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CASE REPORT
Hand

Ulnar Nerve Injury during Treatment of Fourth and Fifth Metacarpal Fractures: A Case Report and Anatomical Review

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Summary: The deep branch of the ulnar nerve (DBUN) is a pure motor nerve. It passes through a hypothenar fibromuscular tunnel and courses radially on the interossei surface. The DBUN is not frequently considered during hand fracture surgery, despite the anatomical course of the nerve in close relation to the carpal and metacarpal bones, which makes it vulnerable to penetrating injury and being injured during hand surgery fixations. In this article, we describe a case of DBUN injury after percutaneous pinning of the fourth and fifth metacarpal bone fractures complicated by intrinsic muscle wasting of the hand that was treated with neuroma excision and sural nerve graft. We present the case of a 36-year-old man, who had a fracture of the base of the fourth and fifth metacarpal bones, which was treated with multiple K-wires. A few months later, the patient presented with weak abduction/adduction of the three ulnar fingers and prominent wasting in the intrinsic muscles of the hand. On hand exploration, a 2-cm neuroma was found along the course of the DBUN distal to the hypothenar fibromuscular tunnel, which was treated by neuroma excision and nerve grafting. Fractures of the fourth and fifth metacarpals and carpometacarpal dislocations are very common and are often treated surgically. To fix these fractures, awareness of the DBUN course in the hand and its proximity to the carpal and metacarpal bones is important. High caution should be taken during percutaneous pinning by inserting K-wires under radiological guidance, minimizing pining attempts and limiting pin tip protrusion to 1–2 mm. *(Plast Reconstr Surg Glob Open 2023; 11:e4979; doi: 10.1097/GOX.0000000000004979; Published online 11 October 2023.)*

The ulnar nerve along its course in the hand may be injured in association with fractures and dislocations. More specifically, the deep branch of the ulnar nerve (DBUN) is vulnerable to trauma because of its close anatomical course to the base of the metacarpal bones.

The clinical picture of isolated iatrogenic DBUN injury might be obscured in early postoperative days, as weak hand function might be attributed to postoperative pain, until prominent hand muscle wasting is documented clinically.

Few publications have reported DBUN injuries in association with fractures of the pisiform bone, fifth metacarpal bone, and carpometacarpal dislocations.[1] Injury to the DBUN may also be iatrogenic during carpal tunnel release[2] or open reduction and fixation of the fifth metacarpal bone using plates and screws.[3] Here, we report the first case of DBUN injury after percutaneous pinning of the fourth and fifth metacarpal bone fractures complicated by intrinsic muscle wasting of the hand that was treated with neuroma excision and reconstructed using a sural nerve graft.

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We present the case of a 36-year-old, right-handed man who presented with fourth and fifth proximal metacarpal fractures in the left hand. The patient was examined preoperatively, and no motor or sensory deficits were noticed along the ulnar nerve distribution. On the

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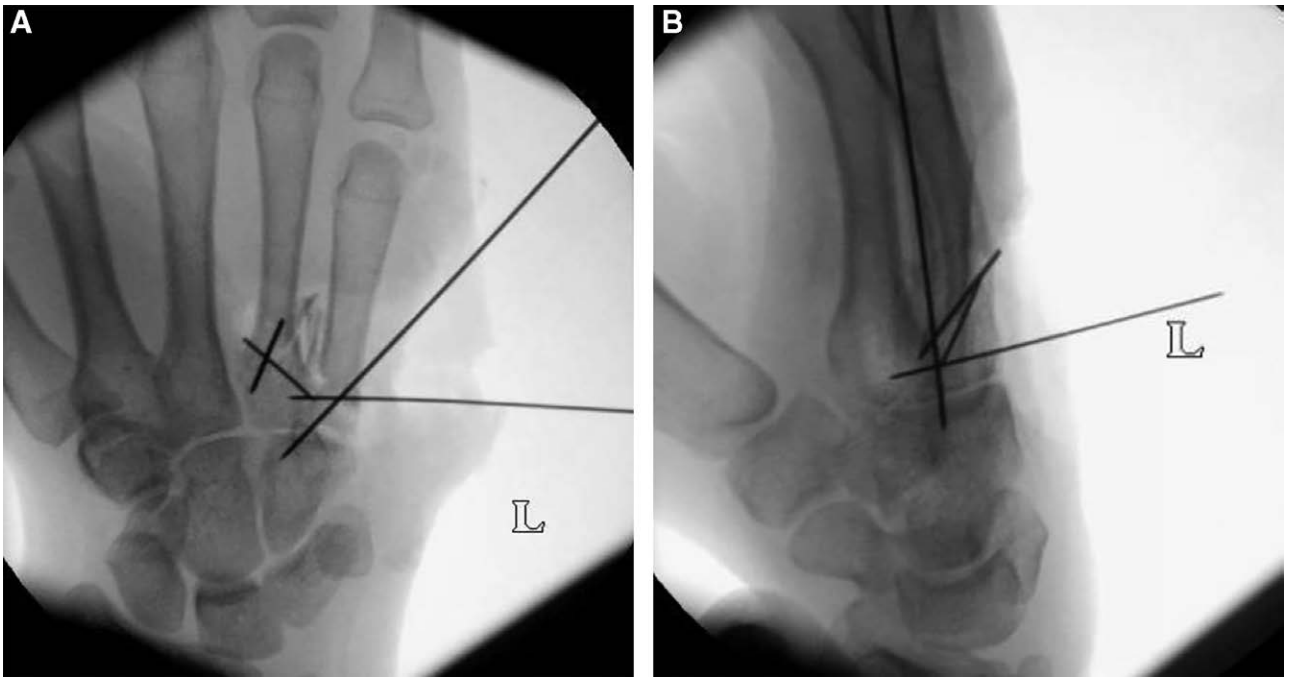

