

CARPOMETACARPAL DISLOCATIONS OF THE FINGERS

SOHAIL AHMAD, MD, and KEVIN D. PLANCHER, MD, MS

Injuries to the carpometacarpal joints (II-V) in the hand are uncommon. They comprise less than 1% of all hand and wrist injuries.^{1,2} Patients with these injuries may see a physician several times before the proper diagnosis is determined.³ This article reviews the anatomy, diagnosis, and treatment of carpometacarpal dislocations of the fingers.

KEY WORDS: carpometacarpal dislocations, Bora view, carpometacarpal arthrodesis, resection arthroplasty

The stability and integrity of the finger carpometacarpal (CMC) joints are dependent on both static and dynamic forces. The static force is the anatomic configuration of the joint with its strong volar and dorsal interosseous ligaments. Dynamic forces include various muscular forces crossing the joint.^{4,5}

ANATOMY

Static forces such as the distal carpal row, with its ligamentous connections, form the fixed transverse arch of the hand.⁶ The mobile longitudinal arches of the hand⁶ are formed by the thumb CMC and ring and little finger CMC joints. The index and long metacarpals, with their respective articulations (the trapezoid and capitate) form the central rigid unit of the CMC joints of the hand. This anatomic relationship forms an interlocking keystone configuration. This central unit is flanked radially by the thumb CMC joint, and ulnarly by the ring and little CMC joints.^{5,7,8}

The index and long carpometacarpal joints are stabilized dynamically by the insertions of the extensor carpi radialis longus and extensor carpi radialis brevis along the dorsoradial border of the index metacarpal, and the base of the dorsal surface of the long metacarpal. Additional stabilizers are formed from the insertions of the flexor carpi radialis on the volar surfaces of both metacarpals.^{7,8} These static (anatomic ligaments) and dynamic (muscular insertions) forces of the index and long CMC joints will limit motion at these joints to 1° and 2° to 3° of motion in the anteroposterior (AP) plane, respectively.^{7,9}

The ring and little metacarpals articulate with the bifaceted hamate. The ring CMC joint is relatively flat and transverse, whereas the little (V) CMC joint has an oblique orientation. This orientation gives the fifth CMC joint a shallow saddle-like configuration with 5° to 20° more

mobility than the ring CMC joint (8° to 10° vs 15° to 30°).^{7,8,10} Dynamic stabilization across the fifth finger CMC is provided by the extensor carpi ulnaris attachment along the dorsal ulnar border of the fifth metacarpal, the pisometacarpal ligament volarly, and the hypothenar muscles.

DIAGNOSIS

Carpometacarpal dislocations are often missed on initial presentation.^{5,11} The injury may be overlooked when associated with long bone injuries or when inadequate radiographs are taken.^{2,8} Mechanisms of injury including sudden violent impacts, motor vehicle accidents, falls from tall heights, and fighting must increase the index of suspicion for this injury.

The patient will complain of localized swelling and tenderness over the involved CMC joints. The neurovascular examination must not be overlooked to avoid missing an injury to the deep motor branch of the ulnar nerve.^{6,7,12} Carpal tunnel syndrome as a result of a traumatic injury to the median nerve has also been described with these injuries.^{8,13}

Radiographic Evaluation

The physician evaluating CMC injuries may only be given routine AP and lateral films of the hand. The clinician should obtain oblique x-rays that help profile each carpometacarpal joint.

Bora and Didizian¹⁴ described taking a radiograph with the injured hand in 30° of pronation from the routine AP image to profile the ring and little finger carpometacarpal joints. (Fig 1) Other investigators advocate oblique radiographs taken in 30° of pronation and supination from the lateral to best image the carpometacarpal joints.^{2,5}

Fisher et al³ described the importance of symmetry and parallelism of the normal CMC joints seen on the AP radiograph. The width of the index through little CMC joint spaces is a relatively constant distance of 1 to 2 mm. If there is a change in this measurement, a high index of suspicion must exist for a CMC joint injury. Fisher et al³ also stressed the importance of parallel M lines on normal AP radiographs. The proximal line of the M is a zig-zag line drawn along the distal curvatures of the trapezoid, capitate and hamate. The distal line of the M is a symmetric

From Albany Medical Center, Albany, NY; Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, NY; and Steadman Hawkins Clinic, Vail, CO.

Address reprint requests to Kevin D. Plancher, MD, Montefiore Medical Center, 111 E 210th St, Bronx, NY 10467-2490.

