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Original Research Article

"Bouquet technique" for displaced boxers fracture: Surgical technique and outcomes in 143 consecutive cases

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Abstract

Background: Fifth metacarpal neck fractures, also known as Boxer's fractures, commonly occur as a result of axial impact on a clenched fist. There is no agreement over the optimum management of undisplaced boxers fracture. We present the results of treatment by a Bouquet technique, described by Foucher in 143 consecutive cases of displaced fifth metacarpal neck fractures.

Methods: We retrospectively reviewed our records for 143 consecutive cases of fifth metacarpal neck fractures treated with Bouquet technique. Clinical and radiological evaluation was done at 6 weeks, 12 weeks and 6 months. Total active motion of the fifth digit, radiography and complications if any were noted.

Results: Of 143 cases, there were 113 cases with closed reduction and 30 with open reduction. Radiological union was achieved in 140 cases. Remaining 3 were lost to follow up. Good to excellent result was achieved in 95% cases. Seven cases developed bursitis at the K-wire entry site which required k-wire removal.

Conclusion: The technique of flexible antegrade intramedulary nailing of fifth metacarpal neck fractures is simple, safe, soft tissue sparing, minimally invasive technique giving excellent functional and cosmetic results with minimal complications.

Keywords: Boxers fracture; k-wire; bouquet technique; fifth metacarpal; outcomes.

1. Introduction

Fifth metacarpal neck fractures are interesting due to the frequency of their occurrence and numerous modalities of their treatment, namely compression bandage, functional splinting, closed reduction and splinting, transfixation or cross K wiring, intramedulary wire fixation, open reduction and plate or tension band wire fixation, external fixation etc. Moreover all the treatment modalities have reported good functional and end results.[1-5,9,17,32,45,46]

These fractures, also referred to as 'Boxer's fracture'[9], are commonly encountered in the dominant hand of individuals and show male predominance. They commonly occur as a result of an axial impact on a clenched fist.[2-5] While there is universal agreement over the management of undisplaced fractures by non-operative means, a varied opinion exists regarding the amount of acceptable volar angulation for non-operative management.[2-9,17,22,27,32,38,41-45] Various reports suggest that it is almost impossible to maintain the reduction by non-operative means. [7,9,20,21,28,37,43,46] This leads to persistent deformity and morbidity in almost every case of displaced fifth metacarpal neck fracture treated non-operatively.

Biomechanical experiment studies have demonstrated altered intrinsic muscle tensions and dynamics with persistent angulation and shortening of the metacarpal head. There are number of patients unwilling to accept the cosmetic deformity of the knuckle that occurs in nearly every case of conservative treatment. There may be pseudo clawing, cramping, loss of endurance and weakness of the hand.[22,24] A non compliant patient is another indication for surgery.[29]

We have conducted the retrospective review of 143 isolated extra-articular displaced fifth metacarpal neck fractures with or without soft tissue injury. These fractures

were treated by either closed or open reduction and were stabilized with multiple flexible antegrade intramedulary nailing technique using pre-bent blunt tipped K wires, as described by Foucher[21]. The aim of the treatment was to reduce any deformity such as volar flexion, malrotation, deviation and shortening, and to restore the anatomy. Our purpose was to evaluate the functional outcome of this technique in the fifth metacarpal neck fractures.

2. Materials and methods

142 patients with 143 isolated displaced fifth metacarpal neck fractures were treated with this method by two surgeons between 2003 and 2011. Records were collected from the hospital database. There were 110 males and 33 females in the cohort studied with a mean age of 26.4 years (Range: 16-48). Majority of the fractures were due to boxing punch and others due to blunt trauma. Five patients had associated extensor tendon injury that required suturing. The patients were treated between two days and two months following the injury. Patients with any other associated injuries were excluded from the study.

