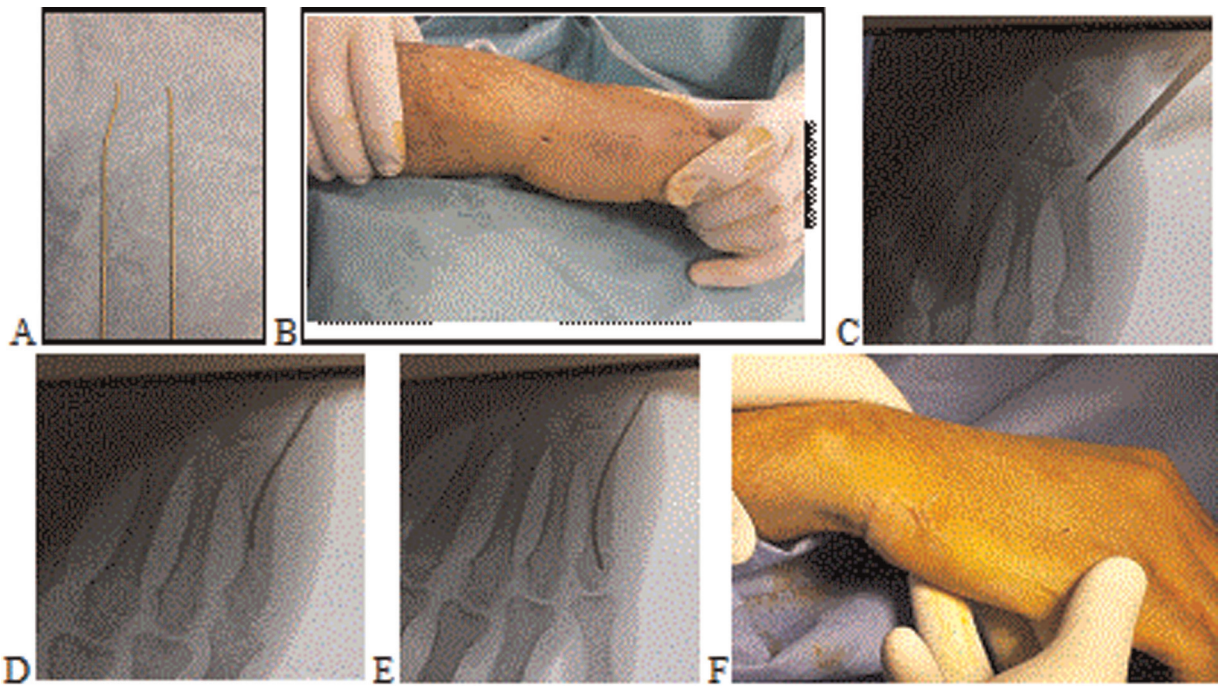
With the aforementioned criteria, 24 patients were included in the study. Fractures were on the right hand in 20 patients (83.3%) and on the left in four (16.7%). The dominant side was affected in 21 patients (87.5%). The mode of trauma was punching a hard surface in anger in 20 patients (83.3%) and direct trauma in four (16.7%).

Surgical technique

The surgical procedure was performed with block anesthesia in nine patients (37.5%) and under general anesthesia in 15 patients (62.5%). The patient was laid in the supine position. Closed reduction was applied employing the Jahss maneuver under fluoroscopic image guidance. Then, a small incision of less than 5 mm was made distal to the carpometacarpal joint, proximal to the base of fifth metacarpal. Standard access of the pin should preferably be on the margin of the opponens digiti minimi, on the median line of the lateral side of the fifth metacarpal bone to avoid the risk of iatrogenic injury to the minima dorsal branch of ulnar nerve (DBUN).

A cortical window was created with a sharp awl and widened cautiously. Fixation was performed with an intramedullary insertion of single pre-contoured elastic (Nancy) nail 2 mm in an antegrade fashion. The elastic nail was prepended in smooth curve lazy S shape. Distal angulation of the nail after check the reduction was advanced toward the palmar aspect of metacarpal head and then rotated toward the dorsal aspect of the metacarpal head to correct the palmar angulation (Fig. 1). Stability of the reduction was checked under image intensifier. Distal ends of the nail were advanced to the cancellous part of the metacarpal head

Figure 1



(a) Elastic nail prepening; (b) skin incsion; (c) Insertion the Awel; (d) antegrade nail proximal part; (e) enter the distal part; (f) skin cluture by single stitch.

for adequate fixation. Proximal ends of the wires were cut off at the cortex level and left under the skin. The surgical incision site was closed with 4/0 absorbable sutures.

