Median Nerve Injury following K-wire Fixation of Bennett's Fracture—Lessons Learned

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Abstract Bennett's fracture is a relatively common injury. The fracture is unstable due to the displacing forces acting on the distal fragment and very commonly treated by stabilization with Kirschner wires. This would seem a relatively safe procedure, and injury to the median nerve has never been reported. We present this unusual complication following one such procedure with the evaluation of a safe approach utilizing the relevant surgical and radiological anatomy.

Keywords Bennett's fracture · Kirschner wire · Median nerve injury

Introduction

Bennett's fracture refers to an intra-articular fracture separating the volar ulnar aspect of the metacarpal base from the remaining thumb metacarpal [1]. These fractures are very unstable and are best treated by closed reduction and percutaneous pinning or open reduction and fixation. Percutaneous pinning involves Kirschner wires being driven from the radial base of the thumb metacarpal into the trapezium and/or into the adjacent index metacarpal base. However, the median nerve lies in the carpal tunnel in close proximity to the trapeziometacarpal joint and injury during procedure, though rare, may be a potential complication.

Case Report

A 29-year-old farmer sustained a displaced Bennett's fracture in his dominant right hand after a fall. The fracture was manipulated under anesthesia and stabilized with Kirschner wires. Only an anteroposterior intra-operative picture of the hand (Fig. 1) before plaster was used to confirm the final position of the wires. Post-operatively, the patient started complaining of tingling and numbness in the distribution of median nerve. Passive stretching of index and middle fingers to exclude volar compartment syndrome, caused significant and sharp pain at the level of transverse carpal ligament but no discomfort at the forearm volar compartment. Primary measures of splitting the cast and elevation of hand did not relieve symptoms. Post-operative X-rays in plaster revealed the wires to have migrated far more medially than that accepted intra-operatively. The lateral views also confirmed the wires passing volarly raising the suspicion of the wires causing the symptoms (Fig. 2). The lack of stable bony fixation had obviously led to the migration of wires after the application of plaster. A decision was made to explore the median nerve in the carpal tunnel to assess the extent of damage. One of the Kirschner wires was found to have transfixed transverse ligament with the tip rubbing against the volar aspect of the median nerve (Fig. 3). The nerve was intact with a minor bruise over the volar and radial aspect. The wires were removed and fracture stabilized with new Kirschner wires. The intra-operative image confirmed satisfactory position of the wires. A meticulous carpal tunnel release was also performed. Post-operatively, the patient was more comfortable with disappearance of tingling and burning sensations as well as sharp pain with passive stretch. However, there were areas of patchy numbness in the distribution of median nerve that dis-

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Figure 1 Intra-operative anteroposterior view of fixation with wires before plaster.

appeared with recovery of sensory loss in 3 months. There were some residual vasomotor changes in index and middle fingers that recovered at 6 months.

Discussion

Bennett's fracture is typically the result of an axial load on a partially flexed metacarpal and can be associated with fractures of the trapezium and/or concomitant ulnar collateral ligament injuries of the MCP joint [2]. As a result of the fracture, the metacarpal shaft subluxes in a dorsal, proximal, and radial direction due to the pull of the

abductor pollicis longus, extensor pollicis longus, extensor pollicis brevis, and the adductor pollicis longus. The fracture is unstable due to the displacing forces acting on the distal fragment. Proper reduction of the fracture requires axial traction, palmar abduction, and pronation while applying external pressure over the metacarpal base [1, 3–5]. Although earlier reports have noted satisfactory outcomes with non-operative treatment, more recent studies have shown poor outcomes with casting alone for this injury [6–9]. Surgical treatment varies from closed reduction with percutaneous pinning to open reduction with either pins or interfragmentary fixation. Once the articular surface is successfully reduced, Kirschner wires are driven from the radial base of the thumb metacarpal into the trapezium and/or into the adjacent index metacarpal base.

However, the median nerve lies in close proximity to the trapeziometacarpal joint. The radial border of the carpal groove is formed by the tubercles of the scaphoid and trapezium [10], which is converted into the osteofibrous carpal tunnel by the flexor retinaculum situated volarly. The median nerve lies just dorsal to the radial third of the flexor retinaculum. According to the cadaveric study conducted by Sora et al. [11], the median nerve passes just 8 mm ulnar to the scaphoid tubercle. The distance between the median nerve and the trapezium, at the level of the hamate hook, was 7 mm, ranging from 5.2 to 9.4 mm. Moreover, the position and movements of the thumb occur in a plane different from the rest of the

Figure 2 Post operation X-ray showing volar and far too medial excursion of wires.

