

THUMB BASE FRACTURES

– Written by *Gustavo Vinagre, Flávio Cruz and Jonny K Andersson, Qatar*

INTRODUCTION

Acute traumatic fractures of the base of the thumb are frequent and their consequences can affect the well-functioning of the thumb. Handball players and football goalkeepers are prone to get these injuries.

The first carpometacarpal (CMC) joint is vital to the function of the hand, and trauma to the thumb CMC joint could lead to two special entities: Bennett and Rolando fractures. They generally occur after trauma by compression along the axis of the thumb in flexion, such as falling on an outstretched hand or by direct trauma, for example when saving a hard shot as goalkeeper.

Bennett fractures are intra-articular fractures in which the metacarpal shaft is proximally and radially displaced by the pull of the abductor pollicis longus (APL) tendon, leaving an intact ulnar fragment at the base of the thumb metacarpal, that is held reduced by the strong volar beak ligament (Figure 1A).

Rolando fractures are complex intra-articular fractures involving the base of the thumb metacarpal that often have a T- or Y-type pattern. These fractures are classically described as being three-part; however, the name also applies to more comminuted fracture variants (Figure 1B).

ANATOMY

The thumb metacarpal serves as the site of attachment for several tendons, including the abductor pollicis longus (APL) at the proximal base, the adductor pollicis (AP) distally, and the thenar muscles volarly. Joint stability is maintained by five primary ligaments: the anterior-volar (beak), the posterior oblique, the dorsal radial, the anterior intermetacarpal ligaments and the posterior intermetacarpal ligaments.

HISTORY AND PHYSICAL ASSESSMENT

Fractures of the thumb CMC joint are the most common of all thumb fractures.

Most of these fractures occur with direct trauma to the thumb tip, often from a fall or sports-related injury. These injuries are more common in young males, and often affect the dominant hand. It is important to determine if the patient had pre-existing basal joint arthritis, which will affect treatment option and expected results¹.

Common physical examination findings include tenderness and ecchymosis surrounding the thumb CMC joint and the thenar, crepitus with attempted motion, instability, and a "shelf" deformity resulting from displacement of the metacarpal shaft dorsally.

Clinical diagnosis is often difficult because of the rapid onset of edema which masks anatomical landmarks, hence the importance of pain and sometimes a discrete functional impairment. Inspection may reveal shortening and adduction of the thumb, and a 'dinner fork' type deformity. Palpation may reveal a piano key (Tillaux's) sign and the tension-compression manoeuvre in the axis of the thumb may reveal pistoning².

It is important to do a complete neurovascular examination and to search for associated conditions such as wrist ligamentous injuries. Neurovascular injuries are uncommon but compartment syndrome in the thenar region should be ruled out in higher-energy injuries.

Tendon function should be examined, specifically the extensor pollicis longus (EPL), flexor pollicis longus (FPL), and extensor pollicis brevis (EPB).

IMAGING

Radiographs are the first-line imaging modality and should include AP, lateral, and oblique views. Radiographs of the contralateral, uninjured basal joint can be helpful in certain cases as a template for the surgery.

