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Arthroscopic-Assisted Treatment of Bennett Fractures: A Potentially Advantageous Operative Procedure?

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Abstract

Background: Articular fractures of the base of the first metacarpal (Bennett fractures) have been studied for years to determine the best method of reduction and fixation. This study aims to show the application of the percutaneous reduction and internal fixation technique with cannulated screws and arthroscopic assistance in articular fractures of the base of the first metacarpal. **Methods:** Descriptive cohort study in a series of 30 patients, the first cohort in our country and the largest series published so far, in which 8 patients presented with type 2A fracture and 19 patients with type 2B of the Torres-Becerra classification underwent the mentioned technique under direct vision and control of the articular reduction by arthroscopy evaluating the intraoperative characteristics of the articular surface, stability of de reduction and fixation. Assessment of functional and rehabilitation results with a minimum postoperative follow-up of 6 to 12 months. **Results:** The senior author has used this technique with consistent clinical outcomes to improve reduction and fixation of intra-articular base fractures of first metacarpal bone (Bennett), reducing the articular step-off and gapping permitting an early rehabilitation progress with satisfactory functional results. **Conclusions:** We can suggest that this surgical method for the treatment of Bennett fractures may offer multiple advantages: adequate debridement of the trapeziometacarpal joint, direct visualization of the articular surface during reduction, achieving greater precision in fixation with minimum morbidity, imperceptible incisions and scars, shorter surgical time, and fewer associated complications.

Keywords: arthroscopy, base of thumb, Bennett fracture, percutaneous, trapeziometacarpal joint

Introduction

Articular fractures of the base of the first metacarpal described between 1882 and 1885 by Edward Bennett are very frequent and characterized by a dorsal and radial displacement of the metacarpal diaphysis in relation to the distal fragment in a palmar and well-anchored ulnar direction.[1,2] Considering the possible late arthritic changes and sequelae secondary to a possible incongruence in the reduction of these fractures, it is important to determine the ideal method of reduction and fixation of the fracture, for which reason a great variety of the treatment options have been described, both open and closed methods.

Arthroscopic-assisted reduction and internal fixation has arisen from controversy regarding the accuracy of reduction under fluoroscopy or the need for an open approach for such a procedure. Therefore, a method of reduction and stabilization of Bennett fractures using percutaneous fixation with cannulated screws assisted by arthroscopy and fluoroscopy is presented. This technique may allow greater certainty control of the reduction by directly visualizing the fracture area and potential impacts supporting early rehabilitation.

Methods

A descriptive longitudinal study was carried out during a period between June 2020 and June 2022. A series of 30 patients with the diagnosis of Bennett fracture were classified according to the Torres-Becerra classification, designed for fractures of the base of the thumb (Table 1). All procedures followed were in accordance with the ethical standards

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Table 1. Torres-Becerra Classification.

Type	Fracture characteristics
1A	Extra-articular intracapsular (epibasal)
1B	Extra-articular extracapsular (metaphyseal)
1C	Extra-articular comminuted
2A	Bennett—small fragment
2B	Bennett—large fragment
2C	Bennett associated with trapezius fracture
2D	Rolando
3	Complex

Note. First metacarpal base fractures.
The shaded area represents that the study population belongs to classifications 2A and 2B of the Torres-Becerra classification.

of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 and was approved by our institutional ethics review board.

Demographics of our patients are shown in Supplemental Table 1. The inclusion criteria were adult patients with intra-articular fractures of the base of the first metacarpal 2A or 2B, with less than 3 weeks of evolution; the exclusion criteria were: active infection, severe joint injury, need for diaphyseal fixation, need for soft tissue reconstruction, and a patient refusal procedure. An informed consent was obtained in which the technique as well as the risks and benefits were discussed. All patients underwent surgery, by the same surgeon. Subsequently, the trapeziometacarpal (TMC) joint was immobilized with a splint for a period of 2 weeks, at which time rehabilitation was initiated.

