Tension Band Wiring for Treatment of Extra Articular Fracture of the Base of First Metacarpal

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Abstract Eleven patients with unstable extra-articular fractures of the base of the first metacarpal with angulations more than 30° uncorrected by closed reduction were treated by open reduction and tension band fixation. Ten men and one woman with a mean age of 36.18 years. Fall on a stretched hand was the cause in eight while a punch in two and trauma from a basket ball in one. The mean follow up period was 12.45 months. All fractures united within a mean of 4.36 weeks. Patients were evaluated by subjective and objective criteria: the mean of pain was 0.5, quick-DASH was 10.48 and Kapandji score was 9.8. While the mean of the grip strength was 94 % and the pinch strength was 99 % of the contra lateral hand. There were no complications except local irritation of the k-wires in two patients that had to be removed at 4 months. Tension band technique proved to be a valuable technique which is easy to apply and gives rigid fixation with early mobilization.

Keywords Tension band · Treatment · Extra articular · Base · Metacarpal

Introduction

Extra-articular fractures through the base of the thumb are common and are usually transverse or mildly oblique. The fracture is angulated with its apex dorsal such that the distal fragment is adducted and flexed [1, 2]. Fracture of the base of the first metacarpal being extra-articular and close to the joint with the pull of the deforming forces on the proximal and distal fragment makes it resembling the fracture of the olecranon. In both cases the proximal fragment is small with the pull of triceps in the case of the olecranon and the abductor pollicis longus in case of the first metacarpal creating an angulation dorsally with the distal fragment which is subjected to a deforming force in an opposite direction in both cases. Applying the same principle of tension band wiring as in the olecranon with the tension loop on the dorsal surface will allow conversion of tension forces to compression forces on the palmar surface of the thumb with early mobilization (Photos 1, 2, 3, and 4).

The vast majorities of fractures are stable and require protective cast immobilization in a thumb spica cast for 4–6 weeks. The mobility of the trapeziometacarpal joint allows as much as 30° of angulations at this level without significant loss of function [3]. If the angulation is greater than 30° closed reduction and percutaneous k-wire fixation through the second metacarpal or through the trapeziometacarpal joint transfixing it is required [4–6]. However, this interferes with early mobilization. Other option for failed conservative treatment and loss of reduction is open reduction and internal fixation by plates and screws [7–9]. Such techniques have variable results with different complications. Reviewing the literature, we could not find any series showing the technique

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—The authors have full control on all primary data and they agree to allow the journal to review the data if requested.

—This study was approved by our facility institutional review board and all subjects consented to participate.

Tension band wiring for treatment of extra-articular fracture of the base of the first metacarpal

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Photo 1 Preoperative X-ray showing fracture at base of first metacarpal

of tension band in the treatment of extra-articular fracture of the base of the first metacarpal.

In this study the technique of tension band wiring was used in the treatment of a number of patients with extra-articular fracture of the base of the first metacarpal.

Material

As a prospective study we describe the results in 11 patients treated with tension band fixation for extra-articular fracture of base of first metacarpal during the period (2008–2009). Patient selection criteria were: extra-articular fracture of the base of the first metacarpal with unaccepted or lost reduction and angulations more than 30° . From 23 cases of fracture base of first metacarpal treated by cast immobilization, 11 showed unaccepted or loss of reduction. Ten were men and one woman with a mean age of 36.18 (SD 8.6) years (range 21–48). Five were Manual workers, two white collar employees, one basketball player, one house wife, one computer engineer and one student. Fracture was in the dominant hand that was the right side in 10 patients and the left side in one.

Photo 2 Follow up X-ray showing full union of the fracture after tension band wiring

Photo 3 Follow up picture showing range of flexion and adduction

Fall on a stretched hand was the cause in eight while a punch in two and trauma from a basket ball in one. The mean time from injury to the day of surgery was 13.36 (SD 4.36) days (range 7–21) (Table 1).

Preoperative radiographs, vascular and neurological assessment were done in all patients.

Surgical Procedures

A longitudinal incision was done along the radial subcutaneous border of the thumb metacarpal. Subcutaneous dissection with identification of the cutaneous branches of the radial nerve. Identification and retraction of both the EPB and EPL to the ulnar side. Identification of the fracture site and the ABPL inserted on the base of the first metacarpal. Trial of reduction was done for studying and understanding the fracture configuration. Reduction was achieved by longitudinal traction of the distal fragment with abduction and extension. The thumb metacarpal was then pronated and the base of the metacarpal manually reduced under vision into anatomical position. A transverse drill hole 2 mm was passed distal to the fracture site and more to the dorsal surface through which a wire loop 0.4 mm was passed. The distance spanned by the wire from the fracture was at least equal to the distance from

Photo 4 Follow up picture showing range of extension and abduction

Table 1 Patient data

Age	Sex	Occupation	Mechanism of injury	Time to day of surgery (days)	Healing time (weeks)	Return to work (weeks)	Length of follow up (months)
29	M	White Collar	Punch	21	4	4	8
36	M	Manual Worker	Fall	14	6	6	9
21	M	Student	Punch	12	4	4	17
42	F	House wife	Fall	18	4	4	13
32	M	Basket player	Direct trauma	7	4	6	14
48	M	Manual Worker	Fall	12	4	4	11
46	M	Engineer	Fall	14	4	4	10
38	M	Manual Worker	Fall	16	4	4	12
27	M	White Collar	Fall	10	4	4	10
34	M	Manual Worker	Fall	7	4	4	18
45	M	Manual Worker	Fall	16	6	6	15