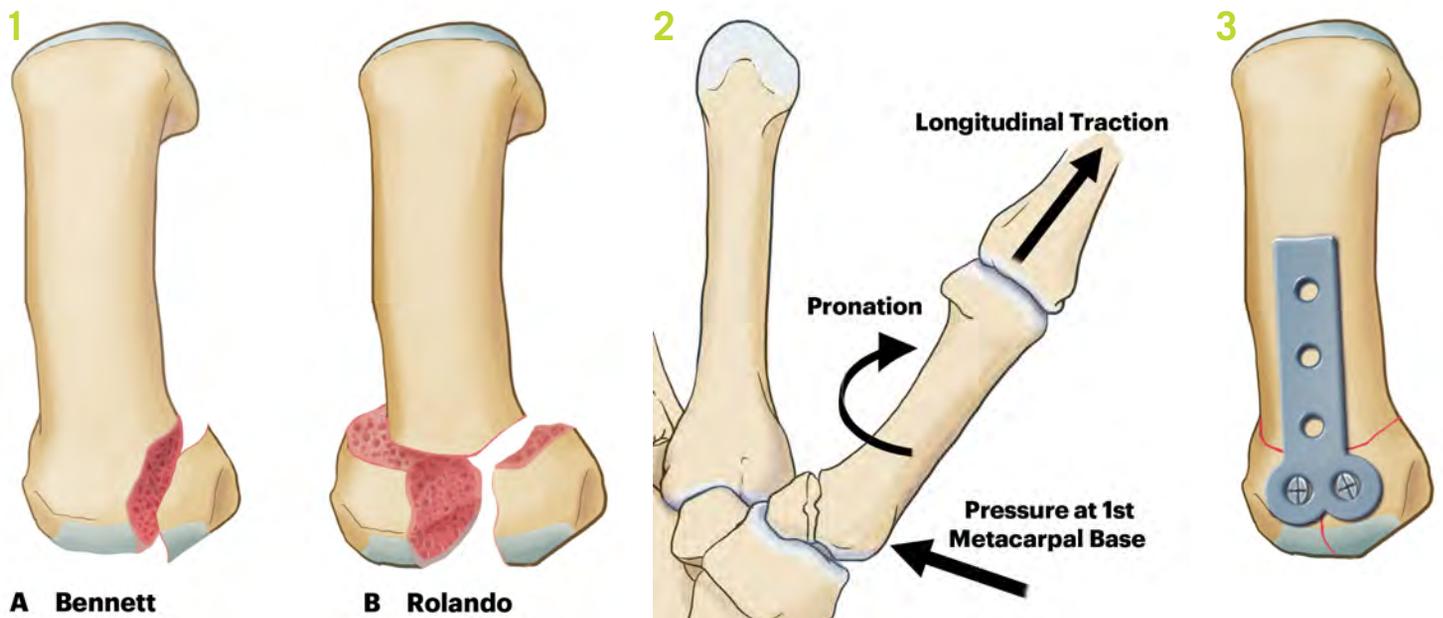


Figure 1: Schematic drawing of a typical Bennett fracture (A): unicondylar fracture of the base of the first metacarpal; and a Rolando fracture (B): multifragmentary fracture with the entire base of the base of the metacarpal being involved.

Figure 2: Closed reduction of Bennett fractures is obtained by applying axial traction, palmar abduction, and pronation to the thumb metacarpal while providing pressure over the dorsal-radial metacarpal base.

Figure 3: Schematic drawing of a Rolando fracture fixed with a plate.

Computed tomography (CT scan) may be indicated if a significant amount of articular comminution is present or when plain radiography is not fully clear for the understanding of the fracture pattern. A traction view may be helpful in Rolando-type fractures in which nonoperative treatment is being considered and tomography is not available.

DIFFERENTIAL DIAGNOSIS

- De Quervain tenosynovitis or FPL synovitis, after overuse among athletes, such as goalkeepers.
- Intraarticular radial plica.
- Thumb CMC joint ligamentous injury and instability
- Basal joint degenerative joint disease.
- STT joint degenerative arthritis.
- Trapezial body fracture.
- Scaphoid fracture or non-union or scapholunate ligament injury.

CONSERVATIVE TREATMENT

Due to the deforming forces that act on the fracture fragments, both injury patterns are usually unstable and difficult to reduce and stabilize by closed means only. Therefore, nonoperative treatment with closed reduction and thumb brace is generally reserved for nondisplaced, minimally

comminuted fractures. Particularly in Bennett fractures, closed reduction (Figure 2) can be achieved and may be indicated if the ulnar fragment is small and if there is a minimal displacement between the volar ulnar fragment and the metacarpal shaft.

However, there is a very low likelihood of maintaining reduction using closed reduction only in displaced fractures, especially if there is a step-off of more than 2 mm.

Residual subluxation of the metacarpal shaft leads to basal joint incongruity and the potential for developing post-traumatic arthrosis. In addition, residual intra-articular step-off greater than 1 mm predispose to the development of arthrosis.

SURGICAL TREATMENT

The majority of displaced Bennett fractures and almost all Rolando fractures require surgery, with closed reduction and percutaneous Kirschner wire fixation (under fluoroscopic guidance) or open reduction and internal fixation (ORIF) with plate (Figure 3) or screws (Figure 4). Bennett fractures with small ulnar fragments can be treated by closed reduction and percutaneous pinning, but fractures with > 50% articular involvement require open reduction and internal fixation with screws.

In ORIF for Bennett fractures, the volar thenar Wagner incision and the use of two 1.3 or 1.5 mm AO compact hand lag-screws is recommended. That approach enables and simplifies the exact anatomical reduction and fixation.

