Acta Biomed 2017; Vol. 88, Supplement 4: 125-131 DOI: 10.23750/abm.v88i4 -S.6804

Case report

Complex lesion of the third metacarpophalangeal joint: complete tear of the radial collateral and deep transverse metacarpal ligament

Alessio Pedrazzini[1], Dario Oliver Dejana[2], Francesco Romagnoli[3], Nicola Bertoni[1], Bianca Pedrabissi[1], Henry Claudel Yewo Simo[1], Banchi Massimo[1], Vanni Medina[1], Francesco Pogliacomi[2], Francesco Ceccarelli[2], Cinzia Marenzi[4], Maria Teresa Zanchi[5]

[1] Orthopaedic Unit, Oglio Po Hospital, Vicomoscano (CR), Italy; [2] Orthopaedics and Traumatology Clinic, Department of Surgical Sciences, University of Parma, Parma, Italy; [3] Centro Riabilitativo della Mano, Parma (PR), Italy; [4] Radiology Unit, Oglio Po Hospital, Vicomoscano (CR); [5] Anesthesiology and intensive care Department, Oglio Po Hospital

Summary. Injuries of collateral ligaments of MCPs joints are often underdiagnosed but have to be considered serious traumas of the hand. In many cases they concern thumb and rarely long fingers. Closed rupture of the deep transverse metacarpal ligament (DTML) is an unusual parallel injury. Both lesions present similar symptoms included local pain, swelling, ecchymosis and deviation of the finger in flexion and can be misdiagnosed. We describe the treatment of a 34 years old woman who sustained a complex lesion of the soft tissues of third metacarpophalangeal joint with complete close tear of the radial collateral and deep transverse metacarpal ligament following a fall during a walk thus leading to a multiplanar instability. Surgery consisted in mini anchor repair or the collateral ligament tear, direct resorbable suture of DTML and a double k-wire stabilization. Follow up at 11 months has shown excellent functional outcomes. (www.actabiomedica.it)

Key words: radial collateral ligament, deep transverse metacarpal ligament, metacarpophalangeal joint

Introduction

The metacarpophalangeal joints (MCP) of the fingers are complex condylar hinge joints (ginglymus) capable of multiplanar motion (1-3).

The MCPs joints of the ulnar four digits are characterized by high stability as consequence their own ligamentous structure. The capsule of the metacarpophalangeal joint is reinforced on all sides. It extends from the metacarpal neck to the base of the proximal phalanx. Dorsally it is reinforced by the common extensor tendon and volarly by the volar plate and the deep transverse metacarpal ligament (DTML). The latter runs across the palmar surfaces of the heads of the second, third, fourth and fifth metacarpal bones, connecting them together and merges with the collateral ligaments of MCP joints providing some radial and ulnar stability (12).

This capsule is reinforced by the collateral and accessory collateral ligaments and the tendons of the interosseous muscles. The collateral ligaments represent a deep portion of the capsule which can be clinically significant, because they can be avulsed while the capsule remains intact (4).

The collateral ligaments originate dorsally from the radial and ulnar tuberosities of the metacarpal head and course distally and obliquely to insert on the radial and ulnar tuberosities on the palmar proximal margins of the base of the proximal phalanx.

The accessory collateral ligaments originate just palmar to the collateral ligaments and insert on the lateral sides of the volar plate.

The collateral and accessory collateral ligaments act in a reciprocal fashion: the collateral becomes progressively stretched during flexion and shortens during extension; the accessory collateral ligaments are tensed in extension and relaxed during flexion (1-3, 5).

A significant force is reported to be required to injure the collateral ligament with acute ulnar or radial deviation or forced twisting injury. The collateral ligaments are susceptible to injury from laterally directed stresses. Such stresses are usually associated with some dorsally directed component leading to volar plate tear.

Isolates tears of collateral ligaments are rare and concomitant lesions, such as rupture of the deep transverse metacarpal ligament (DTML), should be always investigated.

Injuries to the ligaments of MCP joints fingers are probably more common than expected and a basic understanding of the complex anatomy and of common ligaments injury mechanisms can help in the proper diagnosis and treatment.

Case report

C.C., a 34-year-old female, fell with her fingers straight on the ground during a walk and sustained a complex lesion of the soft tissues of third metacarpophalangeal joint. Pain (accentuated by gripping) and swelling in the region surrounding the third metacarpophalangeal joint of the right hand characterized the clinical presentation.

The patient was admitted at our Emergency Room (ER) and conventional radiographs were done (AP and LL) but no sign of fracture, ligament avulsion or dislocation were observed.

Multiplanar instability (dorso-volar and radio-ulnar) with floating of the third finger, ulnar deviation during flexion at the metacarpophalangeal joint (figure 1A) and palpatory dorso-volar conjunction of second intermetacarpal space were detected (figure 1B). Therefore MRI imaging were done and a anechoic fluid was visible within the third MTC joint (figure 2).

Surgery was performed within 2 days of the injury under regional anesthesia and antibiotic prophylaxis with cefazolin sodium was administered.

