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BENNETT FRACTURE

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ABSTRACT

Introduction: *The intra-articular fracture separating the palmar ulnar aspect of the base of the first metacarpal from the rest of the first metacarpal is called Bennett's fracture. Injuries are usually caused by axial loads on the partially flexed metacarpal bones. Radiographs are needed to evaluate these injuries and to schedule surgery to relieve them, since such fractures are assumed to be unstable. Surgical treatment of these fractures alters depending on the extent of the injury. It may include closed reduction with percutaneous fixation or open reduction with fixation or interfragmentary fixation. With good fracture localization and fixation, the postoperative outcome is usually good.*

Objective: *to detail the current information related to Bennett's fracture, presentation, evaluation, comparison with Rolando's fracture, in addition to the diagnosis and treatment of the disease.*

Methodology: *a total of 28 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 18 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: Bennett fracture. Bennett's, fratura da base do primer metacarpiano.*

Results: *Anteroposterior, lateral and oblique projections are common when taking radiographs of the hand, however Robert's view can reveal more details about the injury. Both Bennett's and Rolando's fractures present the same pathogenic mechanism however the damaging force is of greater magnitude than in Bennet's fractures.*

K-wire fixation is better than plate and/or screw osteosynthesis as a treatment because of the benefit of keeping costs down without harming the patient in the long term. Direct visualization is the most accurate method to assess joint separation and articular pitch, PA, AP and lateral projections on fluoroscopic examination may not be sufficient to determine the final position of a reduced Bennett fracture.

Conclusions: *Although there is no consensus on which treatment is best, surgical treatment of Bennett fractures is usually used because closed reduction and cast immobilization without internal fixation are often unstable due to deforming forces. Indications for surgical treatment for fractures of the base of the first metacarpal include extra-articular fractures with more than 30 degrees of angulation after reduction; loss of reduction after non-operative treatment; and intra-articular fractures: displaced Bennett fractures greater than 1 mm or any Rolando fracture.The arthroscopically assisted screw fixation of Bennett reported fewer complications, shorter immobilization time and shorter tourniquet time.*

Keywords: *fracture, Bennett, metacarpal, first.*

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INTRODUCTION

The intra-articular fracture that separates the palmar ulnar aspect of the base of the first metacarpal from the rest of the first metacarpal is called Bennett's fracture, it is a subluxation fracture of the carpometacarpal joint of the thumb, with an important palmar anterior marginal fracture segment(1-3).

The name of the fracture is given by the professor of surgery at Trinity College Dublin, Edward Hallaran Bennett, who described it in 1882 and described it as a fracture that "passed obliquely through the base of the bone, detaching the greater part of the articular surface", and which resembled a dorsal subluxation of the first metacarpal(2,4,5).

The injuries are usually caused by axial loads on the partially flexed metacarpal bones and are occasionally associated with wrist fractures or ligament injuries. Bennett's fractures are therefore the result of opposing tensile forces of the anterior oblique ligament plus an axial load on a flexed thumb or a shear force against the first web space (motorcyclist thumb). Radiographs are needed to evaluate these injuries and schedule surgery to relieve them, as such fractures are assumed to be unstable. Surgical treatment of these fractures alters depending on the extent of the injury. It may include closed reduction with percutaneous fixation or open reduction with fixation or interfragmentary fixation. With good fracture localization and fixation, the postoperative outcome is usually good(1,6).

METHODOLOGY

A total of 28 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 18 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: Bennett fracture, first metatarsal fracture, fratura do Bennett.

The choice of the bibliography exposes elements related to Bennett's fracture; in addition to this factor, its presentation, evaluation, comparison, in addition to the diagnosis and treatment of the disease are shown.

DEVELOPMENT

This fracture, which results from axial loading on a partially flexed metacarpal, may also involve the adjacent carpal bone (trapezium) and/or ulnar collateral ligament of the metacarpophalangeal (MCF) joint of the thumb(1).

Thumb fractures include the subtype known as Bennett's fracture. Children and the elderly have been found to be more prone to total fractures of the thumb. While 20% of hand fractures in patients older than 65 years involved the thumb, 22% of all tubular bone fractures in children aged 0 to 16 years involved the first radius. The thumb was the most frequently fractured tubular bone in the elderly, with an oblique intra-articular fracture pattern(1).

Approximately 10% of all fractures are metacarpal bone fractures. This accounts for almost 40% of all hand fractures(2).

Metacarpal fractures occur 2.5% of the time in adults. The most frequent type of thumb fractures involves the articular surface of the carpometacarpal joint. The second most frequent metacarpal injury after the fracture of the metacarpal neck of the little finger is the thumb fracture, which accounts for 25% of all metacarpal fractures(2).