We used the technique of flexible antegrade intramedullary nailing. All the patients were operated by closed reduction or open reduction with internal fixation with K-wires as described by Foucher[21]. Postoperatively, a volar slab extending up to the proximal inter phalangeal joint was given for 2 weeks. Mobilization of proximal interphalangeal joint was begun immediately after surgery whereas metacarpophalangeal joint mobilization was started at 2 weeks under supervision. All patients were followed up for minimum period of six months. Clinical evaluation was done at 6 weeks, 12 weeks and 6 months post-operatively. Clinical evaluation included measurement of Total Active Motion (TAM) at fifth digit. TAM was defined as the sum of active motions for the three joints of the finger viz. metacarpophalangeal joint, proximal interphalangeal joint and distal interphalangeal joint. Radiological evaluation was done with x-rays taken immediate postoperatively, at 6 weeks and 12 weeks. We retrospectively reviewed the prospectively collected data.

3. Results

Of the 143 cases, closed reduction was performed in 113 patients and open reduction in 30. On an average three K wires were used per case (Range: 2-4). Seven patients developed adventitious bursitis due to backing out of the K wires at the proximal metacarpal entry point, four weeks after surgery. This problem was resolved completely after the removal of K wires after confirming fracture union. Radiologically, the fractures united in 140 cases without any change in the reduced position of metacarpal head achieved during surgery. Remaining 3 patients were lost to follow-up.

The criterion for evaluating our results was based on TAM (Total Active Movement) at the fifth digit. All the cases with closed reduction and multiple intramedulary nailing (n=113) had excellent TAM. They recovered with the TAM of greater than 220 degrees within six weeks post surgery. They were grouped as 'excellent results'. Out of the remaining 30 patients who required open reduction, 20 patients achieved TAM greater than 220 degrees; however the time taken was about twelve weeks. These patients were grouped as 'good results'. Fair results were achieved in the remaining seven patients with the TAM of 180 degrees at twelve weeks. Five of these patients had extensor tendon injury that had to be sutured at the time of surgery along with open fracture fixation.

Table 1: TAM result

TAM (Total Active Motion)	Result	n (Percentage)
>220º @ 6 weeks	Excellent	113(80%)
>220º @ 12 weeks	Good	20(15%)
>180º @ 12 weeks	Fair	7 (5%)

3.1 Surgical Technique

All the cases were operated under brachial block with patient in supine position and hand to be operated over side arm support. After standard scrubbing, painting and draping, a small incision is made over the dorsum of hand at the base of fifth metacarpal. Extensor tendon is retracted to expose the bone. The entry portal site is dorsal and proximal metaphyseal and is selected under image intensifier guidance as far from the fracture site as possible. (Figure 1)

A single entry portal is made with 2.5 mm K wire at 45 degrees angulation towards the fracture site. The intramedulary canal is confirmed with curved tip of another 2.5 mm K wire that acts as an awl. (Figure 2)

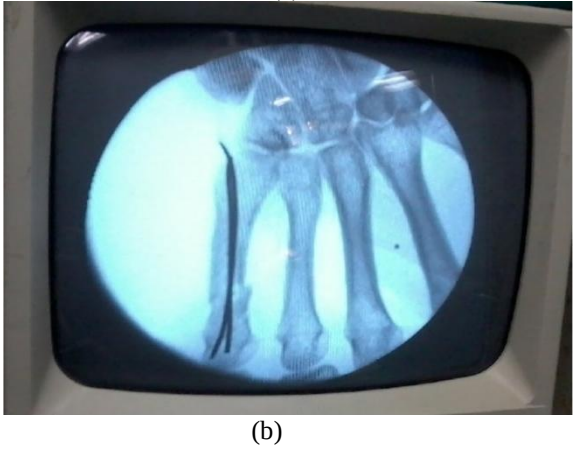
The K wires which are used as flexible nails are 0.8 to 1 mm thick and their blunt tips are bent 20 to 30 degrees in such a way that they skid along the medulary canal of the fifth metacarpal when inserted at 45 degrees through the dorsal entry portal. Further the K wires are bent at right angle in the same plane about 6 to 7 cm from the tip so that the tip can be controlled and rotated in the desired direction (Figure 2). Two to four 0.8 mm to 1 mm such K wires those are used as flexible nails are inserted into the medulary canal through the entry portal and advanced up to the fracture site. Fracture reduction is done under image intensifier guidance; rotation is corrected by rotation the little finger and the wires are further advanced up to the subchondral bone. While advancing, the wires are also rotated so that their tips engage different quadrants of fifth metacarpal head from within, thus providing stability. Now the K wires are cut at the entry portal as near to the bone as possible to avoid tethering of the extensor tendon. (Figure 3a and b) The wound is closed. Post operatively a volar slab is given that extends up to the proximal interphalangeal joint.