Fig. 1. Displaced and comminuted fracture of the bases of the fourth and fifth metacarpal bones. AP (A) and lateral views (B) of the left hand showing postoperative K-wire fixation of fourth and fifth metacarpal bone fractures.

same day of presentation, percutaneous pinning using K-wires was attempted by another surgeon in the same institute (Fig. 1). Four months after the first surgery and during outpatient follow-up, the patient was found to have remarkable hand weakness and reduced range of motion. These findings were missed by the first surgeon until prominent features of muscle wasting were clinically evident. The patient was referred to the hand surgeon (M.M.) for senior opinion. On clinical examination, the patient had first dorsal interosseous muscle wasting, loss of abduction and adduction of the ulnar three fingers, and weak thumb to index pinching. However, the two-point discrimination for testing the sensation along the ulnar side of the hand was intact, and hypothenar muscle wasting was absent. The pinch scale on the affected hand was 5 kg compared with 15 kg on the normal right hand. A decision for hand exploration was taken by the author (M.M.). On exploration, a 2-cm neuroma-in-continuity was found on the course of the DBUN distal to the hypothenar fibromuscular tunnel (Fig. 2).

The neuroma was excised, and the sural nerve graft was harvested for nerve reconstruction by the senior author (M.M.). Histopathological examination confirmed that the mass was a neuroma. On the 12th week of postoperative follow-up, the patient showed signs of recovery in pinch power and fair abduction/adduction in the three ulnar fingers.

DISCUSSION

The ulnar nerve divides into two terminal branches at the wrist: the superficial sensory branch and the DBUN, which provides four major divisions with 20 branches supplying the hypothenar muscles, medial two lumbricals, interossei, adductor pollicis, all the carpometacarpal joints, the ring and little metacarpophalangeal joints,[4] and sometimes the deep part of the flexor pollicis brevis and opponens pollicis.[5]

The DBUN is a pure motor nerve that supplies most of the intrinsic muscles of the hand. Once the nerve passes the hypothenar fibromuscular tunnel, traversing the proximal third of the fourth and fifth metacarpals, it becomes vulnerable to injury during skeletal trauma in carpometacarpal dislocations, proximal third metacarpal fracture, and metacarpal fracture fixation by screws, or by percutaneous pinning of fifth and/or fourth metacarpal bone fracture dislocations, as in our case. (**See figure 1, Supplemental Digital Content 1,** which displays the course of the DBUN in close relation to the base of the fourth and fifth metacarpal bones and carpometacarpal joints. **http://links.lww.com/PRSGO/C815**.)

Injury to the DBUN during percutaneous fixation of the proximal third of the fourth and fifth metacarpal bone fractures and dislocations might pass unnoticed until muscle wasting of the hand is clinically witnessed; for any chance of recovery, re-innervation would need to take place long before 12–18 months, after which muscle wasting is unlikely to be reversible. Prompt clinical examination and documentation of motor hand function preoperatively and postoperatively are crucial to determine if a DBUN injury is related to carpometacarpal dislocation and proximal third fracture or is caused by percutaneous fixation.

Gil and colleagues, in their anatomical study, have measured the distance from the DBUN crossing points on the fifth and fourth metacarpals to a transverse line drawn between the proximal border of the pisiform and the