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Figure 1. Bennett's fracture in radiography

Source: Carter KR, Nallamothu SV. Bennett Fracture. StatPearls Publishing; 2022(1)

Bennett's fracture has a unique fracture pattern. The palmar ulnar fragment of the first metacarpal is held in place by its ligamentous attachment to the trapezium during axial loading with the rest of the metacarpal in motion, causing the base of the first metacarpal to break with intra-articular extension. The main fracture line follows this area of weakness and runs in the opposite direction. The abductor pollicis longus, extensor pollicis longus, extensor pollicis brevis and adductor pollicis brevis, which are still attached to the fragment, are pulling on the fracture, causing the diaphysis of the first metacarpal to subluxate dorsally, proximally and radially(1).

The ligaments that give stability to the thumb complement the absence of bony insertion. The dorsoradial ligament, which prevents dorsomedial subluxation, and the anterior palmar ligament, which prevents dorsal subluxation(2). Detailed description of the ligament anatomy of the palmar burst fracture increases the likelihood for improved reduction and treatment of this common hand injury(7).

The presenting signs and symptoms of Bennett's fracture initially are pain, edema, tenderness in the tenar area, functional impairment of the thumb, and joint instability. There are late symptoms that occur according to the chosen treatment, such as closed or open reduction. In patients who opted for closed reduction, there were more late symptoms such as deformity and restriction of movement. In patients who underwent open reduction, symptoms were observed over a longer period of time, with motion restriction and decreased grip strength predominating; however, patients did not notice this alteration until the post 10-year evaluation. In all patients, regardless of the approach used, osteoarthritic changes could be observed with a greater predominance in patients with a closed approach where even arthritis was observed(8-10).

Anteroposterior (AP), lateral and oblique projections are common when taking radiographs of the hand. One of these is Robert's view, which can be obtained in addition to other dedicated projections of the thumb to reveal more details about the lesion. The forearm is hyperpronated, the dorsal aspect of the thumb is pressed against the radiographic film and the x-ray beam is pointed 90 degrees in the direction of the film for this view, which is a true AP projection of the first carpometacarpal joint(1).

Another projection is the Bett, which is obtained with the palm overpronated 20 degrees against the film and the beam directed 15 degrees proximal to distal. Pressing the radial aspect of the thumbs in an AP view can also be used to take stress radiographs, which may show that the base of the metacarpal is subluxed relative to the trapezium on the side experiencing symptoms(1).

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Figure 2. Bennett's fracture on oblique radiograph.

Source: Carter KR, Nallamothu SV. Bennett Fracture. StatPearls Publishing; 2022(1)

Gredda divided Bennett's fractures into three categories according to their radiographic appearance: Type I, an impaction fracture without subluxation of the first metacarpal; Type II, an injury with a small ulnar avulsion fragment along with metacarpal dislocation; and Type III, an injury with both characteristic(1).

As external pressure is applied to the base of the first metacarpal, axial traction with palmar abduction and pronation is necessary. It has been shown that the "hitchhiker's position" with the thumb extended can lead to fracture displacement(1).

When first described by Bennett, treatment was by closed reduction and splinting, which remained the preferred therapeutic method until the 1970s. Today, a wide variety of surgical treatment of Bennett fractures is commonly used, most often consisting of closed reduction with percutaneous pinning or open reduction with pins or interfragmentary screws. In case reviews, all fixation methods have proven to be effective. The complete view of the articular surface of the first metacarpal is difficult to achieve from the dorsoradial aspect of the hand. The palmar approach allows optimal exposure of the fracture. The osteosynthesis can be placed ulnar-radially from the minor fragment giving a correct reduction and stabilization(1,11).

To reduce subluxation of the first metacarpal diaphysis, closed reduction therapy often involves intermetacarpal fixation from the first to the second metacarpal and/or to the trapezium. If open reduction is chosen to treat this fracture, a Wagner incision is most often used. There is still disagreement as to whether to treat these fractures with an open reduction or a closed reduction(1). However, one thing is certain: the joint must be

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reduced to achieve good functional results after this fracture-dislocation(2).

Most Bennett fractures are treated surgically because closed reduction and cast immobilization without internal fixation are often unstable due to deforming forces (abductor pollicis brevis, flexor pollicis brevis, flexor pollicis adductor distal extension and abductor pollicis longus proximal extension)(4).

A clinical study determined that K-wire fixation is better than plate and/or screw osteosynthesis as a treatment for Bennett fracture, due to the benefit of keeping costs low without harming the patient in the long term(12).

The various forms of closed reduction and percutaneous fixation (CRPF), open reduction and internal fixation (ORIF) and arthroscopy-assisted fixation are surgical fixation techniques. Orthopedic surgeons are still divided on the best course of action(4).

ORIF has typically been recommended the instant the fracture fragment is more than 25% of the articular surface and when the joint line cannot be reduced to less than 2 mm of displacement with closed reduction. Closed reduction and percutaneous fixation generate adequate clinical results, although complications such as pintract infections and secondary dislocation have been reported(4,13).