Surgical Technique

The patients were placed in the supine position under local (27 patients), regional (2 patients), or general (1 patient) anesthesia. We do not use or recommend routine tourniquet, except under special conditions. The patient was positioned in elbow flexion at 90°, and the arm in the sterile traction tower (Tienken) placing a finger trap on the thumb, then traction was applied until the thumb was stable. It is not necessary to apply more than 5 kg of traction (Figure 1). We use portals 1R (radial to the Abductor Pollicis Longus) where the base of the thumb, TMC joint, ligaments, and capsule can be visualized and 1U (radial to the Extensor Pollicis Longus) where the oblique palmar ligament is better seen. Portals were located with an 18G hypodermic needle, and were incised with a No. 15 scalpel blade, taking special care to only incise the skin, and the rest is dissected with a fine tip mosquito until entering to the joint. Under dry arthroscopy technique, the 1.9-mm × 30° lens (Tienken) was introduced through the radial portal and through the ulnar portal a 2.0-oscillating blade was introduced to perform articular debridement until the fracture site was identified (Figure 2).

Figure 1. Distribution inside the operating room with the patient in supine decubitus, shoulder abduction, elbow flexion 90° with traction tower at the level of the first finger, location of the arthroscopy tower, and fluoroscope (C-arm in transverse direction) for a complementary visualization by the surgeon.

With the arthroscope still in position, a C-arm was placed with a 90° rotation, to observe the fracture area under fluoroscopy, then the fragment was mobilized, with an arthroscopic probe feeler, to achieve reduction of the fracture fragment, an intra-articular needle 18G is introduced, perpendicular to the reduced fracture line, which will serve as a direction for the positioning of the guide pins. Under fluoroscopic control, the fragment was fixed with one or two 0.9-mm percutaneous guide pins; 3-mm incisions were made with a No. 15 scalpel blade dissecting the surrounding tissue and measuring the length of the screws. The 2.0-mm or 2.25-mm headless cannulated screws were inserted with simultaneous arthroscopy and fluoroscopy verification of reduction and fixation stability. The size of the fragment is used to determine whether to add 1 or 2 screws or Kirschner wires (K-wires) (Figures 3 and 4). Instruments were removed, portals were closed with separate 5/0 nonabsorbable suture stitches, and the TMC joint was immobilized with a cone-shaped splint (modification of thumb-spica model) of the first finger for 2 weeks, followed by physical rehabilitation.

Postoperative Follow-up

Weekly assessment was performed for the first month, then every month until third month and every 3 months to complete 1 year of follow-up. At 2 weeks, splint was removed and passive movement exercises were taught for an initial rehabilitation as well as the use of thumb-spica removable splint. At 3 weeks, active movements were initiated in a hand therapy rehabilitation program with weight-lifting

