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Original Research Article

The study outcome of bouquet technique for the management of displaced boxer's fracture

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ABSTRACT

Background: Fifth metacarpal neck fracture is also called Boxer's fracture. Most commonly occurs due to aggression behaviour that result in punch on a wall with a clenched first. If there is a displacement of boxer's fracture more than 50^0 then it has to be managed operatively. We here present the outcome of bouquet technique that we used to operate the 80 cases of 5th metacarpal neck fracture.
Methods: We studied and did follow up of the 80, 5th metacarpal neck fracture that managed by bouquet technique. Clinical and radiological assessment was done at 4weeks and 6 weeks and 12 weeks. Total active motion, radiography and complication were noted.
Results: Out of 80 patients that were studied 72 got excellent results and 8 got fair results. Whereas one patient got infection and 2 got adventitious bursitis at the entry site which requires k wire removal.
Conclusions: The technique of antegrade intramedullary 3 kirschners wire in management of 5th metacarpal neck fracture is safe, simple, soft tissue sparing, minimally invasive technique with excellent functional and cosmetic outcome with minimal complications.

Keywords: Boxer's fracture, Bouquet technique, Kirschner wire, 5th metacarpal neck

INTRODUCTION

Isolated metacarpal fractures are one of the most common injuries of hand and they account for 36% of hand fractures.[1] Among these the fractures of the neck of the 5th metacarpal (also known as Boxer's Fracture) is a common injury and accounts for approximately 20% of all hand fractures.[2] Boxer's fracture usually occurs when an object is punched with a closed fist, resulting in a direct impact to the knuckles of the hand. This causes the fifth metacarpal neck to fracture, often with displacement of the metacarpal head in a palmar direction. Boxer's fracture is generally associated with aggressive behaviour, and is more likely to be seen in men than women, although it can also occur during sports or in people who fall on to one of their closed fists.[3] It is mostly seen in dominant hand. When the impact is axial the fracture is transverse, the fracture lines become oblique when there is torsion in addition to compression, and its more comminuted in high energy trauma.[4] When sufficient force is applied to the metacarpal phalangeal joint to cause fracture, the tension from the hand muscles can cause palmar angulation.[5] Normal angulation between the little finger metacarpal head and neck is 15º, Ozturk et al stated that any increase in this angulation may compromise hand function.[6] Also, correlation is observed between the extent of the palmar angulation and long- term functional impairment of hand.[7] Metacarpal neck fracture presents with features like palpable metacarpal head in the palm, decreased range of motion and loss of metacarpal head prominence. The main

deformity in metacarpal neck fractures is palmar angulation of apex which can be due to impaction which occurs on dorsum of head, more comminution in the volar aspect and the action of intrinsic muscle on volar aspect causing flexion of metacarpal head leading to shortening of the metacarpal. Closed reduction can be performed on these fractures but often they fail because of the muscle forces acting on the distal part of the fractured metacarpal.[8] Closed reduction of the metacarpal neck fracture by Jahss manoeuvre and cast immobilization is usually performed.[9] Many surgical techniques have been described to treat the unstable fifth metacarpal neck fractures in order to achieve reduction and obtain stability, like a) closed reduction and retrograde pinning using intramedullary K-wires, b) closed reduction and antegrade intramedullary pinning using intramedullary K-wire (2 to 4) Bouquet technique c) Close reduction and transverse pinning with K-wires, d) Open reduction and internal fixation with mini condylar blade plate osteosynthesis.[10,11] The variability in the treatment options is due to many reasons, including patient choice, surgeon's preference, their experience, and local practice patterns. Presently, there is no consensus regarding the optimal management of the little finger metacarpal fractures worldwide. Although fracture of the neck of the 5th metacarpal is common injury, no established management protocol exits. The degree of acceptable palmar angulation of the neck of 5th metacarpal fracture is debatable.[12] Recommendation in the literature varies from 20º to 70º of angulation.[13,14] This study has the primary objective for determining the efficacy of percutaneous antegrade multiple intramedullary pinning 3 kirschner wire with respect to functional and radiological outcomes.

We have conducted the study on 80 patients with isolated extra-articular displaced fifth metacarpal neck fractures with or without soft tissue injury. These fractures were treated by closed reduction and were stabilized with multiple flexible antegrade intramedullary nailing technique (3 kirschner wire) using pre-bent blunt tipped K wires. 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 Bouquet technique in the management of fifth metacarpal neck fractures.