Bennett fractures can be reliably treated with CRPF when the persistent step and gap after fixation does not exceed 2 mm(14). In non-athletes, there is dispute regarding the amount of joint step-out that is acceptable at the fracture site. Some studies have found no correlation between the quality of articular reduction and radiographic results, while other biomechanical analyses have shown that 2 mm of persistent staggering of the articular surface does not change contact pressures. They conclude that bony apposition of the fragments within 2 mm and correction of any joint subluxation will be accepted without increasing the risk of post-traumatic arthritis, however anatomical reduction is preferred(1).

The treatment algorithm in the absence of studies is still unclear. According to a clinical study, the double intermetacarpal nailing technique according to Iselin is an economical, easy and simple technique to perform, using technical measures, optimal results are achieved in both small and large fragment Bennett fractures(4).

Indications for surgical treatment (closed reduction and K-wiring, open reduction and internal fixation with plates or screws, or external fixation) for fractures of the base of the first metacarpal include extra-articular fractures with more than 30 degrees of angulation after reduction; loss of reduction after non-surgical treatment; and intra-articular fractures: Bennett fractures displaced more than 1 mm or any Rolando fracture(15).

We consider it important to differentiate Bennet's fracture from Rolando's fracture, the latter represents 21% of the fractures of the base of the first metacarpal, intra-articular with detachment of some fragments, classically three. Both Bennett and Rolando fractures present the same pathogenic mechanism, however the damaging force is of greater magnitude than in Bennett fractures and the treatment is preferably surgical; ligamentotaxis with percutaneous traction may be of choice in intensely comminuted fractures, with the risk of presenting a poor quality restoration of the articular surface and/or exposure to infectious complications(16).

Figure 3. Rolando's Fracture.

Source: Feletti F, Varacallo M. Rolando Fractures. StatPearls Publishing; 2022(16).

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The effectiveness of open reduction internal fixation versus arthroscopically assisted screw fixation of Bennett fractures was compared by Pomares and colleagues. In the arthroscopic group compared to the open fixation group, they reported fewer complications (1 of 11 vs. 6 of 11), shorter immobilization time (3.9 weeks vs. 7.1 weeks), and shorter tourniquet time (42 minutes vs. 56 minutes). Additionally, the percutaneous group showed a higher return to work rate (91%) than the open group (70%) did. Another study by Zemirline and colleagues suggested that at short-term follow-up, arthroscopic-assisted percutaneous screw fixation of Bennett fracture led to satisfactory reduction of the joint in all cases, key pinch was 73%, and grip strength of the contralateral side was 85%. However, at the 4.5 month final follow-up, it was noted that 4 patients had a subsequent displacement of the surgical reduction(17).

According to a clinical trial, direct visualization is the most accurate method for assessing joint separation and articular pitch compared to the postero-anterior (PA), anterior-posterior (AP) and lateral views of a fluoroscopic examination. The PA, AP and lateral projections in a fluoroscopic examination may not be sufficient to determine the final position of a reduced Bennett fracture, as surgeons should be aware. The use of arthroscopic examination, three-dimensional fluoroscopy or live fluoroscopy should also be considered (18).

CONCLUSIONS

Bennett's fracture results from axial loading on a partially flexed metacarpal, which may involve the adjacent carpal bone and/or ulnar collateral ligament of the thumb metacarpophalangeal joint. The presenting signs and symptoms of Bennett's fracture initially are pain, edema, tenderness in the tenar area, functional impairment of the thumb, and joint instability.

Anteroposterior, lateral and oblique projections are common when taking radiographs of the hand. Robert's view may reveal more details about the injury.

Both Bennetts and Rolando's fractures present the same pathogenic mechanism, however the damaging force is of greater magnitude than in Bennett's fractures.

Although there is no consensus on the best treatment, surgical treatment of Bennett fractures is usually used, most often consisting of closed reduction with percutaneous pinning or open reduction with pins or interfragmentary screws. Most Bennett fractures are treated surgically because closed reduction and cast immobilization without internal fixation are often unstable due to deforming forces. A clinical study determined that K-wire fixation is better than plate and/or screw osteosynthesis as a treatment because of the benefit of keeping costs down without harming the patient in the long term.

Bennett fractures can be reliably treated with CRPF when the persistent step and gap after fixation does not exceed 2 mm.

The effectiveness of open reduction internal fixation versus arthroscopically assisted screw fixation of Bennett fractures was compared. In the arthroscopic group compared to the open fixation group, they reported fewer complications, shorter immobilization time and shorter tourniquet time. Another study suggested that at short-term follow-up, arthroscopic-assisted percutaneous screw fixation of Bennett fracture led to satisfactory reduction of the joint in all cases. Direct visualization is the most accurate method to assess joint separation and articular pitch, PA, AP and lateral projections in a fluoroscopic examination may not be sufficient to determine the final position of a reduced Bennett fracture.

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