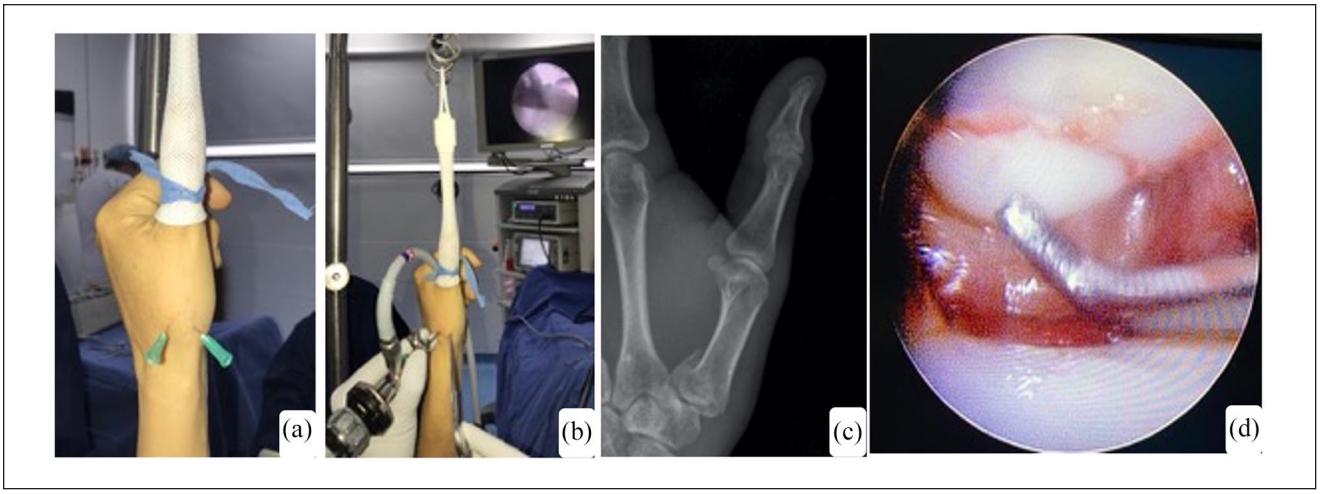

Figure 2. (a) Portals 1R and 1U. (b) Introduction of trocar and camera with 1.9-mm lens with direct visualization in the arthroscopy tower. (c) Evidence of articular fracture of the base of the left first metacarpal of large fragment (2B Torres-Becerra). (d) Arthroscopic visualization of bone fragment and tracing of the fracture of the base of the first metacarpal.