M male, *F* female

the fracture to the tip of the base of the first metacarpal. Definitive reduction and fixation with (1.2–1.4) mm K-wire perpendicular to the fracture and passed from proximal to distal. Two k- wires were used to act as an internal splint offsetting rotational and angular displacement forces. Intraoperative fluoroscopy was used to confirm reduction and position of the K-wires. The wire loop was then passed around the K-wires and deep to the ABPL then tightened. This technique was based on the placement of a wire loop dorsal to the midaxis of the metacarpal. In this position with movement of the thumb in flexion and adduction, tensile or distraction forces occur at the dorsal surface of the fracture site where the wire loop is located. Tension in the wire loop is then transformed into compressive forces on the palmar surface of the bone enhancing bone healing. Passing the wire loop deep ABPL adds more tension in the wire. The K wires were cut flush to the bone. Closure of the wound and a dorsal splint for 48 h was then applied.

Post Operative Protocol

After 48 h early mobilization was advised. The post surgery splint was removed and the patient was put in a removable splint with exercises every 2 h. However, the patient was instructed to wear the splint during night. At 4 weeks a plain X-ray was done. If there was definitive signs of healing the splint was completely removed with full mobilization and gradual return of work. If not, another 2 weeks with the same protocol was advised. Consecutive plain X-ray and clinical evaluation was done at 4 weeks, 3 months and 6 months. Evaluation involved the assessment of subjective and objective criteria. Subjective criteria as pain using a visual analog scale, and overall function by the quick-DASH score. Objective criteria as mobility using the Kapandji score, grip

and pinch strength using the JAMAR hand dynamometer and pinch Gauge.

Results

All fractures united within a mean of 4.36 (SD 0.8) weeks (range 4–6). The mean follow-up period was 12.45 (SD 3.2) months (range 8–18). Patients were evaluated by subjective and objective criteria. Pain mean was rated 0.5 (SD 1.0) and the mean of quick-DASH was 10.48 (SD 5.2). Mean of the Kapandji score was 9.8 (SD 0.4), the grip strength mean was 94 % (SD 3.7) and the pinch strength mean was 99 % (SD 6.3) of the contra lateral hand (Table 2).

Table 2 Patient results

Grip strength %	Pinch strength %	Kapandji scale	VAS	Quick DASH score
84.6	88.4	9	3	16.4
95.2	94.2	10	1	14.2
98.1	97	10	0	17.6
97.8	106	10	0	4.8
96.5	97.3	10	2	9.2
95.2	94.2	10	0	10.4
93.9	109.3	10	0	6.4
94.7	94.2	9	0	11.2
95.8	106	10	0	7
92.1	100	10	0	5.2
91.6	103	10	0	12.9

VAS visual analog scale, *DASH* disability of arm, shoulder and hand

There were no reported complications except local irritation of the placed k-wires in two patients that had to be removed at 4 months.

Discussion

Fracture of the base of the first metacarpal resembles fracture of the olecranon. The majority of these fractures are transverse or short oblique. These fractures are extra-articular, close to the joint and subjected to a group of deforming forces.

The deforming forces around the base of the first metacarpal are the APB, AP, and FPB for the distal fragment and the ABPL for the proximal fragment creating an apex dorsally. Applying the same principle for tension band in fractures of the olecranon allows conversion of the tension forces on the dorsal surface to compression forces on the palmar surface of the first metacarpal with early mobilization and flexion of the thumb.

Fracture of base of first metacarpal is usually treated by cast and is underlooked without great concern during the follow up [10]. Patient that end up with deformity more than 30° will have narrow web space, weak pinch and grip and may be deformity of compensatory hyperextension of the MP and flexion of IP [9]. In cases when there is early loss of reduction and still possibility of closed reduction, percutaneous fixation is recommended by some authors [11]. However the disadvantage of this technique is that it is impossible to mobilize the patient and allow him to return to work. While, in those cases presenting late with no possibility of closed reduction then open reduction and internal fixation is recommended. Most authors use plates and screws with different types of plates recommended [12]. Some authors even use double plating [13, 14]. In this study we describe the technique of tension band which is an easy procedure that most of hand surgeons and physiotherapist are familiar with in the elbow, in a new site which is the base of the first metacarpal.

The results, both objective and subjective are excellent with minimal complications as compared to other studies using plates and screws [7, 15]. All patients returned to their original work within a mean period of 4.5 weeks which is a less period than reported by other authors [9, 14]. Also pain is minimal in this technique because of the minimal dissection and no bulky construct as in plates.

The high success rate of this technique over plates and screws may be attributed to the small size of the proximal fragment that gives no space to put enough screws in the case of plates and screws technique compared to the construct of tension band that provides very effective control on both rotation and angular displacement in these small fragments.

Another cause of high success rate is that early mobilization with this technique is recommended and enhances healing. The therapists do understand the principle of tension band as in the elbow so they encourage the patient to early move without fear as experienced in plates and screws.

Another important advantage of tension band fixation is the low cost of surgery. The use of T-pates, locked plate and double row plates are expensive with high costs as mentioned by Diaconu et al., 2011 [14]. Open reduction and internal fixation of extra articular fracture of the base of the first metacarpal by tension band proved to be a valuable technique which is easy with minimal complications.

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