Intra-Articular Fracture of the Base of the First Metacarpal Bone: Treatment Through a Volar Approach

HAND
2018, Vol. 13(1) 90–94
© The Author(s) 2017
Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/1558944716685828
hand.sagepub.com

Violeta Levy¹, Marcelo Mazzola¹, and Martín Gonzalez¹

Abstract

Background: Management of Bennett fractures has been controversial. Early reports supported closed reduction and casting with or without percutaneous pinning. Later, open reduction and internal fixation was advocated. The purpose of this article is to assess the surgical treatment using a direct volar approach. **Methods:** Between March 2008 and December 2014, 21 patients with intra-articular first metacarpal fractures displaced more than 1 mm were operated on using a direct volar approach. Fixation was done with micro-screws or K-wires, always placed from ulnar to radial during thumb supination. The articular step-off, secondary displacement incidence and consolidation rate time were measured. At final follow-up, we assessed the thumbs for range of motion, residual pain, and grip strength. Sensitive areas around the scar were evaluated. Mean follow-up was 8 months. **Results:** Anatomical reduction was achieved in all cases. One secondary displacement was registered. The mean distance between the tip of the thumb and the fifth metacarpophalangeal joint was less than 10 mm; reposition was complete. Mean palmar abduction was 63°. Grip strength averaged 84.6% of the opposite side. The mean visual analog scale score was 0. No sensory disturbances around the scar were recorded. **Conclusions:** The complete visualization of the first metacarpal articular surface is hard to accomplish from the dorsoradial aspect of the hand. The volar approach offers an excellent fracture exposure. It is possible to place the osteosynthesis in ulna-radial fashion from the smaller fragment achieving correct reduction and stabilization. In spite of the proximity to the radial and median nerve branches, we found no complications.

Keywords: approach, Bennett, fracture, metacarpal, volar

Introduction

Treatment of intra-articular fracture of the base of the first metacarpal has been controversial since Bennett described it in 1882. The injury occurs as a result of an axial load on the partially flexed metacarpal, and it is unstable due to the traction of the abductor pollicis longus muscle on the distal fragment. No consensus has been reached so far regarding the long-term clinical benefits generated by an anatomic reduction of this type of fractures,⁴ although articular step-offs exceeding 1 mm seem to be less tolerated.¹¹ The literature advocates different treatments, namely closed reduction,^{2,12} percutaneous pinning or open reduction and internal fixation often followed by cast immobilization. Percutaneous pinning can join adjacent fragments and/or metacarpals and/or the first metacarpal and the trapezium bone.^{15,17} Open reduction and internal fixation can be carried out by dorsal¹⁷ or volar⁹ approach using pins, screws, or tension bands as osteosynthesis.^{11,18}

We found only 1 article in the global literature, written by Galnlu and Kanyi,⁸ about the use of the volar approach for treating this type of fractures, apart from the original

article by Gedda and Moberg,⁹ published in 1953. The palmar approach is not usually chosen when these patients are operated on.

The objective of this article is to assess the treatment of fractures of the base of the first metacarpal with articular step-offs exceeding 1 mm (Figure 1) using an open volar approach, clearly observing the articular surface of the metacarpal (Figure 2) and placing the osteosynthesis from the ulnar to the radial side.

Materials and Methods

From March 2008 to December 2014, we used a volar approach to operate on 21 patients (19 men and 2 women)

¹Spanish Hospital, Buenos Aires, Argentina

Corresponding Author:

Violeta Levy, Hand Surgery Service, Department of Orthopedic Surgery, Spanish Hospital, 2975 Belgrano Avenue, Buenos Aires C1209AAN, Argentina.

Email: vdlevy@gmail.com

Figure 1. Intra-articular fracture at the base of the first metacarpal.

with intra-articular fracture of the base the first metacarpal into 2 or 3 fragments, closed and displaced more than 1 mm. Open and comminuted fractures were excluded. Our Institution does not require institutional review board approval.

The average age was 32 years (range, 22-52 years), and the median follow-up time was 8 months (interquartile range 25%-75%, 3-10). The average time between trauma and surgery was 6 days. Injuries were divided into occurring at work (13), doing sports (3), and carrying out daily activities (5). The dominant thumb was affected in 14 cases.

