Collateral Ligament Injuries of the Metacarpophalangeal Joints of the Fingers

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Collateral ligament injuries of the metacarpophalangeal joints of the fingers are uncommon and may be neglected by the patient or under-diagnosed by physicians, especially at the point of entry to medical care. The incidence of collateral ligament injuries of the metacarpophalangeal joints in the hand is approximately 1 in 1000 hand injuries [1]. Of these, 61% involve the thumb, whereas 39% occur in the fingers. Collateral ligament injuries of the metacarpophalangeal joints of the fingers are most common in the fourth decade, affect men and women almost equally, and typically occur from a laterally directed force with the joint in some degree of flexion. The middle finger is most frequently involved, and radial and ulnar collateral ligament injuries are approximately evenly distributed. Radial disruptions are more frequent in the ring and small fingers. Ulnar collateral ligament injuries may be more common in the index finger metacarpophalangeal joint, but complete radial collateral ligament tear and instability of the index finger may have particularly devastating consequences if not diagnosed and repaired [2–4].

The collateral ligament may tear from its origin, insertion, or within its substance [1,5–8]. Tears at the insertion are most common, whereas tears from the origin are least frequent. There is typically an accompanying overlying transverse or oblique tear of the adjacent sagittal band of the extensor hood (Fig. 1). The accessory collateral ligament may tear in more severe injuries. The dorsal interosseous tendon may also be avulsed from its insertion [9]. A torn portion of the sagittal band may become interposed between the two ends of the torn collateral ligaments, similar to the Stener lesion seen in some complete tears of the ulnar collateral ligament of the metacarpophalangeal joint of the thumb [1,5,9–11].

Anatomy and kinesiology

The metacarpophalangeal joints of the fingers are complex diarthrodial joints [12–14]. In the sagittal plane, the condylar metacarpal head has an ellipsoid shape. Its multiaxial center of rotation rotates palmarward in a spiraling arc parallel to its articular surface as the joint flexes, creating a variable radius of curvature and “cam effect” [12]. The metacarpal head is trapezoidal in the coronal plane, with its wider diameter at its palmar base.

The articular surface of the proximal phalanx is oval, shallow, and convex in relation to its corresponding surface of the metacarpal head [12,13]. The greater diameter of this oblong “glenoid cavity” is in the transverse coronal plane and its lesser diameter is in the anteroposterior coronal plane. It covers most of the transverse coronal articular surface of the metacarpal head.
throughout its range of motion but only approximately one third in the sagittal plane at any point of motion.

The articular geometry, coupled with the ligamentous constraints, creates incrementally increasing stability as the joint flexes [12–16]. The proper and accessory collateral ligaments, palmar plate, sagittal bands, deep transverse intermetacarpal ligaments, and corner ligaments of the interosseous fascia afford static joint constraint. The intrinsic and extrinsic muscles provide some additional dynamic stability.

The collateral and accessory collateral ligaments are the primary soft tissue stabilizers of the metacarpophalangeal joint and form a reciprocal force couple that provides lateral stability and guides the metacarpophalangeal joint throughout its range of flexion and extension [13–15]. The collateral ligament is a robust cord that originates from the posterior tubercle on the lateral surface of the metacarpal head and courses obliquely to insert on the palmar portion of the lateral surface of the base of the proximal phalanx. The radial collateral ligament originates and attaches slightly closer to the joint margins and courses more horizontally than its ulnar counterpart. This ligament lies just dorsal to the flexion–extension axis of the joint and progressively tightens and limits abduction and adduction throughout joint flexion. The collateral ligament gradually relaxes throughout extension.

The accessory collateral ligament is a fan-shaped triangle that originates from its apex at the anterior tubercle on the lateral surface of the metacarpal head and spreads toward the palm to insert along the base of the triangle on the lateral margin of the palmar plate [13–15]. The accessory collateral ligament is positioned palmar to the flexion–extension axis of the joint. The ligament is tense and longer in joint extension; it relaxes and shortens during joint flexion.

The palmar plate has a thin membranous origin from the palmar aspect of the metacarpal neck, gradually thickening as it courses distally, and has a stout fibrocartilaginous insertion into the palmar lip of the base of the proximal phalanx [16]. The palmar plate is longer, thinner, more flexible, and less likely to adhere or contract than its palmar counterpart at the proximal interphalangeal joint. The deep transverse intermetacarpal ligaments, corner ligaments, and accessory collateral ligaments provide additional lateral stability to the metacarpophalangeal joint through their attachments to the lateral edges of the palmar plate.

The finger metacarpophalangeal joints are capable of multiplanar motion [7,13,14]. The flexion–extension arc forms the principal axis of finger metacarpophalangeal joint motion. A normal joint flexes approximately 90° and may extend as much as 20° to 30°. Abduction and adduction of up to 10° to 40°, depending on the specific finger, are greatest in full extension and become increasingly constrained throughout flexion. Some rotation and deviation also occur during flexion, pinching, and grasping. The joint supinates a few degrees during flexion and reciprocally pronates slightly during extension.