Figure 3 Tip of K-wire found rubbing the median nerve during exploration.

Figure 4 The safe reference line drawn along the ulnar border of index metacarpal defining the medial limit of wire passage.

fingers [12]. Flexion of the thumb is accompanied by pronation of the metacarpal and extension by supination. Therefore, in varying positions of the palmar-abducted thumb, a Kirschner wire, if not directed at the index metacarpal, may actually slip volar to the carpus and compromise the median nerve. An anteroposterior or an oblique view of the hand would fail to pick up the volar transgression of the wires if separate views of the trapeziometacarpal joint are not included. A true intra-operative anteroposterior and lateral views of the trapeziometacarpal joint was obviously lacking in the above case. Therefore, the direction and length of wire placement is crucial. However, gross swelling over the fracture site can distort the surface landmarks and in spite of best efforts, the direction of the wire may be deviated from the safe path. This may result in the wire passing volarly, and if it extends far too medially, is likely to injure the median nerve. Median nerve injury may also occur if the wire passes far too medially after transfixing the trapezium. Simultaneous radiological guidance in two planes is often difficult intra-operatively. Therefore, a radiological land-

mark defining the location of median nerve in at least one plane could be a useful intra-operative guide. As the measurements described in the cadaveric study by Sora et al. [11] are from bony landmarks, they could serve as a reasonable guide to judge the position of median nerve on radiographs. In an anteroposterior or posteroanterior radiograph of the hand, this point lies within the line drawn along the ulnar border of index metacarpal shaft (Fig. 4) and trapezoid. This could be considered as a safe reference line defining the medial limit of wire passage. This ensures safety of the median nerve intra-operatively even if there is an unintentional volar transgression of the wire. Once this safe medial limit has been verified in the anteroposterior view of the hand, a perpendicular view helps to confirm placement of wire into the trapezium or index metacarpal.

Conclusion

It is quite evident that the median nerve being very close to the trapezium, is at risk of being injured during Kirschner wire fixation of Bennett's fracture or any fracture around the base of thumb. A wire misdirected volarly and far too medially can compromise the median nerve. The line extrapolated down the ulnar border of the index metacarpal shaft and the trapezoid is a useful radiological reference to determine the location of median nerve in the palm and ensure safe placement of wires. A true anteroposterior and lateral radiographs of the trapeziometacarpal joint should always be taken to confirm the adequacy of reduction and placement of wires. It would also be a good practice to include radiographs in plaster to confirm the final position.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Edmunds JO. Traumatic dislocations and instability of the trapeziometacarpal joint of the thumb. *Hand Clin.* 2006;22: 365–92.
2. McGuigan FX, Culp RW. Surgical treatment of intra-articular fractures of the trapezium. *J Hand Surg (Am).* 2002;27:697–703.
3. Kahler DM. Fractures and dislocations of the base of the thumb. *J South Orthop Assoc.* 1995;4:69–76.
4. Soyer AD. Fractures of the base of the first metacarpal: current treatment options. *J Am Acad Orthop Surg.* 1999;7:403–12.
5. Stern P. Fractures of the metacarpals and phalanges. In: Green DP, Hotchkiss RN, Pederson WC, editors. *Green's operative hand surgery.* 5th ed. Philadelphia: Elsevier Churchill Livingstone; 2005. p. 711–71.

6. Kjaer-Petersen K, Langhoff O, Andersen K. Bennett's fracture. *J Hand Surg (Br)*. 1990;15:58–61.
7. Oosterbos CJ, de Boer HH. Nonoperative treatment of Bennett's fracture: a 13-year follow-up. *J Orthop Trauma*. 1995;9:23–7.
8. Thurston AJ, Dempsey SM. Bennett's fracture: a medium to longterm review. *Aust NZ J Surg*. 1993;63:120–3.
9. Timmenga EJ, Blokhuis TJ, Maas M, Raaijmakers EL. Long-term evaluation of Bennett's fracture. A comparison between open and closed reduction. *J Hand Surg (Br)*. 1994;19:373–7.
10. Johnson D, Ellis H. Wrist and hand. In: Standring S, editor. *Gray's anatomy: the anatomical basis of clinical practice*. 39th ed. New York: Elsevier Churchill Livingston; 2005. p. 894–7.
11. Sora MC, Genser-Strobl B. The sectional anatomy of the carpal tunnel and its related neurovascular structures studied by using plastination. *Eur J Neurol*. 2005;12:380–4.
12. Kuczynski K. Carpometacarpal joint of the human thumb. *J Anat*. 1974;118:119–26.