The duration of surgery ranged between 15 and 35 min, with a mean of 23.13±2.8. Splints applied after wound dressings were removed on the seventh day. Simple daily activities and use of keyboard and pens were allowed.

The nails of all patients were removed on the eighth postoperative week under local anesthesia without redisplacement in any cases.

Statistical analysis was performed using the SPSS 20.0 software (IBM Corp. Released 2011, IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY: IBM Corp.). The level of significance was set at ($P<0.001$).

Results

This study reported the results of 24 patients who were affected by closed fractures of the neck of the fifth metacarpal bone (boxer's fracture) and were treated with percutaneous single elastic intramedullary nailing, to verify the effectiveness of this surgical treatment. The average follow-up period was 20.75 months. The parameters evaluated included angulation, rotational alignment, postoperative MCP range of motion, and time to union.

At the end of the follow-up, the mean total active motion was 261° (range: 220–270°). The grip strength of studied patients ranged from 88 to 96%, with a mean of 92.7±2.6. The mean angulation decreased from 44.6° (range: 41–57°) preoperatively to 1.5° (range: 0–10°) postoperatively ($P<0.001$). Preoperative metacarpal shortening of 8.6 mm (range: 6–15 mm) improved to 0.5 mm (range: 0–2 mm) on the 45th postoperative day. The mean Quick-DASH score on the 30th-day follow-up was 2.3 (range: 0–14.7), whereas it was noted as 0.69 (range: 0–2.3) at the final follow-up. In one case, we found reduction loss during postoperative period (palmar angulation was increased from 2 to 7° and metacarpal shortening was 2). No other surgical complications were observed in either early-term or late-term follow-up.

The mean duration from the time of fracture to treatment was 1.8 days (range: 0–4 day). Preoperative palmar angulation was 44.6° (range: 41–57°), whereas a mean of 1.8° (range: 0–7°) was measured after the 45th postoperative day. Preoperative metacarpal shortening of 9.3 mm (range: 6–15 mm) improved to 0.5 mm (range: 0–2 mm) on the 45th postoperative day. In terms of total joint range of motion, flexion of the treated side was at 96% (range: 85–100%) and extension at 97% (range: 92–100%) when measured versus the healthy-side values on the 45th day follow-up (Fig. 2). The mean Quick-DASH score on the 30th-day follow-up was 2.3 (range: 0–14.7), whereas it was noted as 0.69 (range: 0–2.3) at the final follow-up. In one case, we found reduction loss during postoperative period (palmar angulation was increased from 2 to 7° and metacarpal shortening was 2 mm. At the final follow-up, no patient reported residual pain and all fractures proceeded to bony union.

Discussion

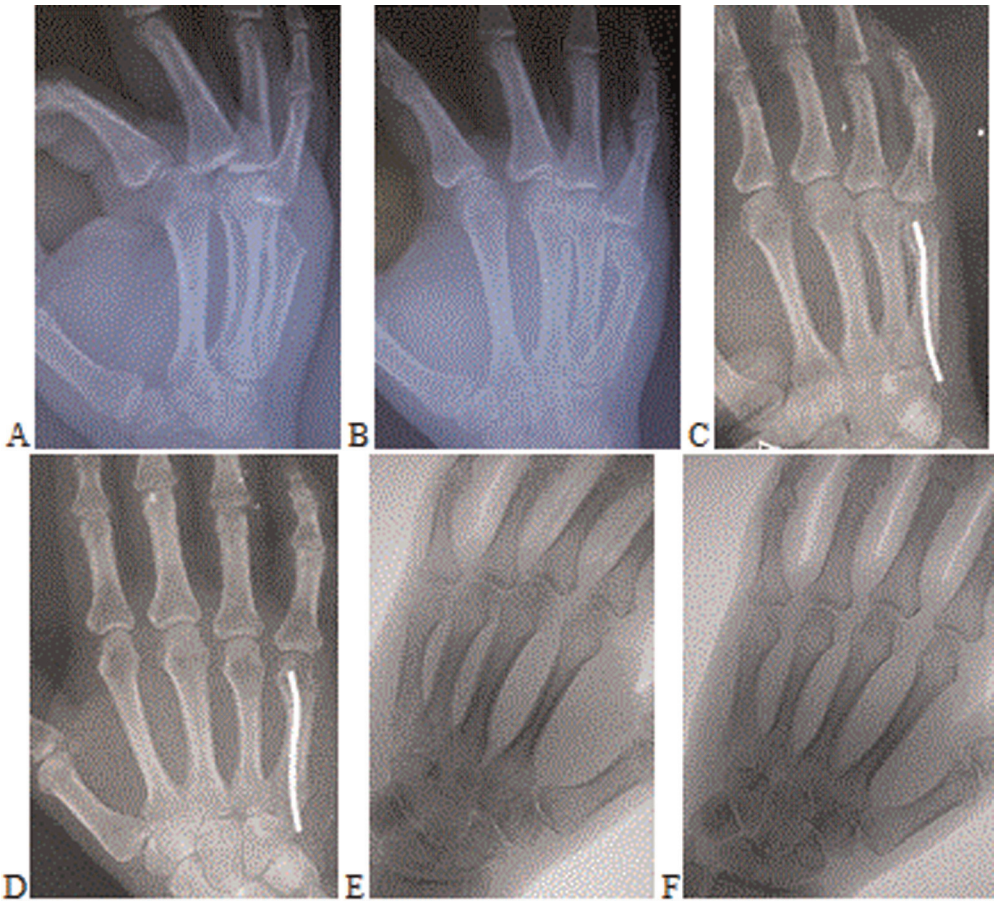
The management of boxer's fracture is still controversial [14]. Various operative techniques have been proposed for the surgical treatment of these fractures [15]. The principles of treatment include restoration of articular anatomy, stable fixation of fractures, elimination of angular or rotational deformity, and rapid restoration of mobility and function [16,17].