Clinical examination

Localized pain, swelling, ecchymosis, and tenderness may accompany injuries of the collateral
ligament complex [1]. Metacarpophalangeal joint and finger motion may be compromised. The extended finger may be malaligned, indicating a complete collateral ligament tear. Scissoring may be seen during finger flexion. Sestero and Stern [17] reported a common triad of clinical findings in complete collateral ligament tears: localized swelling at the injury site, finger malalignment in the coronal plane, and laxity of the metacarpophalangeal joint at 90° of flexion.

Instability may be determined by clinical stress testing of the metacarpophalangeal joint [1,2,4–6,17–19]. Local anesthesia may be necessary to perform this maneuver. Clinical stress testing of the collateral ligament is performed with the metacarpophalangeal joint fully flexed. In the fully flexed position, the normal collateral ligament is fully stretched and lateral deviation of the base of the proximal phalanx is prevented. Lateral stress testing with the metacarpophalangeal joint in full extension tests the integrity of the accessory collateral ligament. Pain without laxity may indicate ligament attenuation or a small partial tear (grade I injury). Pain with laxity and an end point may indicate a more serious partial tear (grade II injury). Laxity and lack of an end point are indicative of a complete tear (grade III injury). The resting finger may deviate away from the side of the tear in extension or overlap an adjacent finger during flexion, securing the diagnosis of a complete tear. Inability to abduct or adduct the finger toward the site of the injury may indicate an interosseous tendon avulsion [4,9].

**Imaging**

Plain radiographs should be taken before stress testing. A plain radiograph may disclose joint subluxation (Fig. 2). An avulsed bone fragment from the margin of the base of the proximal phalanx may be a sentinel to the lesion [1,20,21]. When such a fracture is present and undisplaced, it should not be disturbed and stress testing should be deferred. Otherwise, a stress radiograph may reveal joint instability directly or by comparison with similar views of the same finger of the uninvolved opposite hand (Fig. 3) [1,4].

Brewerton views of the metacarpal head may be helpful in identifying displaced avulsion fractures [17,20,22]. The beam is angled 15° from ulnar to radial, with the dorsum of the fingers flat on the cassette and the metacarpophalangeal joints flexed 65°. A stress view in the Brewerton position may be helpful in assessing joint stability in the absence of a fracture [1,19,21].

Arthrography and MRI have been successful in diagnosing and defining collateral ligament tears and in determining the presence of a Stenor-type lesion [8,9,23,24]. An intact capsular and ligamentous system resists the injection of more than 1 mL of fluid. A lack of resistance to injection of more than 1 mL of fluid or extrusion of fluid at the injury site may indicate a tear in the joint encapsule. Ishizuki [9] was able to distinguish isolated collateral ligament tears, dorsal interosseous avulsions, dorsal capsular tears, and a Stenor-equivalent injury on arthrogram. Delaere and colleagues [1] and Gaston and colleagues [4] did not believe that an arthrogram was necessary for successful diagnosis and treatment of the spectrum of collateral ligament injuries.

Theumann and colleagues [8] were able to differentiate partial from complete collateral ligament tears on T-1 MRI obtained with the metacarpophalangeal joint flexed. Extensor
hood, interosseous tendon, palmar plate, and osteochondral lesions were also easily identified. Sagittal views were optimal for identifying palmar plate lesions. Magnetic resonance arthrography does not have a significant advantage over conventional MRI [24].

Treatment

Nonoperative treatment

Stable partial metacarpophalangeal collateral ligament tears and tears with undisplaced or minimally displaced avulsion fractures may be treated symptomatically and supportively [1]. Static splinting for 3 weeks may be prudent in patients who have avulsion fractures and index or small finger injuries. Protective splinting may be continued between therapy sessions for an additional 3 weeks. Splints should position the metacarpophalangeal joint at approximately 30° of flexion to avoid extension contracture. Interdigital “buddy-taping” to the finger adjacent to the lesion may be sufficient to protect the injured middle finger while allowing progressive functional recovery as local signs and symptoms recede. Buddy-taping may be useful at some point in treatment for other fingers. When symptoms persist beyond 1 month following injury or when instability becomes manifest during the course of treatment, surgery should be considered. Strengthening exercises may be initiated 6 weeks after injury.

Operative treatment

Acute tears

Complete collateral ligament tears are more likely to heal uneventfully when repaired initially [1,2,5–7,11,22]. Radial collateral ligament injuries of the index finger are approached through a midaxial incision. Central digits may be approached dorsally. An intact sagittal band must be incised to expose the collateral ligament and any associated lesions. Torn sagittal bands may expose the lesion and may be extended by further incision if necessary. One side of a torn sagittal band may interpose under the torn ligament, which creates a situation analogous to the Stener lesion that has been reported in ulnar collateral ligament tears of the metacarpophalangeal joint of the thumb [1,5,9,11]. It is particularly important to reconstitute the collateral ligament in these instances. Pull-out or bone anchor sutures have been especially effective in achieving ligament repair at the
origin or insertion of the ligament (Fig. 4) [4,6,7]. Substance tears may be repaired by direct suture. The re-establishment of radial collateral ligament stability is particularly important for the metacarpophalangeal joint of the index finger, owing to the considerable forces placed on this joint during pinch and grasp and with the use of tools [2–4]. A single transarticular Kirschner wire may be used at the discretion of the surgeon for tenuous repairs or in potentially noncompliant patients.