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Fig 1. (A) Clinical photograph showing position of the hand for the Bora view. (B) Radiographic positioning for the Bora view. (Copyright Dr Kevin D. Plancher.)

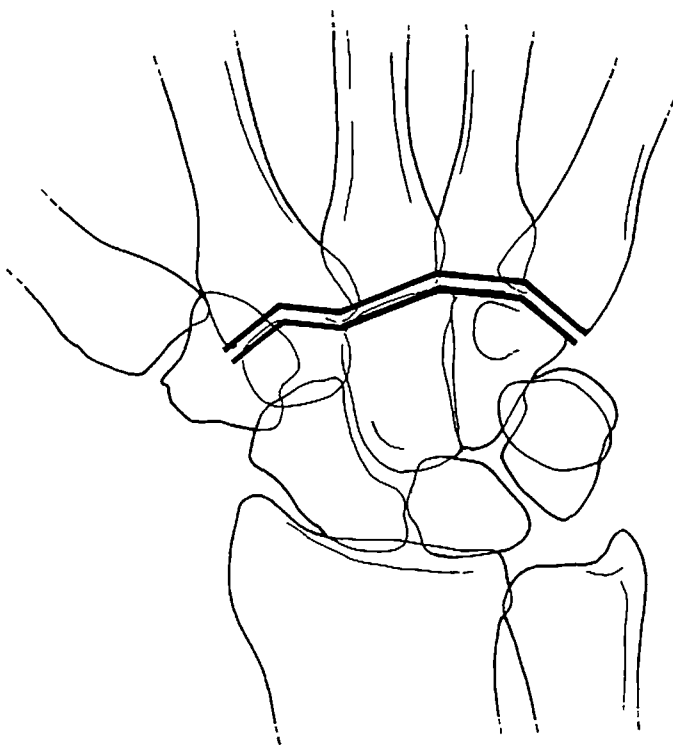


Fig 2. Parallel M lines. One line is drawn along the distal borders of the trapezoid, capitate, and hamate. Another line is drawn along the bases of the index through little metacarpals. The width between these two lines should remain uniform.



Fig 3. Percutaneous pinning of multiple CMC joints using distal metacarpal entry points. (Copyright Dr Kevin D. Plancher.)

