

# Combined Fracture of Carpal and Volar Divergent Dislocation of the Second to Fifth Carpometacarpal Joints

## Kombinovaná zlomenina zápěstí a volární divergentní dislokace 2.–5. karpometakarpálního kloubu

Q. LIU, L. TANG, P. LIANG, J. YE, X. HU, J. DENG

<sup>1</sup> Department of Orthopedics, Jiangxi Province Xing Guo People's Hospital, Xingguo, Jiangxi Province, China

<sup>2</sup> Department of Rehabilitation Medicine, Jiangxi Province Xing Guo People's Hospital, Xingguo, Jiangxi Province, China

### SUMMARY

The volar divergent dislocation of the second to fifth carpometacarpal joints and involving fracture of carpal is an extremely rare injury. We reported a case of 55-year-old man, victim of a motorbike, who was struck by a car, admitted at the emergency department unable to move his left hand with severe swelling. X-rays and CT scan showed a volar divergent dislocation of second to fifth carpometacarpal joints and involving fracture of carpal. Patient underwent closed reduction and plaster fixation right way, after one week, he received open reduction internal fixation with K-wire and plaster. Functional exercise was started progressively once K-wire and plaster were removed after six weeks. At six months follow-up, results were excellent and patient has regained all of his range of motion and hand activities.

**Key words:** carpometacarpal joint, palmar, divergent, dislocation, hand, wrist.

### INTRODUCTION

The dislocation of carpometacarpal joints (CMC) is an uncommon injury, they are usually the fifth or the third to fourth CMC, rarely the second to fifth or all five CMC. The dislocation of CMC represents less than 1% of all hand injuries (10, 12). The volar dislocation of CMC are less common than dorsal dislocation of CMC, and divergent type of CMC dislocations is more rare (2). Since the first CMC dislocations was reported in 1873 (13), the cases of CMC dislocations were gradually increasing. As far as we know, the volar divergent dislocation of the second to fifth CMC and combined fracture of carpal was never reported until our observation that described the anatomy and mechanism of injury, clinical diagnosis, treatment and functional results.

### CASE

A 55-year-old man, victim of a motorbike, who was struck by a car, was admitted at the emergency department unable to move his left hand with severe swelling for two hours. On physical examination, there were severe swelling and pain on the left hand and tenderness percussion pain on the wrist, and we did not found neurovascular deficiencies or skin wound. The anteroposterior radiograph of the hand showed loss of parallelism and apparent shortening of the second to fifth metacarpals. Lateral radiograph showed volar radial dislocation of the second to fifth CMC, which against divergent metacarpal base in volar direction (Fig. A). Three-dimensional CT showed volar radial dislocation of the second to fifth

CMC and avulsion fracture of trapezoid bone and hamate (Fig. B). So patient underwent closed reduction and plaster fixation right way, Postoperative X-rays revealed the fifth CMC failed (Fig. C). When the swelling was better, he received open reduction internal fixation with K-wire and plaster after one week. A transverse incision was made at the dorsal metacarpal joint of the left wrist, we found dorsal carpal ligament of the CMC were laniated from the second to fifth metacarpal base and the dislocation and fracture just as the CT showed. So the small free bone fragments were removed firstly, trapezoid bone was reduced and stabilized by two K-wires, then the second to fifth CMC were reduced successively and stabilized by four K-wires. In order to enhance stability, one K-wire was fixed at the base of the second and third metacarpale, the other for the fourth and fifth metacarpale (Fig. D). We repaired the dorsal carpal ligament at last. A fluoroscopic check indicated well reduction and alignment of the CMC joints. The left hand was immobilized in a short-arm thumb plaster cast in functional position for 6 weeks after surgery, which allowed active motion of the ulnar four digits. Functional exercise was started progressively with the help of rehabilitation therapist once K-wire and plaster were removed after six weeks. At six months follow-up, results were excellent and patient has recovered all of his range of motion and hand activities. Radiological control after six months follow-up revealed trapezoid bone and hamate had healed and no recurrence of CMC instability (Fig. E). he was satisfied with grip and pinch strength except for mild aching with changes in weather comparing to the uninjured hand (Figs. F and G).



Fig. A. The radiograph of the hand showing volar radial dislocation of the second to fifth carpometacarpal joints.

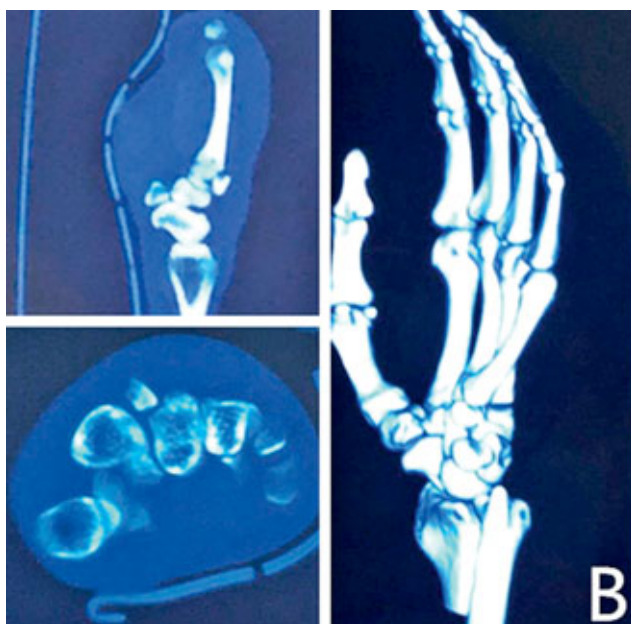


Fig. B. Three-dimensional CT showed volar radial dislocation of the second to fifth carpometacarpal joints and avulsion fracture of trapezoid bone and hamate.