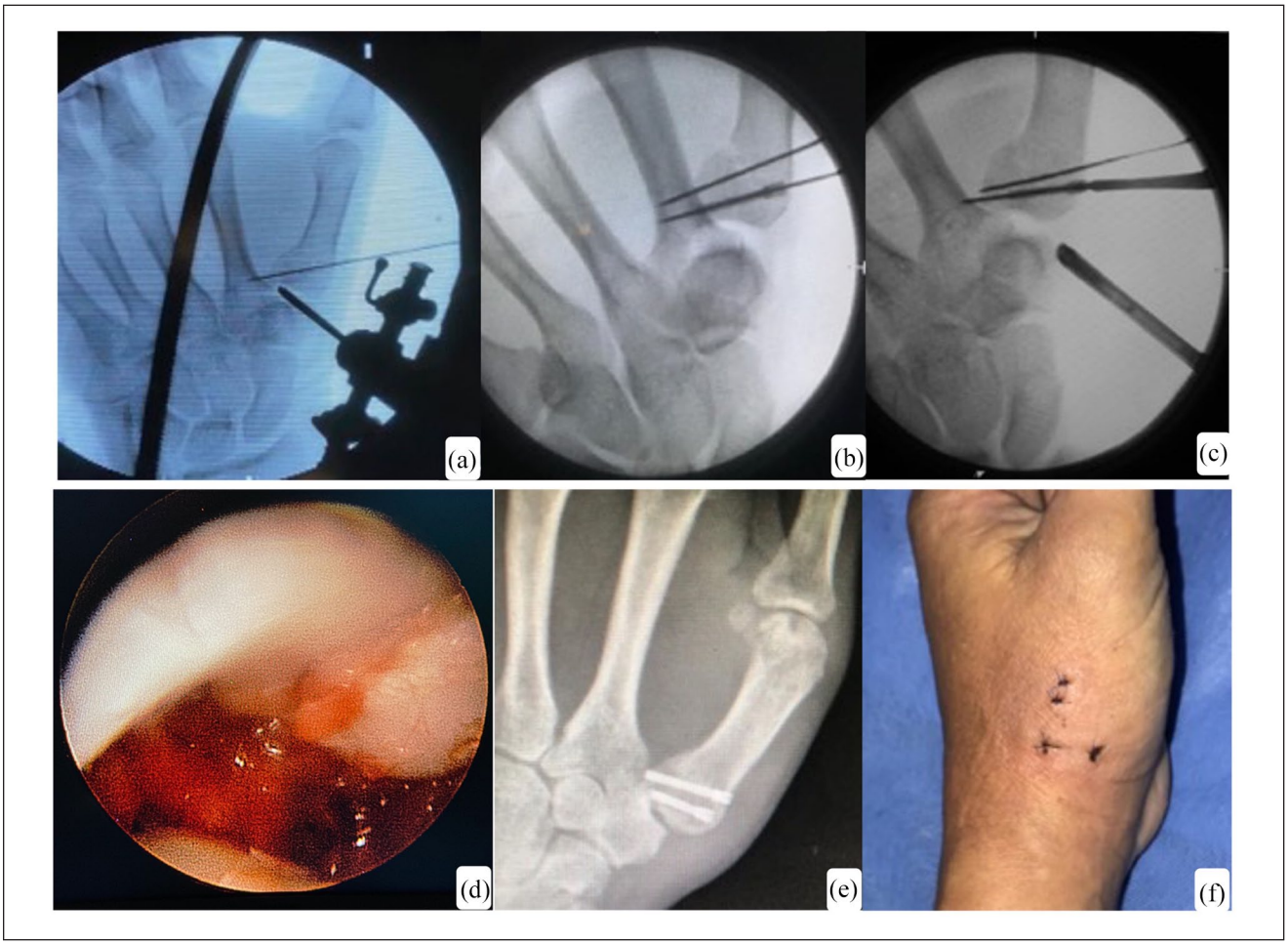

Figure 3. (a-b) Shows initiation of Kirschner wire fixation under arthroscopy and fluoroscopic control. (c) Shows the passage of the 2.0 cannulated screw with the previously inserted Kirschner pin as a guide. (d) Arthroscopic view of the reduction. (e) Immediate pop definitive radiograph showing adequate reduction and fixation of fracture traces. (f) Minimal approach with subsequent imperceptible scar.

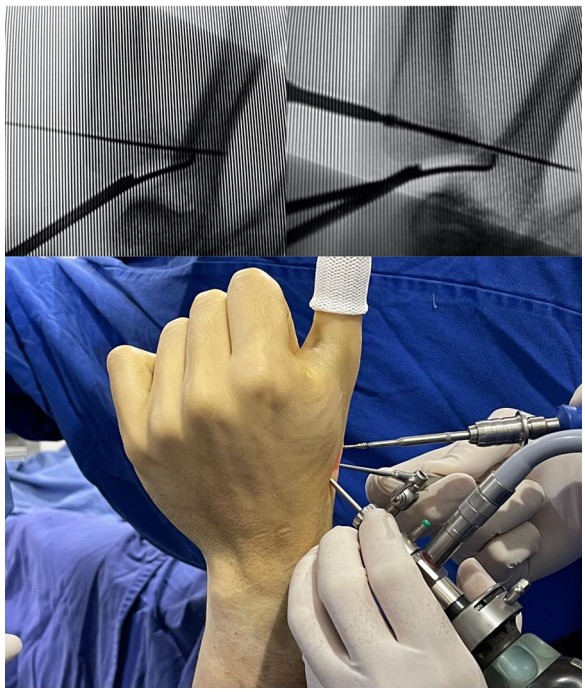

Figure 4. The reduction can be maintained with the arthroscopic probe while fixation with the guide and screw, thus avoiding displacement during fixation.

restriction. At 3rd-, 9th-, and 12th-month follow-up, data were collected from the measurement instruments such as Kapandji score and Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score to calculate the disability of the hand by evaluating the ability to perform tasks individually. Pain score evaluation was made at 2 weeks and 3rd-, 9th-, and 12th-month follow-up after surgery by numeric rating scale (NRS). A postoperative subjective evaluation was made comparing functional recovery of the hand with reference to the patient's previous condition and contralateral hand. The data were subsequently analyzed by means of a database using the SPSS statistical system.

Results

In this series of cases, there were 30 patients (29 men and 1 woman), average age of 34 (20-54) years; and in the analysis of the fracture fragment, 9 were type 2A and 21 were 2B of the Torres-Becerra Classification. Thirteen cases showed involvement of the dominant hand, and the left hand was the most affected (Supplemental Table 1).

The procedure was performed with an average time of 35 minutes under local anesthesia, with wide-awake local anesthesia no tourniquet (WALANT) technique in 27 cases, 2 cases with regional block, and 1 case under general anesthesia because of a contralateral distal radius fracture which was treated in the same surgical procedure and required a torniquet use. A 1.9-mm lens and Eberle arthroscopy camera set (Tienken) were used in all cases. In 21 cases, fixation was done with 2.25-mm headless cannulated screws, in 7 cases with 2.0-mm headless cannulated screws, and in 2 cases due to the minimal size of the bone fragment, fixation was performed with one or two 1.0-mm K-wires, which were removed after 4 weeks. All patients had adequate reduction, and fixation of the fracture line was achieved with satisfactory final arthroscopic control, with fixation stability and no evidence of bone step-off in 28 patients and step-off less than 1 mm in 2 cases, as evidenced in postoperative radiological controls (Figure 5). In most cases, there was no bone gapping; however, in less than 14% of the patients there was a bone gapping less than 2 mm. All patients started rehabilitation at 2 weeks, 26 patients returned to work at 4 weeks, and 4 patients at seventh week, two of them were fixed with Kirschner pins. At 3-month follow-up, 27 patients had a score of 10 points on the Kapandji score, at 9 months all patients achieved 10 points. A mean QuickDASH score of 2.3 was obtained in all cases, and there was an average of 2 points on the NRS for the first 2 weeks with no residual pain after that time. The scar was highly satisfactory in all patients (Figure 6). No patient required reintervention during the entire follow-up of the study.