Figure 1: The entry portal site (dorsal and proximal metaphyseal)

Figure 2: The intramedulary canal is confirmed with curved tip (2.5 mm K wire that acts as an awl)

Figure 3: K wires are cut at the entry portal as near to the bone as possible to avoid tethering of the extensor tendon

(a)



(b)

4. Discussion

Fifth metacarpal fractures are very common and easy to diagnose. While there is a universal agreement on the conservative management of undisplaced fractures, there are varied opinions regarding the acceptability of the degree of displacement and angulation of the distal fragment for conservative management. The acceptable volar angulation of metacarpal head in literature ranges from anywhere between 20 degrees to 70 degrees.[2,4-6,9,17,28,32,38,41,44,45] However some authors do not consider even 15 degrees of angulation acceptable.

The residual volar flexion deformity of the metacarpal neck may cause discomfort, pain in gripping, cramping, weakness, loss of endurance and even pseudo clawing. [3,4,22,23] Various experimental and biomechanical studies have confirmed the deleterious influences of residual angulation and metacarpal shortening on hand function.[1,42]

A closed reduction of displaced metacarpal neck fracture is reported to be difficult to achieve and impossible to retain in reduced position by non operative methods. By closed means using plaster splints, three point fixation cannot be achieved.[7,17,21,28,37,44,46] Green and Rowland mentioned that all the fractures of metacarpal neck are inherently unstable due to deforming muscle forces and volar comminution at the fracture site.[28,39]

Therefore all the displaced metacarpal neck fractures qualify to be called as unstable as defined by Dabezies and Schutte, and would justify internal stabilization [14]. Ashkenaze and Ruby have called for reduction and stabilization of irreducible, rotated and unstable fractures of metacarpal neck.[3]

Open reduction and internal rigid fixation using plates has been recommended for unstable fractures.[14,15,19] These may cause problems with fracture healing, soft tissue tethering, extensor tendon adhesions, and wound breakdown. Further, rigid fixation is difficult to obtain as the fracture is so distal that there is a limited room for hardware. In those fractures which present late, it would be difficult to get adequate purchase in the porotic distal fragment.[40,45] Fusetti *et al* concluded that metacarpal plate fixation remains fraught with complications and unsatisfactory results.[24]

The use of miniplates is reserved for fractures with comminution, bone loss and in cases of complex hand trauma.[10,12,13,16,27,30,31,34,48]

Tension band wiring has also been considered by some authors for fixation of these fractures.[3,31] Melone cautioned against indiscriminate use of rigid internal fixation using plates and screws or tension band wires as it is exceedingly difficult in small bones with delicate soft tissue envelope.[49]

Percutaneous interfragmentary wiring seems to be less aggressive and most widely used. Transfixation of

adjacent metacarpals has been reported by few authors.[3,35] Axial K wires fixation consisting of percutaneous introduction of intramedulary wire through reduced metacarpal head was reported by a few authors[3,18,31,33,36]. Jobe in 1998 reported retrograde intramedulary K wire fixation after open reduction of the fracture site.[33] Although these methods are relatively easy to perform, they have several disadvantages. They may lead to soft tissue tethering and adhesions. Percutaneous K wires may hinder the mobilization due to pain. They may get infected if wire ends are left exposed outside the skin. When inserted retrograde these K wires may damage the joint cartilage. Single k-wire across the fracture does not control the rotation of distal fragment. Meals and Meuli do not consider axial K wires fixation as intramedulary fixation as the wires do not have any hold on the inner cortex of the bone.[47]