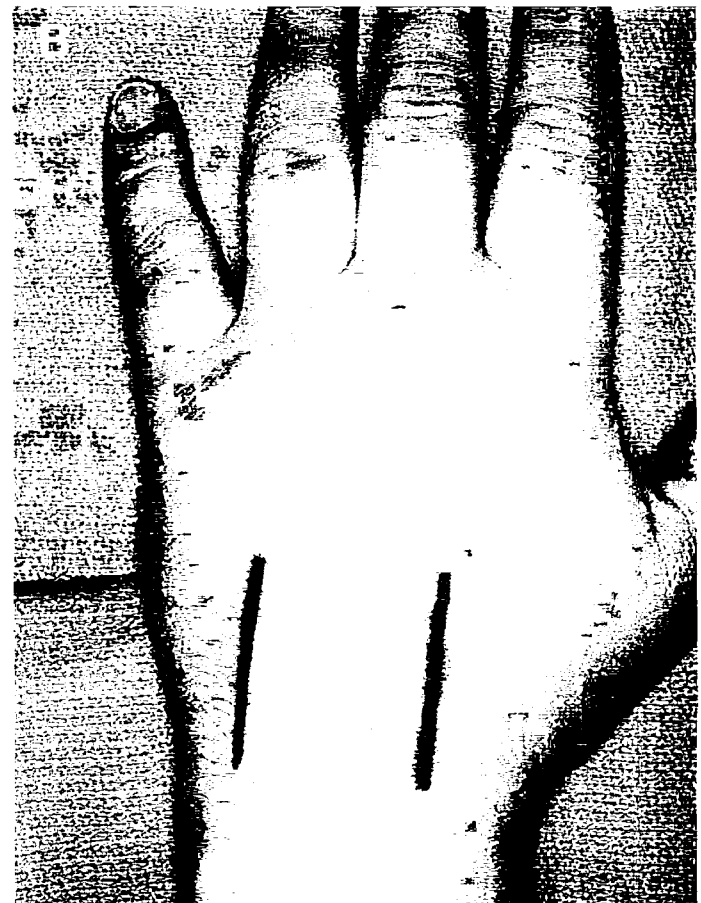
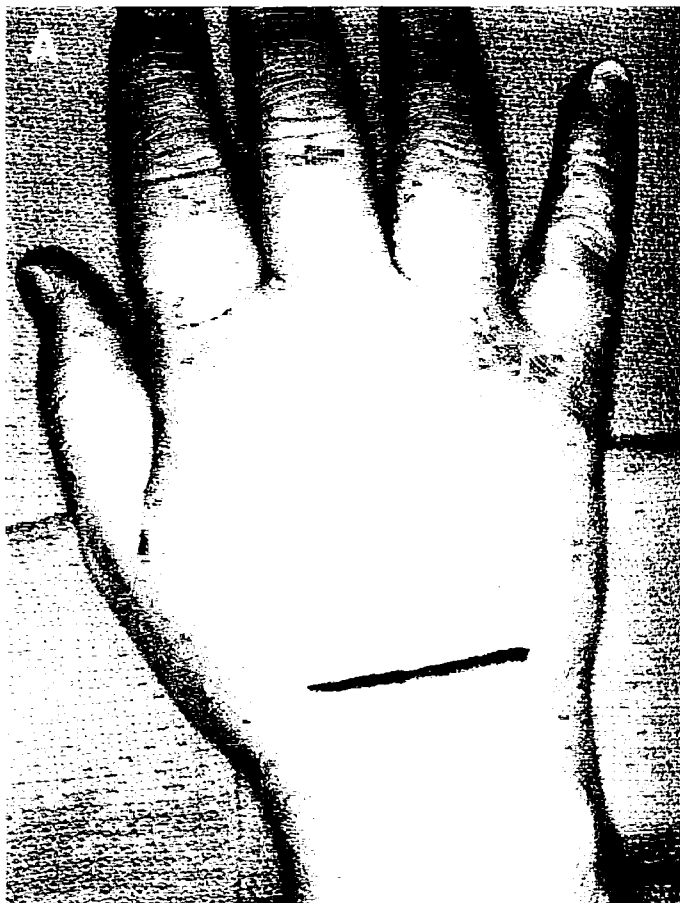


Fig 4. (A) Approach to CMC joints via a single transverse incision. (B) Approach to CMC joints through two spaced longitudinal



Fig 5. (A, top) Clinical photograph of dislocated rotated index CMC. (A, bottom) AP view of rotated dislocated index CMC. (B) Oblique view of rotated dislocated index CMC. (C) AP view of plate fixation of index CMC.



Fig 5 (Cont'd). (D) Lateral view of plate fixation of index CMC. (E) Oblique view of plate fixation of index CMC. (F) AP view two years after hardware removal from index CMC. (G) Lateral view two years after hardware removal from index CMC. (Reprinted with permission.²²)