The main goals of surgery are to restore the articular congruity of the thumb CMC joint and to align the first metacarpal base articular surface with the trapezium. If the thumb CMC joint fracture is associated with trapezial body fractures, the trapezial articular surface should first be reduced anatomically, before proceeding with the thumb metacarpal fracture.

POST-OPERATIVE CARE AND REHABILITATION

A thumb splint is applied after the surgery in the operating room. It could be replaced with a removable custom-made brace (with the IP-joint free for range of motion training) after approximately 2 weeks, and should be maintained for 4 to 6 weeks, until fracture union. Hand therapy should begin early (1 to 2 weeks postoperatively) for thumb IP and MP joint mobilization and active range-of-motion exercises.

It has been shown that the dorsal radial ligament (DRL) in the thumb base joint contains most mechanoreceptors³ and

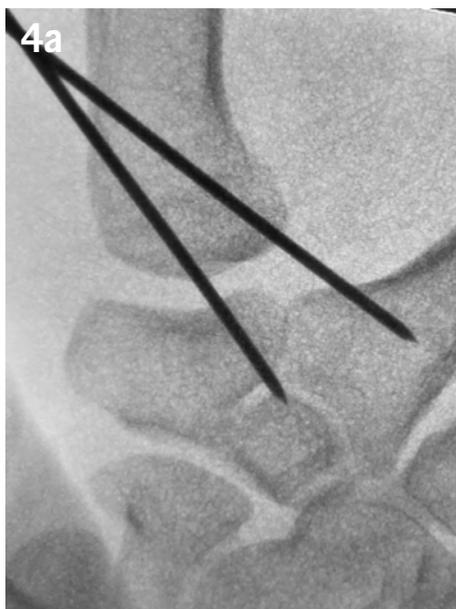


Figure 4: Anatomical reduction of an intra-articular thumb base fracture (a) is mandatory, to reduce the risk of secondary degenerative arthritis and allow a faster return-to-play (RTP). In Bennett fractures with > 50% articular involvement (b), open reduction and internal fixation with screws is preferred.

is the most important ligament in terms of dynamic stability in the thumb base. Proprioception training after fracture healing should therefore include specific training of the opponens pollicis muscle (making a “C” with the thumb and index finger) and the first dorsal interosseus muscle (abduction of the index finger), with the resistance of tension bands. Adding this specific training after fracture healing, and in between seasons, especially for goalkeepers, could perhaps be beneficial.

Return-to-play (RTP) should be individualized, depending on sports, side of injury and position of the athlete. It should start in a protective splint or cast not less than 2 weeks (once the wound has healed) and it can go up to 10 weeks depending on the recovery and the type of sport⁴. The treating physician must balance pressure from athletes, parents, coaches, and executives to expedite RTP with the long-term well-being of the athlete. However, one must carefully weigh the added risks involved with surgical intervention and respect biologic and bone healing time.

OUTCOMES

The majority of the patients can expect a good recovery after surgical treatment of Bennett or Rolando fractures. Superior results are seen in surgically treated fractures in which there is no residual subluxation of the thumb metacarpal shaft and less than 1 mm of intra-articular displacement. It is generally agreed that if pain and articular incongruity persist after 6 months of observation and physiotherapy after closed or open surgery, fusion of

the thumb metacarpal to the trapezium (younger patients, athletes; although difficulty with placing their hand on a flat surface after surgery) or basal joint arthroplasty (older, lower-demand patients) may be indicated.

COMPLICATIONS

- Malunion and subsequent degenerative arthritis resulting from inadequate articular reduction.
- Pin tract infection (better to shorten the K wires and leave them under the skin).
- Neuroma of superficial cutaneous nerves.

However, 90% of the treated patients – including athletes - can expect a good recovery after surgical treatment, with correct reduction and fixation of the fracture and after completing the physiotherapy rehabilitation.

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Gustavo Vinagre M.D., Ph.D.

Orthopaedic Surgeon and Sports Medicine Specialist

Flávio Cruz M.D.

Orthopaedic Surgeon

Jonny K Andersson M.D., Ph.D.

Senior Consultant Hand Surgery

Aspetar Orthopaedic and Sports Medicine Hospital
Doha, Qatar

Contact: kent.andersson@aspetar.com