Operative Technique

A 2.5 cm curve skin incision was made between the palmaris longus tendons and the abductor pollicis longus (following the thenar crease at the base of the first metacarpal). We proximally freed the thenar muscles from their origin; and through a volar capsulotomy, we approached the base of the first metacarpal and visualized the whole articular surface. After we got anatomical reduction of the fracture (Figure 3) the thumb was supinated and the osteosynthesis was placed from the ulnar to the radial side. We used pins or screws (Figure 4) depending on the fragment size. Then we

Figure 2. Visualization of the articular surface through a volar approach.

sutured the capsule and the thenar muscles were reattached. Patients used a cast during 5 weeks.

The subjective assessment implied the following: completing the visual analog scale (VAS) and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, searching for paresthesias during the immediate postoperative period and when discharged, performing the Weber test on the thumb pulp, and asking all the patients whether they could resume their daily activities. The objective evaluation of the trapeziometacarpal (TMC) mobility included the following: goniometry of the first interosseous space opening, assessment of flexion and opposition (distance in millimeters from the thumb pulp to the palmar digital crease of the fifth finger), and ability to reposition the thumb (when the patient can lift the thumb off the table while the palm is resting on it).¹⁴ The grip strength was measured using a dynamometer, and we compared it with the contralateral side; in order to exclude the discrepancies between the dominant hand and the nondominant one, we based ourselves on the following premise: the grip force is 6% higher in the dominant hand.⁷

In anteroposterior, lateral, and oblique radiographs, we evaluated the number of fragments at the base of the first metacarpal, the percentage of damaged articular surface, and the presence of TMC subluxation; we measured the articular step-off and took into account the fracture consolidation time.

Figure 3. Fracture reduction with a clamp, checking under direct view.

Figure 4. Fluoroscopy after osteosynthesis with a screw.

Table 1. Clinical Assessment.

Opposition Distance from the thumb pulp to the palmar digital crease of the fifth finger		Reposition The thumb can be lifted off the table		Visual analog scale (1 to 10)	
Mean $\pm$ SD (mm)	Range (mm)	All		Median	Interquartile range (25%-75%)
3 $\pm$ 2.8	0-10			0	0-1.5

Results

The median VAS score was 0 (interquartile range 25%-75%, 0-1.5) and the mean QuickDASH was 15 when discharged. We recorded neither dysesthesia nor hyperesthesia in the sensitive areas of the median or radial nerve. Thenar atrophy never occurred. The Weber test did not show any change between the preoperative and the postoperative assessment.

The mean opening of the first web was $63^\circ \pm 6^\circ$. All patients reached a distance between the thumb and the metacarpophalangeal crease of the fifth ray lower than 10 mm. They could all lift the thumb off the table with the palm of the hand resting on it (reposition). The average grip strength after 8 months was 84% of the contralateral side. Everybody could resume their normal activities (Tables 1 and 2).

In the preoperative radiographs, we observed 16 cases with 2 fragments and 5 cases with 3. The percentage of fractured articular surface was higher than 20% in 18 patients and lower in 3. We found TMC subluxation in 19 cases. The average articular step-off was 2.8 ± 1.7 mm (range, 1.5-5 mm) and anatomical restitution was reached in all the cases. The average consolidation time was 6.1 ± 1.7 weeks (range, 4-8 weeks). We recorded a case of secondary displacement, and we performed resection arthroplasty as rescue treatment. In one case, it was necessary to remove a pin using the same approach.

Discussion

Most authors prefer to treat Bennett's fractures with closed reduction and percutaneous pinning^{1,6} In a cadaveric study, Capo et al⁵ have proved that the reduction observed in the fluoroscopy during closed operation of these cases is frequently wrong compared with that observed under direct vision.

The degree of accepted articular incongruence has been studied by many authors. Cannon et al⁴ suggest that there is no relation between fracture reduction and the presence of pain or posterior osteoarthritis. However, Kjaer-Petersen et al,¹¹ in their series of 41 patients, concluded that residual step-offs exceeding 1 mm show long-term symptoms in

Table 2. Clinical Assessment.

	Injured side		Healthy side		Injured side mean/healthy side mean
	Mean $\pm$ SD	Range	Mean $\pm$ SD	Range	
Opening of the first web	63° $\pm$ 6°	50°-70°	65°	60°-70°	97.3%
Grip force	30.8 $\pm$ 9.38 kg	12-45 kg	36.8 $\pm$ 5 kg	32-45 kg	84.6%

Figure 5. With thumb supination and direct visualization of the articular surface, the screw can be placed from ulnar to radial, making a good grasp of the smaller fragment.