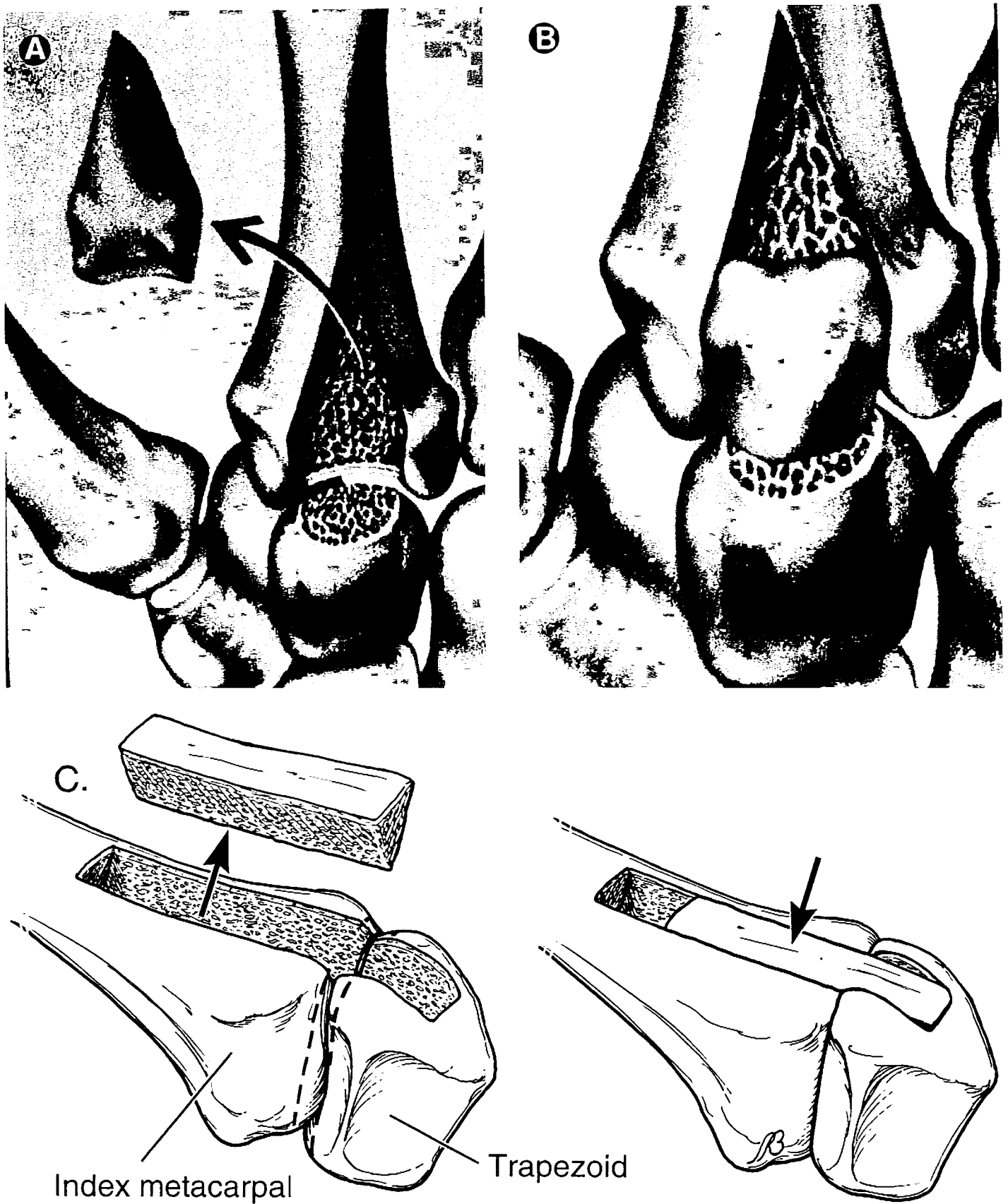


Fig 6. (A) Triangular bone graft harvested from base of index metacarpal. (B) Inverted graft impacted into trapezoid. (C) Positioning of inverted impacted graft. (D) Radiograph after graft positioning for arthrodesis of index CMC.

zig-zag line running along the bases of the index through little metacarpals. A break in the parallelism of the M lines is suggestive of carpometacarpal dislocation (Fig 2).

Computed tomography and tri-spiral tomography are

useful diagnostic modalities, especially in cases with multiple CMC dislocations with associated fractures. These images aid in identification of multiple fragments that may be difficult to discern on routine radiography. Computed



Fig 6 (Cont'd). (E) Postoperative x-ray after long CMC arthrodesis. (Reprinted with permission¹¹ from Churchill Livingstone, New York from Carroll RE, Carlson E: Diagnosis and treatment of injury to the second and third carpometacarpal joints. *J Hand Surg* 14A:102-107, 1989.)

tomography may also be used in preoperative planning for surgical intervention of these complex injuries.^{2,15}

TREATMENT

Treatments vary from nonoperative to open reduction with internal fixation.¹⁶ There is currently no literature comparing outcomes with these different treatment regimes.

Nonoperative Treatment

Early investigators have suggested that unreduced finger (II-V) CMC dislocations produce little functional deficits or symptoms.^{17,18} Recent literature has shown that these injuries disrupt both the central rigid index and long finger CMC arch as well as the mobile longitudinal ring and little finger CMC arch ulnarly. This disruption leads to decreased motor strength, range of motion, and axial length.^{19,20}

Expedient closed reduction is often the first line of treatment. Under adequate anesthesia, longitudinal traction (manually or with finger traps) is applied to achieve length. A volar to dorsal or dorsal to volar pressure, depending on the orientation of the dislocation, is applied to effect reduction. The reduction maneuver is not difficult. The difficulty arises in maintaining the reduction secondary to the deforming forces from muscular insertions of the flexor carpi radialis, extensor carpi radialis brevis, extensor

carpi radialis longus, extensor carpi ulnaris, and the flexor carpi ulnaris via the pisometacarpal ligament. If nonoperative treatment with a cast or splint is chosen, weekly visits in the early postreduction period are needed with close follow-up. Serial radiographs need to be obtained to check for redisplacement of the CMC joints.^{7,8} If the reduction is lost, then operative intervention is necessary.