Fig. C. X-rays revealed patient underwent closed reduction immediately, the fifth carpometacarpal joints was still dislocated.

## DISCUSSION

It was reported that the most frequent CMC dislocation is dorsal dislocation of the fifth CMC, it account for 80% CMC dislocation, And the fifth CMC dislocation is more than 50% hand injuries in isolate CMC disloca-



Fig. D. Postoperative X-rays showed the second to fifth carpometacarpal joints and carpus were reduced and stabilized by K-wires.



Fig. E. Postoperative six months X-rays showed there was no osteonecrosis of carpus and recurrence.



Figs. F and G. Clinical images showed normal hand function.

tion or fracture-dislocation (5). The dislocation of the second to the fifth CMC and combined fracture of carpal is rare hand injury. To our knowledge, the volar divergent dislocation of the second to fifth CMC and combined fracture of carpal was never reported. The anatomy of CMC tells us that the second to fifth CMC are slip joint,

while the fifth CMC is trapezoid joint. The bases of the second and fifth metacarpals are firmly fixed to the carpus by multiple, thick and strong ligaments. For example, dorsal ligaments, volar ligaments and interosseous ligaments (7, 8). So the dislocation of CMC, especially multiple CMC, is extremely low. But the fifth CMC is easier to dislocate than others with fewer ligamentous attachments.

The dislocation of CMC occurs mainly in young adults and multiple injuries. Due to life-threatening craniocerebral, thoracic-abdominal trauma and severe swelling of soft tissues, the dislocation of CMC can be inadvertently overlooked. Iconography examination plays an important role in diagnosing CMC dislocation. Anteroposterior radiographs showed apparent shortening of metacarpals and loss of parallelism (M sign) between metacarpal bases and carpal bones, what is more, CMC dislocation should be given a strict lateral radiographs for concealing by overlapping of the joints. CT scan should be performed to confirm diagnosis avulsion fracture of carpal (6). The mechanism of injury and the type of dislocation depend on multiple violent impact, the flexion and extension of CMC, ligamentous attachments. The dorsal dislocation of CMC is rare but severe hand injuries associated with high-energy trauma, while The volar divergent dislocation of the second to fifth CMC and combined fracture of carpal is less common (14). The possible cause of the injury is that the CMC is struck by two shear forces in opposite directions with gripping the handle in accident, one direct volar violence for the distal dorsal of the metacarpale, the other indirect clogging force from handle for the base of the wrist (4). The dorsal of ligamentous attachments are teared and then CMC were dislocated, what is worse, the volar of ligamentous attachments are fairly to resist the forces (11). So there is the volar divergent dislocation of CMC and combined fracture of carpal.

The dislocation of CMC can be treated conservatively or operatively. We should attempt firstly to close reduction for the acute injury, while delayed dislocation more than two weeks or unsatisfactory closed reduction with or without fracture require open reduction and internal fixation. It is good for the stability of CMC with repairing the dorsal of ligamentous attachments after internal fixation. There is a higher risk of re-dislocation of the CMC treated conservatively than open reduction, especially for the patient with fracture of the base of the metacarpal or carpal (9, 15). As we all known, the plate and K-wire are the most commonly used fixation. It was reported that K-wire fixation was superior to plate fixation, the reason was that the K-wire was so elastic that decreased the stiffness of the CMC as more as possible (1). Besides, Arthroscopic reduction and percutaneous fixation of CMC dislocations with fracture is another new minimally invasive technique, it was known that the articular fracture fragment is often volar, and difficult to visualize and reduce from a dorsal approach for open reduction. We can make good use of the ability of arthroscopic to directly visualize the quality of the articular reduction. But it was not suitable for multiple CMC dislocations

with fracture. There are some possible complications of dislocation of CMC, for example the persistence of residual pain of the CMC, a decrease in grip strength, subluxations and osteoarthritis of the CMC (3). The better functional exercise you do as early as possible once the K-wire and plaster are removed, the less complications are residual.

*This study was approved by the ethics board of Xing Guo People's Hospital.*

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## Corresponding author:

Qiang Liu  
Department of Orthopedics  
Jiangxi Province Xing Guo People's Hospital  
Wenming 699<sup>th</sup> road  
Xingguo 342400, Jiangxi Province, China  
E-mail: 279141824@qq.com