Facca *et al.* [13] reported better results in the group stabilized with intramedullary K-wire in comparison with a second group treated with locking plates and immediate mobilization. In this second series treated with locking plates, it was reported a deficit, despite immediate mobilization, of the MP joint owing to the adherences of the extensor tendons.

Retrograde fixation has the relative disadvantages of MCP joint stiffness and extensor lag resulting from limitation of MCP joint extension and trauma to the extensor hood and collateral ligaments during wire insertion [18].

Transverse pinning has been studded by a number of authors [19]. The technique was described most precisely by Lamb and colleagues. It is an easy procedure, which has many advantages: it is simple and quick, it provides good stability, is not very painful, and has a low learning curve for the surgeon. On the contrary, it has some problems. The distal K-wire may damage the MCP articulation, especially for distal fractures. Introducing a K-wire through the intermetacarpal space may damage the interosseous muscles. Involvement of the ring metacarpal in the fixation makes movement between the two ulnar metacarpal bones impossible and therefore may reduce

Figure 2



(a–b) Radiography preoperative; (c–d) postoperative radiaography; (e–f) after coplet union and removale of elastic nail.

mobility of the hand. This, perhaps, is the reason for the poorer functional outcome with this technique when compared with intramedullary pinning.

Intramedullary pinning and internal fixation with locking plates are the other two common methods of treatment for boxer's fracture. Recently, in a comparative study on fifth metacarpal neck fracture fixation, Facca *et al*. [20] reported better results in the series stabilized with intramedullary K-wire in comparison with a second series treated with locking plates and immediate mobilization. In this second series treated with locking plates, the authors reported a deficit, despite immediate mobilization, of the MP joint due to the adherences of the extensor. Winter *et al*. [21] in their short-term retrospective study, with a mean follow-up of 2.7 months, reported that in the boxer's fracture, intramedullary pinning gave better functional outcomes than transverse pinning, although they concluded that intramedullary pinning is technically more demanding than transverse pinning and the surgeon has a more definite learning curve. The functional and radiological results demonstrated that surgically treated patients with antigrade single elastic nail gained hand functions earlier and returned to active daily living and work activities in a short period of time with low incidance of deformity.The use of titanium nails allowed greater elasticity than was available in the steel nails. The elastic nail (Nancy) has superior biomechanics than K-wire in the ability to withstand axial loads, and prepending in lazy S shape allows three-point fixation and gives more stabilty and allows early recovery [22].

The results of this study confirm the significant proximity of the dorsal digital branch to the little finger (DDBLF) of the DBUN to the course of the pin, with potential iatrogenic injury during the fifth metacarpal subcapital fracture treatment. This study emphasizes the risk of iatrogenic injury to the DBUN and is important because loss of sensibility can affect the nimbleness and function of the hand. Standard access of the pin should preferably be on the margin of the opponens digiti minimi, on the median line of the lateral side of the fifth metacarpal bone.

Conclusion

The use of minimally invasive percutaneous antegrade intramedullary nailing using a single Nancy nail after prepending in the form of Lazy S shape in fifth metacarpal neck fracture (boxers' fractures) is effective. This would yield fast functional recovery of the hand and allows for early return to daily activities and work, with minor or no complications.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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