Operative Treatment

Various treatment regimes have been described for CMC dislocations. These include closed reduction and percutaneous pinning, open reduction with pins, screws, or plates. Chronic or missed CMC dislocations can be treated with an arthrodesis with or without fixation, or a resection arthroplasty. The method of treatment is based on the surgeon's preference and the patient's demands.

Internal fixation of CMC dislocations is preferred by most authors because of its reliability in maintaining a reduction.^{2,5,8} Once reduction is obtained, percutaneous pinning may be performed (Fig 3). This procedure may be performed under a wrist block with the use of a pediatric tourniquet placed around the forearm. A .045 inch K-wire is placed on a power drill. The pin can penetrate the skin at the level of the proximal metacarpal flare of the involved CMC joint.^{2,7,8} The wire should be inserted dorsally to avoid injury to the deep motor branch of the ulnar nerve

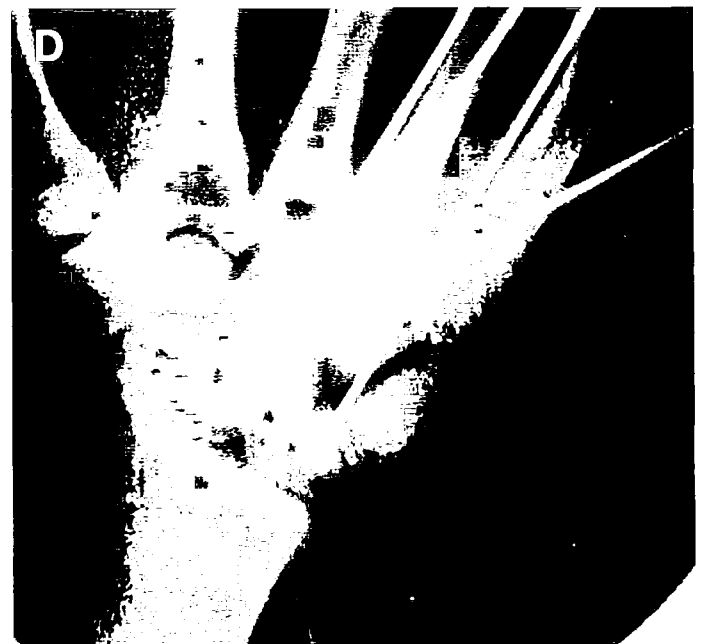


Fig 7. (A) AP view of fracture dislocations of ring and little CMC joints. (B) Lateral view of fracture dislocations of ring and little CMC joints. (C) Oblique view of fracture dislocations of ring and little CMC joints. (D) Arthrodesis using open reduction, pinning, and iliac crest bone graft.



Fig 7 (Cont'd). (E) Postoperative AP radiograph showing fusion of ring and little CMC joints. (Copyright Dr Kevin D. Plancher.)

when working ulnarly. When pinning the ring or little finger CMC, we recommend placing the K-wire obliquely into the hamate. The little finger metacarpal may also be pinned to the ring metacarpal. When pinning the index and middle finger metacarpal, the K-wire may be introduced longitudinally into the trapezoid or capitate or obliquely into an adjacent carpal bone to maximize stability. Once CMC joint reduction and stability are achieved, the pins are bent and cut past the skin. We allow immediate active range of motion at the proximal interphalangeal and distal interphalangeal joints and when possible the metacarpal-phalangeal joint. The wrist is kept immobilized for at least 6 weeks in a fabricated splint or fiberglass proximal phalanx blocking cast. The pins are removed at 6 to 8 weeks in the office.

Closed reduction may not be possible for a variety of reasons, including an injury with an open fracture, tendon or ligamentous interposition, or a chronic injury with surrounding fibrosis.^{5,8,21} In these cases, an open reduction must be performed. All four finger CMC joints may be accessed via two spaced parallel longitudinal incisions or a single transverse incision^{7,10} (Fig 4). Care must be taken to preserve major dorsal veins and the dorsal sensory branches of the radial and ulnar nerves.^{2,5}

We prefer two longitudinal incisions. Once the extensor tendons are retracted, the dorsal capsule is exposed. Any interposed fragments are then removed following direct visual reduction. Internal fixation with pins, screws, or

plates is then performed (Fig 5). We recommend reconstructing the normally rigid index and middle CMC joints and then proceeding medially and laterally in cases of multiple dislocations. Internal fixation is recommended for high energy injuries, which almost always have associated fractures.