METHODS

We did this study in Sawai Man Singh Medical College and attached Hospital, Jaipur, Rajasthan. It is a prospective interventional study with 80 patients had isolated displaced (>50 volar angulation) fifth metacarpal neck fractures were treated with this method by 2 surgeons between 2020 and 2022 by taking the ethical clearance approved by ethical committee.The results were analyzed by Standard deviation technique. There were 65 males and 15 females in the cohort studied with a mean age of 33.03 years (range: 18-50). Majority of the injuries are associated with aggression behaviour so that punch on a wall by clenched fist and others due to blunt trauma. Five patients had associated extensor tendon injury that required suturing. The patients were treated within two days following the injury. Patients with any other associated injuries and intra articular and comminuted fractures, pathological fracture, associated neurovascular components were excluded from the study. We used the technique of flexible antegrade intramedullary nailing (Kirschner wire). All the patients were operated by closed reduction with internal fixation with K-wires. Postoperatively, a cockup 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 4 weeks under supervision. All patients were followed up for minimum period of 3 months. Clinical evaluation was done at 4 weeks, 6 weeks and 12weeks 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.

Figure 1: Pre op X-ray.

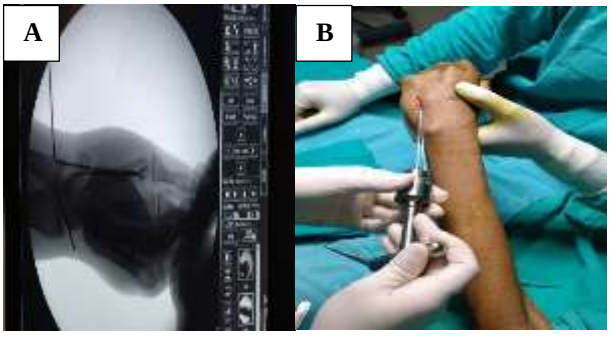

Figure 2: IITV and view of intramedullary canal. 2A) Intra-op IITV image. 2B) Entry point is made and the intramedullary canal is confirmed with curved tip (2.5mm K-wire).

All the cases were operated under supraclavicular 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.[15] 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.[16] A single-entry portal is made with 2.5 mm (Figure 2) K wire at 45 degrees angulation towards the fracture site. The intramedullary canal is confirmed with curved tip of another 2.5 mm K wire that acts as an awl. 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 medullary canal of the fifth metacarpal when inserted at 45 degrees through the dorsal entry portal.[17] 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.[18] Two to four 0.8 mm to 1 mm such K wires those are used as flexible nails are inserted into the medullary 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.[19] While advancing, the wires are also rotated so that their tips engage different quadrants of fifth metacarpal head from within, thus providing stability. Subsequently 3 wires are used. 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 3) The wound is closed. Post operatively a cockup slab is given that extends up to the distal interphalangeal joint.[20]

Figure 3: K-wires are bend at 900 at the entry site as near to the bone as possible to avoid tethering of the extensor tendon.

RESULTS

Total sample size was 80 patients, among those 65 males and 15 females, on an average of 3 K-wires we were used per case. Total 3 complications were observed out of which 1 patients had superficial surgical site infection and 2 patients had adventitious bursitis. The criteria for evaluating our results were based on TAM (total active movement) at fifth digit. All the cases with closed reduction and multiple intramedullary K-wiring (N=72) had excellent TAM. They recovered with the TAM of greater than 220^0 within 6 weeks of surgery, they were grouped as excellent results, out of remaining patients got TAM more than 180^0 within 12 weeks and consider then as fair results.

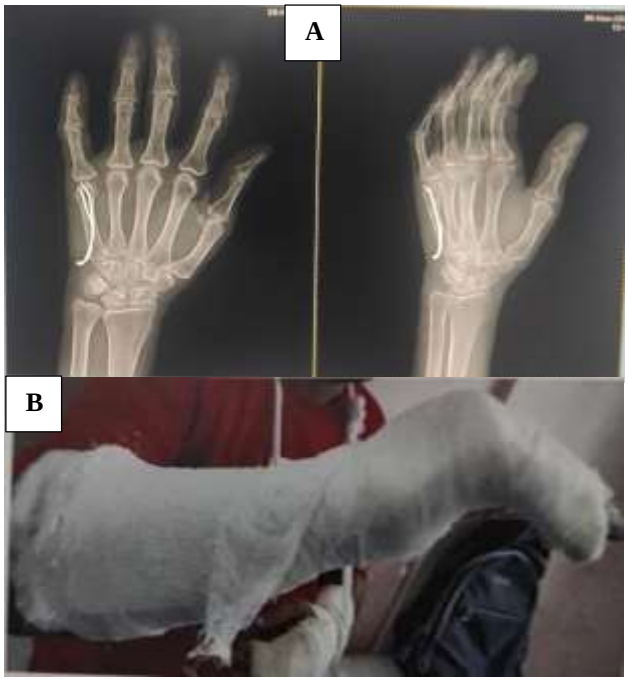

Figure 4: Post-op x-ray and cockup slab. 4A) Post-op x-ray, 4B) Post operatively cockup slab is applied.