Discussion

The surgical treatment of Bennett fractures has been the subject of research and innovative methods of intervention. With the advent of arthroscopy for small joints, several studies have mentioned advantages over open reduction, such as less probability of injuring the radial nerve, less postoperative pain, perceive articular changes before they can be observed in the x-ray, adequate articular visualization, and preservation of ligamentary structures.[3-5] Arthroscopy could be considered as a key device and method to perform procedures of the base of the first metacarpal, mainly because it allows direct visualization of the fracture line, immediate control of the reduction, and internal fixation together with intraoperative fluoroscopy.

The first international publication on trapeziometacarpal arthroscopy was made in 1997 by Berger,[1] where for the first time its usefulness in Bennett fractures was evidenced. In 2010, Culp and Johnson[2] published details of the technique and its indications, but it would not be until 2014 when Zemirline et al[6] published a series of 7 cases, with very good results in functionality and recovery, Pomares et al[7] compared a group of 11 patients treated with arthroscopy against a group of 10 patients with conventional surgery. Marcovici et al[8] in 2021 made a detailed description of the technique and its modalities.

Figure 5. Surgical outcomes in patients with articular fractures of the base of the first metacarpal.
Note. (a) Adequate fixation of large fragment fracture (2B) with 2 cannulated screws (2.0 mm). (b) Small fragment fracture (2A) internal fixation with 1.0 Kirschner pin to maintain fragment reduction and fixation with 2 cannulated screws (2.0 mm). (c) Bennett fracture (2A) fixation with 1 cannulated screw (2.0 mm) with adequate reduction fixation and minimal step. (d) Posterior-anterior radiograph showing fixation of Bennett fracture (2B) with 2 cannulated screws (2.5 mm).

Figure 6. Appearance of the scars at 2 months, now almost imperceptible.

Therefore, it is important to establish a classification of this type of fractures, the most frequently used system is Gedda's, proposed in 1954, a classification system that consists of 3 types depending on the size of the fragment, presence or not of dislocation, and association with epibasal fracture.[9] However, in the present study, the Torres-Becerra classification established by the research group is used, in which a unification of both extra-articular and intra-articular grades is obtained and establishes a more precise categorization in the size of the fragment allowing a better surgical planning. Our study constitutes the largest published series on this technique providing favorable results and better control of reduction and fixation in joint fractures of the base of the first metacarpal associated with the use of fluoroscopy presenting minimal involvement of the TMC joint, low rates of stiffness, absence of long-term related symptoms, positive aesthetic appearance with minimal scarring and high functional capacity of the TMC joint due to the rapid onset of physical rehabilitation. The use of local anesthesia without torniquet (WALANT), which has not been published so far in relation to the arthroscopic technique in thumb base fractures, is introduced. Likewise, it is noteworthy that it is a fast and reproducible procedure, with consistent results in our series.

Conclusions

The arthroscopic-assisted reduction and fixation technique with minimally invasive cannulated screws has proven to be a potentially beneficial alternative for the treatment of these fractures, with the following advantages:

- Tissues around fractures are preserved, and dissection is not required.
- It can be performed with local anesthesia without tourniquet, reducing risks.
- The operating time is shorter compared to conventional surgery.
- Early rehabilitation is possible.
- There is minimal secondary morbidity.
- The technique is highly reproducible.

As a disadvantage, we have the need for arthroscopy resources and the learning curve. Despite being the largest series published in international literature, it is necessary to increase the cohort and a obtain longer follow-up in a randomized trial and comparative studies for more conclusive results.

Ethical Approval

This study was approved by our institutional review board.

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

All patients in the study filled out and approved participation by means of the informed consent, explaining the procedure and virtues that are planned with the described surgical technique.

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.

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