Internal fixation often ensures an earlier return to work with increased range of motion because of the decreased potential to irritate the skin and extensor tendons with motion. Early range of motion is encouraged in CMC dislocations when rigid fixation is obtained to avoid stiffness.⁸

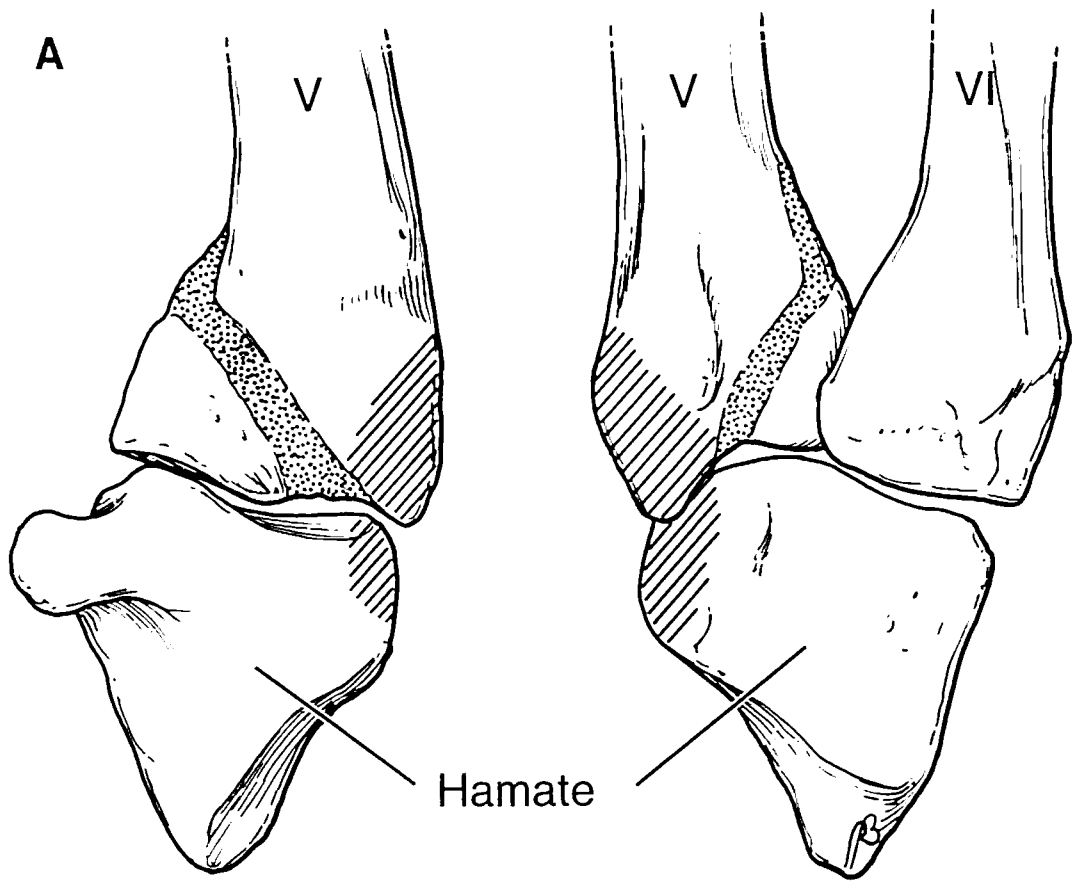
Chronic CMC Dislocations

There is no agreement for the definition of a chronic CMC dislocation. Most authors believe that an injury greater than 3 to 6 months is defined as chronic.^{8,14,20} Others describe associated joint space arthritis and surrounding fibrosis and scarring as features illustrative of chronic CMC dislocations, regardless of the time frame. We define CMC dislocations as chronic when there is a delay in diagnosis and treatment of at least 6 to 12 weeks. At this time, if closed reduction with percutaneous pinning is not possible, we perform an open procedure to reduce and internally fix the joints. If there is destructive joint changes and surrounding fibrosis, we proceed with immediate debridement and fusion.