Table 1: Total active movement (affected hand) (degrees).

Total active movement (degrees)	Result	Number	Percentage
>220º at 6 weeks	Excellent	72	90
>180º at 12 weeks	Fair	8	10
<180^0 at 12 weeks	Poor	0	0
Total		80	100.00

Table 2: Plamar angulation (pre-op radiograph) (degrees).

Palmar angulation (degrees)	Mean	SD	Median (range)
Pre-op	52.01	2.63	52 (50-54)
Post-op	7.28	1.23	8 (6-10)

Table 3: Metacarpal shortening (pre-op radiograph) (mm).

Shortening (mm)	Mean	SD	Median (range)
Pre-op	3.41	0.54	3 (3-5)
Post-op	0.35	0.48	0 (0-1)

DISCUSSION

Fifth metacarpal neck fractures are very common and easy to diagnose. While there is a universal agreement on the conservative management of un displaced fractures, there are varied opinions regarding the acceptability of the

degree of displacement and angulation of the distal fragment for conservative management.[21] The acceptable volar angulation of metacarpal head in literature ranges from anywhere between 20 degrees to 70 degrees. In our study we operated on 5th metacarpal neck fracture of 80 patients with the average angulation of 52 degree and the shortening of 3mm we have done a proper follow up and got the result of 72 patients with excellent results that is TAM >220° at 6 weeks and the fair results of 8 patients with TAM Of >180°at 12 weeks and the post operatively the average angulation is reduced to 8 degree and the shortening reduced to almost nil. 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. Various experimental and biomechanical studies have confirmed the deleterious influences of residual angulation and metacarpal shortening on hand function. 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. 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. Therefore, all the displaced metacarpal neck fractures qualify to be called as unstable as defined by Dabezies and Schutte, and would justify internal stabilization. Ashkenaze and Ruby have called for reduction and stabilization of irreducible, rotated and unstable fractures of metacarpal neck. Open reduction and internal rigid fixation using plates has been recommended for unstable fractures. 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. Fusetti et al concluded that metacarpal plate fixation remains fraught with complications and unsatisfactory results.[22] The use of miniplates is reserved for fractures with comminution, bone loss and in cases of complex hand trauma. Tension band wiring has also been considered by some authors for fixation of these fractures. 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.[23] Percutaneous interfragmentary wiring seems to be less aggressive and most widely used. Trans fixation of adjacent metacarpals has been reported by few authors. Axial K wires fixation consisting of percutaneous introduction of intramedullary wire through reduced metacarpal head was reported by a few authors. Jobe in 1998 reported retrograde intramedullary K wire fixation after open reduction of the fracture site.[24] 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 intramedullary fixation as the wires do not have any hold on the inner cortex of the bone. External fixation has the same risks as percutaneous wires and seems to be an overtreatment to this extra-articular condition.It is indicated only in comminuted fractures with segmental bone loss. Guy Foucher reported the technique of multiple antegrade intramedullary flexible nails (Kirschner wire) fixation for the fifth metacarpal neck fracture for the first time in 1976.[25] Subsequently, the French, German and English literatures have reported favourable results comparable to our series. Other authors have successfully employed this technique in other metacarpal fractures as well. 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 intramedullary locking.[26] Although some authors did not use a splint post operatively, most authors used splint for four weeks. We routinely splint all our cases postoperatively, keeping wrist 20° extension and the metacarpophalangeal joint at 60 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 remove wires only after 6 weeks or their removal slight early if there is any complication such as adventitious bursitis occurs.[27] Our complication rate was comparable to those encountered by the previous authors. 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. Excellent results were seen in total 72 patients, 5 of which required open reduction due to direct trauma and extensor tendon injury which required suturing. Majority of our patients (n=72) went back to their original job in the range of three to four weeks depending on their job demands. These results compare favourably 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. 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. 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 intramedullary stacking of maximum numbers of wires and their properly trimmed proximal ends help minimize the shortening and added advantage of backout of even a single wire doesn't affect the fracture reduction during union. 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 favourably 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.

This study has some limitations. Its not a comparative study. The small number of sample size. The follow up was not long enough to assess the range of movement and pain. The associated comorbidities and its effect on fracture union were not considered, as only 5 patients in our study were having comorbidity. The study was not multicentric.

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 intramedullary nailing (3 kirschner wire) of fifth metacarpal neck fractures described by Foucher is simple, safe, soft tissue sparing, minimally invasive technique, less implant cost giving excellent functional and cosmetic results within a short time permitting early return to work with minimal complications. Palmar angulation and shortening can be corrected and maintained along with rotational alignment with this technique. This technique can be used routinely in clinical practice.

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