External fixation has the same risks as percutaneous wires and seems to be an overtreatment to this extra-articular condition.[45] It is indicated only in comminuted fractures with segmental bone loss.[28]

Guy Foucher reported the technique of multiple antegrade intramedulary flexible nails fixation for the fifth metacarpal neck fracture for the first time in 1976. Subsequently the French, German and English literatures have reported favorable results comparable to our series.[4,6,11,20,21,25,37,38,41,44,45] Other authors have successfully employed this technique in other metacarpal fractures as well.[21,25,26,41,45]

Our indications for internal fixation surgery had been; displaced or unstable fractures of metacarpal necks, open fractures with soft tissue trauma and patients unwilling to accept the cosmetic deformity resulting from non operative treatment.

We use a combination of 0.8 and 1 mm wires and agree with Manueddu and Della Santa that as many wires those can be easily introduced and advanced up to the metacarpal head should be employed in order to maximize the intramedulary locking.[45]

Although some authors did not use a splint post operatively [11,21], most authors used splint for four weeks. We routinely splint all our cases postoperatively, keeping wrist neutral, and the metacarpophalangeal joint at 90 degrees flexion. The interphalangeal joints are kept free for early active mobilization.

Foucher *et al*, Lenoble and Goutallier *et al*, Liew *et al* and many other authors routinely removed wires, however we do not recommend their removal unless requested or any complication such as adventitious bursitis occurs.[21,38,41]

Our complication rate was comparable to those encountered by the previous authors. [4,6,11,21,25,38,41,45] Two of our patients suffered from adventitious bursitis due to the imperfectly trimmed proximal end of wires. These were removed following fracture union. These two patients were included in the group that achieved good function. Fair results were seen in three patients, two of which required open reduction due to direct trauma and extensor tendon injury which required suturing.

Majority of our patients (n=139) went back to their original job in the range of three to four weeks depending on their job demands. These results compare favorably to with the reported time off work in the non-operatively treated series of Arafa *et al*, Eichenholtz *et al*, Hunter and Cowen *et al*, Lowdon *et al*, and McKerrel *et al*.[2,17,32,43,46] The details of remaining patients were not available.

Radiologically all the fractures united in the anatomical or near anatomical correction achieved at the time of surgery. The post operative correction was maintained through the entire length of follow up.

We agree in principle with Manueddu and Della Santa that the technique may not be able to prevent some residual shortening of the metacarpal. [25] This probably occurs due to the comminution of the metacarpal neck at the time of injury. Secondly the fracture fragments may collapse along the implant due to constant pull of the intrinsic muscles. However this is not associated with any functional or cosmetic deficit. Firm anchorage of the blunted prebent tips of the wires in different quadrants of the metacarpal head along with intramedulary stacking of maximum numbers of wires and their properly trimmed proximal ends help minimize the shortening. As opposed to the rigid fixation, flexible fixation stimulates callus formation.

This technique of bouquet osteosynthesis is simple, safe, minimally invasive, and maintains the reduction thus providing reliable fracture stability. It also preserves both carpo-metacarpal and metacarpo-phalangeal joints and spares the extensor hood and the tendon. It allows early mobilization and thus reduces the time off the work. This method compares favorably with the functional non-operative treatment with the main advantage being the restoration of metacarpal anatomy with its functional and cosmetic implications which is impossible to achieve with non-operative methods.

5. Conclusion

Displaced fifth metacarpal neck fractures are unstable and it is impossible to maintain their reduction by non-operative methods. The technique of flexible antegrade intramedulary nailing of fifth metacarpal neck fractures described by Foucher is simple, safe, soft tissue sparing, minimally invasive technique giving excellent functional and cosmetic results within a short time permitting early return to work with minimal complications. The main disadvantage with this technique is a learning curve and technical difficulties in the initial few cases.

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