Arthrodesis is an option in patients with carpometacarpal dislocations that were originally missed and now are symptomatic with pain. Carroll and Carlson¹¹ described the technique for using autogenous bone graft from the metacarpal and wedging it into the corresponding carpus using the same incision and exposure described for open reduction. A triangular segment of bone from the dorsal base of the involved metacarpal is removed with a hand drill and osteotome. The CMC joint cartilage is removed and a wedge cut is made in the corresponding carpal bone. The triangular wedge of bone removed from the metacarpal is then inverted and wedged into a slot in the carpus, to provide structural support¹¹ (Fig 6). This technique can be used to fuse the index metacarpal to the trapezoid or middle metacarpal to the capitate. Carroll and Carlson¹¹ reported 86% of their patients having excellent overall results with this technique. Thirty-six percent of the patients in their study underwent simultaneous K-wire fixation, 29% received autogenous bone graft from the iliac crest or toe phalanx, and only 7% (one patient) in the series required both bone graft and internal fixation for arthrodesis.

Arthrodesis of the CMC joints may be performed using internal fixation with plates, screws, pins, and bone grafts (Fig 7). After exposure, the cartilage about the joint is removed, internal fixation applied, and bone graft placed around the distal carpus and proximal metacarpal. Although allograft can be used for an arthrodesis of the CMC joints, we currently recommend using autograft from the iliac crest with a limited skin incision. Postoperatively, the patient is immobilized for 8 to 12 weeks, or until there is evidence of fusion.

An alternative to arthrodesis of chronic CMC dislocations of the ring and little fingers is resection arthroplasty



Volar view

Dorsal view



(Fig 8). This procedure removes the arthritic portions of the joint and preserves joint motion. After an injury to the ring and little finger CMC joints, a portion of the palmar bony fragment remains concentrically reduced and held in position by the interosseous ligaments volarly. The extensor carpi ulnaris exerts a deforming force dorsally and proximally,⁴ causing the displaced metacarpal shaft to heal in a nonanatomic position. Over time, this leads to osteophyte formation, joint destruction, and pain with ensuing motion deficits.

Black et al⁴ described the technique of resection arthroplasty to alleviate pain and preserve motion. A dorsal exposure over the area of involvement with removal of osteophytes is performed. A small creater is created at the area of joint involvement,⁴ while volarly, the articular surface remains intact. Motion is contingent upon an intact palmar fragment, while the dorsal segment and shaft remain unreduced. Black et al⁴ reported excellent results in 15 of 16 patients treated in this manner for chronic CMC dislocations of the ring and little finger.

SUMMARY AND RECOMMENDATIONS

Dislocations of the CMC joints are rare because of the strong volar and dorsal interosseous ligaments, bony architecture, and multiple insertions across the joints. A high energy mechanism of injury is typical for CMC dislocations of the fingers (II-V). A high index of suspicion is needed when this injury is suspected. Specific radiographs must be obtained to avoid missing this diagnosis.

CMC dislocations can be treated in a variety of ways. In acute injuries, we recommend closed reduction and percutaneous pin fixation. If closed reduction is not possible, open reduction and internal fixation with K-wires or mini-plates may be performed. Arthrodesis is acceptable in acute CMC dislocations; however, we prefer not to fuse joints acutely to preserve joint motion. In chronic CMC dislocations with decreased motion, pain, and loss of strength, arthrodesis is recommended, either with or without internal fixation. Resection arthroplasty⁴ may also be used in select situations when chronic CMC dislocations of

the ring and little fingers have portions of preserved joint margins.

Most patients with CMC dislocations function well once their injuries are recognized and treated appropriately. Currently no outcome studies comparing different treatments have been performed. Our treatment is aimed at achieving reduction and stability acutely with the goals of minimizing pain, maintaining joint motion, and preserving strength and function.

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Fig 8. (A) Volar schematic drawing of a healed fracture dislocation of the little CMC joint. Hatched lines show the area of impingement for resection arthroplasty. Dorsal schematic drawing of a healed fracture dislocation of the little CMC joint. Hatched lines show the area of impingement for resection arthroplasty. (B) Malunion and impingement of little CMC joint. (C) Resection arthroplasty of little CMC joint. (Fig 8C reprinted with permission⁴ from Churchill Livingstone, New York, from Black DM, Watson HK, Vender MI: Arthroplasty of the ulnar carpometacarpal joints. *J Hand Surg* 12A: 1071-1073, 1987.)