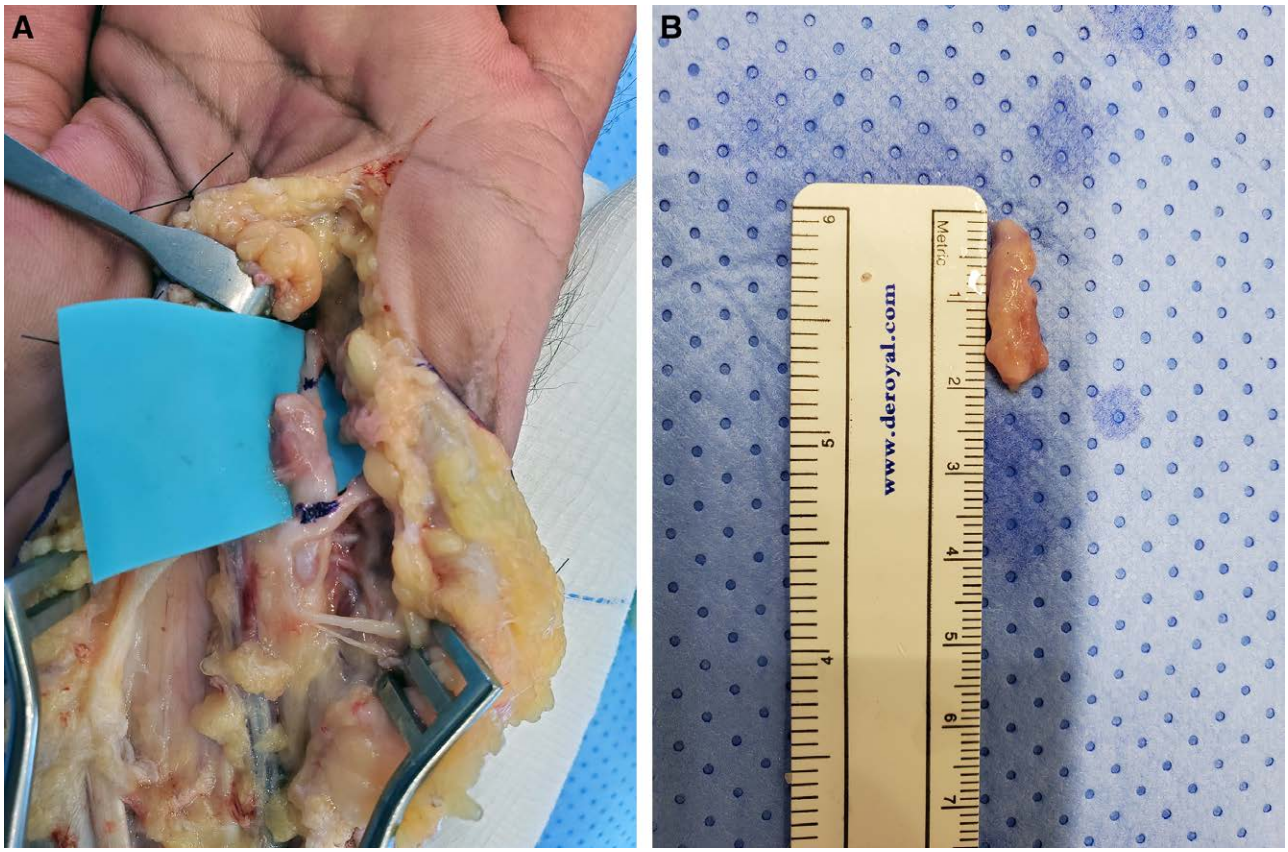

Fig. 2. Neuroma of DBUN. A, Neuroma of the DBUN distal to the hypothenar fibromuscular tunnel. B, DBUN neuroma after excision measuring 2 cm.

tubercle of the scaphoid, the pisoscaphoid line (PSL).[6] They found the distance from the PSL to the crossing point on the fifth metacarpal bone was 28 mm (SD 2.4) in men and 24 mm (SD 2.7) in women, while it was 39 mm (SD 3.6) in men and 35 mm (SD 3.8) in women from the fourth metacarpal bone crossing point. [**See figure 2, Supplemental Digital Content 2,** which displays vertical distances from the PSL (black dotted line) to the crossing point between the DBUN and the fourth and fifth metacarpals. **http://links.lww.com/PRSGO/C816**.]

We suggest that high caution should be taken during percutaneous pinning by inserting K-wires under radiological guidance, minimizing pinning attempts, and limiting pin tip protrusion to 1–2 mm. In addition, anteroposterior K-wires should be minimized to the highest extent possible.

With evidence of DBUN injury, hand exploration and neuroma excision, with a possible need for a nerve graft, is the mainstay for management. Hand function recovery might take some time before witnessing actual thumb to index pinching, considering that nerve regeneration takes 1 mm per day in general estimation, and the distance from the distal to hypothenar fibromuscular tunnel to the division point of the first branches of the adductor pollicis and first dorsal interosseous muscle is approximately 4–5 cm.[6,7] Although limited, nerve transfer options are available to boost the regeneration process with extra fascicles, especially in late presentations, when the time to catch the window for reversible muscle atrophy is crucial. One option is end-to-end nerve transfer of the motor branch of the opponens pollicis to the DBUN for pinch reconstruction.[8] Another option is ETS transfer from the first lumbrical nerve to the deep motor branch of the ulnar nerve, to avoid intrinsic atrophy.[9] However, to the best of our knowledge, this option has only been studied in cadavers and needs to be evaluated clinically.

In conclusion, fractures of the fourth and fifth metacarpals and carpometacarpal dislocations are very common and are often treated surgically. To fix these fractures, awareness of the DBUN course in the hand and its proximity to the carpal and metacarpal bones is important. Great caution should be taken during percutaneous pinning by inserting K-wires under radiological guidance, which leads to fewer attempts and, hence, less likelihood of nerve injury, and limiting pin tip protrusion to 1–2 mm.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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