86% of the cases, while residual step-offs lower than 1 mm only show long-term symptoms in 46% of the cases.

If open reduction and internal fixation is decided, it is common to use a dorsal approach, described by Wagner¹⁵ in 1951. In 1953, Gedda and Moberg⁹ published the volar approach, which requires detachment of the thenar muscles; Burton and Pellegrini,³ and Uriburu et al¹⁴ use this approach to treat TMC osteoarthritis.

Based on anatomic studies of the palmar cutaneous branch^{10,16} and the thenar branch¹³ of the median nerve, we have seen that these structures are beyond the scope of the performed palmar incision, despite their proximity.

The complete visualization of the first metacarpal articular surface is hard to accomplish from the dorsoradial aspect of the hand. The volar approach allows anatomical reduction avoiding residual step-offs (Figure 5). In our series, we did not observe any complications inherent to the surgical approach and we obtained good results. Therefore, we believe that this approach is a feasible option for treating fractures of the base of the first metacarpal with more than 1 mm displacement. A direct volar approach is a reliable and effective procedure for treating intra-articular fractures of the first metacarpal base.

Ethical Approval

Institutional review board approval was not required for this study.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Breen TF, Gelberman RH, Jupiter JB. Intra-articular fractures of the basilar joint of the thumb. *Hand Clin.* 1988;4(3):491-501.
2. Burnham P. Conservative treatment of certain fractures in the hand. *Arch Surg.* 1960;80:173-190.
3. Burton RI, Pellegrini VD. Surgical management of basal joint arthritis of the thumb. Part II. *J Hand Surg Am.* 1986;11:324-332.
4. Cannon SR, Dowd GS, Williams DH, et al. A long-term study following Bennett's fracture. *J Hand Surg Br.* 1986;11:426-431.
5. Capo J, Kinchelow T, Orillaza N, et al. Accuracy of fluoroscopy in closed reduction and percutaneous fixation of simulated Bennett's fracture. *J Hand Surg Am.* 2009;34:637-641.
6. Carlsen B, Moran S. Thumb trauma: Bennett fractures, Rolando fractures, and ulnar collateral ligament injuries. *J Hand Surg Am.* 2009;34:945-952.
7. Crosby CA, Wehbe MA, Mawr B. Hand strength: normative values. *J Hand Surg Am.* 1994;19:665-670.
8. Galnlu LN, Kanyi SM. Bennett's fracture: a direct volar surgical approach. *East Central African J Surgery.* 2008;4:21-24.
9. Gedda KO, Moberg E. Open reduction and osteosynthesis of so-called Bennett's fracture. *Acta Orthop Stand.* 1953;22:249-257.
10. Hobbs R, Magnusen P, Tonkin M. Palmar cutaneous branch of the median nerve. *J Hand Surg Am.* 1990;15:38-43.
11. Kjaer-Petersen K, Langhoff O, Andersen K. Bennett's fracture. *J Hand Surg Br.* 1990;15:58-61.
12. Oosterbos CJ, de Boer HH. Nonoperative treatment of Bennett's fracture: a 13-year follow-up. *J Orthop Trauma.* 1995;9:23-27.
13. Rodriguez R, Strauch R. The middle finger flexion test to locate the thenar motor branch of the median nerve. *J Hand Surg Am.* 2013;38:1547-1550.
14. Uriburu J, Olazabal A, Ciaffi M. Trapeziometacarpal osteoarthritis: surgical technique and results of "stabilized resection-arthroplasty." *J Hand Surg Am.* 1992;17:598-604.
15. Wagner C. Method of treatment of Bennett's fracture. *Am J Surgery.* 1950;80:230-231.
16. Watchmaker G, Weber D, Mackinnon S. Avoidance of transection of the palmar cutaneous branch of the median nerve in carpal tunnel release. *J Hand Surg Am.* 1996;21:644-650.
17. Wiggins H, Bundens WD Jr, Park BJ. A method of treatment of fracture dislocations of the first metacarpal bone. *J Bone Joint Surg Am.* 1954;36:810-819.
18. Zhang X, Shao X, Zhang Z, et al. Treatment of a Bennett fracture using tension bands wiring. *J Hand Surg Am.* 2012;37(3):427-433.