Intra-articular bone fragments should be removed. Displaced avulsed small bone fragments may be resected from the ligament. The ligament is then anchored as outlined previously. Larger displaced avulsion fragments may be repaired with wires or miniscrews to restore the ligament. Green [25] recommended operative treatment for fragments displaced greater than 2 to 3 mm or involving greater than 10% of the joint surface. Sakuma and colleagues [21] associated triangular or rectangular fragments with significant articular involvement and recommended their restoration. In contrast, they found that round fragments were extra-articular and could be successfully managed without surgery. Gee and Pho [26] recommended operative management for all avulsion fractures.

Associated interosseous tendon avulsions should also be repaired by direct, pull-out, or bone anchor suture. Incised or torn sagittal bands should be repaired by direct suture. Failure to repair a sagittal band tear may result in loss of centralization of the extrinsic extensor tendon or tendons of the metacarpophalangeal joint, which in turn may result in chronic pain, swelling, extensor lag, finger deviation, snapping at the metacarpophalangeal joint, and ultimately arthritis. Reconstruction may also be necessary for the residuals of an unrepaired sagittal band lesion alone, if left unattended [27].

Chronic tears

Patients who have chronic metacarpophalangeal joint instability tend to become symptomatic and may experience pain, swelling, tenderness, and weakness. Instability of the metacarpophalangeal joint may be present. Deformity may be apparent.

Symptomatic chronic instability without arthritis may be managed by delayed or late repair in some patients or by ligament reconstruction in others, using a tendon or Dacron graft [3,4,18,19,28,29]. The palmaris longus is a frequently used donor tendon. The graft may be inserted into a bony tunnel and secured with a pull-out suture or by bone anchor sutures (Fig. 5).

Postoperatively, the rehabilitation regimen for operated fingers is similar to the course of therapy described for nonoperative treatment.

Discussion

Injuries of the collateral ligament complex of the metacarpophalangeal joints of the fingers are relatively rare injuries. Some complete metacarpophalangeal collateral ligament tears may be apparent, owing to deviated posture of the finger on inspection or as a result of instability detected during stress testing [1–7,17–19]. Arthrography or MRI, with or without contrast, may diagnose a tear and define its extent [8,9,24].

Data regarding treatment and outcomes have come from expert opinion, individual case reports, and small retrospective or prospective case studies.
The composite information supports nonoperative treatment for stable partial tears (grade I injuries), early initial repair of complete tears and unstable injuries (grade III injuries), and the reconstruction of symptomatic chronic injuries without arthritis. Judgment plays a vital role in managing grade II injuries, but the trend is to repair lesions exhibiting instability. Studies accompanied by objective clinical outcome measurements in the early initial operative treatment of acute complete tears or unstable injuries report full or nearly full recovery of motion and strength within 12 weeks in most patients [1,2,5–7,11].


Sequential sectioning of the collateral and accessory collateral ligaments incrementally increases ulnar deviation and palmar translation of the base of the proximal phalanx on the metacarpal head during simulated pinch [3]. Further division of the dorsal capsule and palmar plate resulted in additional ulnar deviation, palmar translation, pronation, and ulnar shift. These findings support the consensus view of clinicians that early diagnosis and treatment, especially primary repair of complete tears, are important for optimal outcome.

Failure to initially repair a completely torn collateral ligament of a metacarpophalangeal joint of a finger may result in chronic pain, instability, deformity, weakness, and arthritis. Although not quite as reliable as early repair, late ligament repair or reconstruction may provide substantial improvement, if not full recovery, provided there is no arthritis (see Fig. 5) [4,9,18,19,28].

Riederer and colleagues [19] reported 16 good or excellent results and 4 poor results following radial collateral ligament reconstruction of finger metacarpophalangeal joints, with tendon grafts.

Fig. 5. (A, B) The patient whose injury is depicted in Fig. 3 has had reconstruction of the collateral ligament of the metacarpophalangeal joint with a tendon graft secured with mini–bone anchors.
in 20 patients followed for an average of 105 months. Sixteen patients had good or excellent pain relief. Fourteen patients had stable joints, 4 had minimal residual instability, and 2 had marked instability. The patients regained an average of 93% of their grip strength and 92% of their pinch strength. Advancing age at the time of injury adversely influenced outcome. Dray and colleagues [18] reported the successful reconstruction of six finger metacarpophalangeal joint collateral ligaments in patients who had rheumatoid arthritis (five with local tissues and one with a tendon graft).

Chronic radial collateral ligament injuries of the metacarpophalangeal joint of the index finger, especially those with a static pronation deformity, tend to have greater residual impairment and may bypass the index finger for pinch, even after ligament reconstruction [4]. Arthritic joints may require arthroplasty.

References

[26] Gee TC, Pho RW. Avulsion-fracture at the proximal attachment of the radial collateral ligament of the