The lesion was approached through a dorso-radial incision of about 3 cm of length localized over the third metacarpophalangeal joint. After identification of the dorsal sensory nervous branches, the extensor tendon was dissected longitudinally for about 2,5 cm. Once the capsule was exposed, a longitudinal capsulectomy was performed. Complete tear of the radial collateral and accessory collateral ligaments origins from the phalange and deep transverse metacarpal ligament rupture was observed (figure 3) as well as intra-articular fluid.

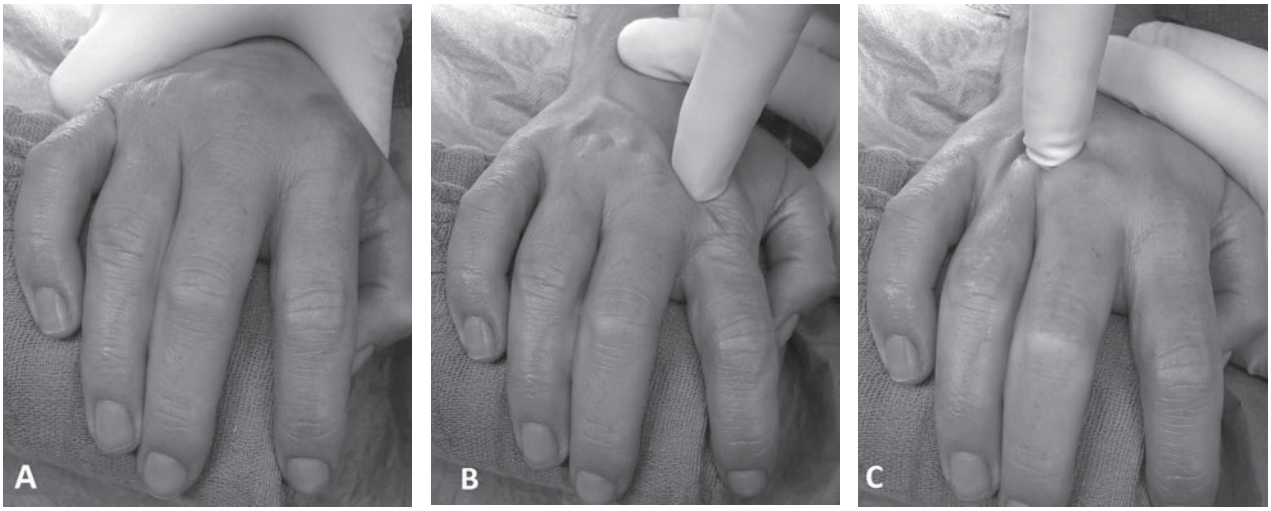

Figure 1. Ulnar deviation of the third finger (a); dorso-volar palpation demonstrated DTML lesion at the second intermetacarpal space (b) and integrity of third intermetacarpal space (c)

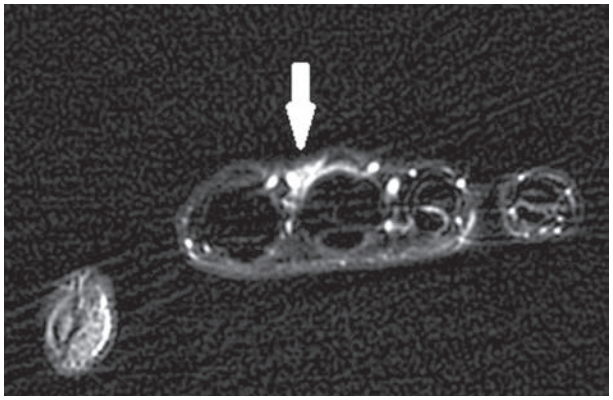

Figure 2. MRI view anechoic fluid within the third MTC joint (arrow)

Figure 3. Complete lesion of both collateral and accessory collateral ligaments

A micro bone anchor 3 mm (De Puy Synthes, Raynham, MA, USA) was inserted in the base of the radial part of the proximal phalange at the origin of the radial collateral ligament (figure 4). The metacarpophalangeal joint was reduced, and the torn radial collateral ligament origin was attached to the anchor. The deep transverse metacarpal ligament was repaired with resorbable suture.

At the end of the procedure capsulodesis and repair of the extensor apparatus after fixation of the second and third metacarpus with two 1,4 and 1,6 Kirschner wires (K-wires) under fluoroscopy (figure 5) were performed.

The final functional assessment did not show ulnar deviation either in flexion or in extension. Joint alignment, stability, and full passive range of motion were completely restored (figure 6).

The metacarpophalangeal joint was immobilized in a plaster cast at 30° of flexion for 3 weeks and interphalangeal joint motion was encouraged immediately

Figure 4. Micro-anchor positioning on radial surface of the proximal phalange base

Figure 5. Postoperative x-rays

Figure 6. Postoperative clinical views with no evidence of ulnar deviation either in flexion or in extension in comparison with contralateral hand

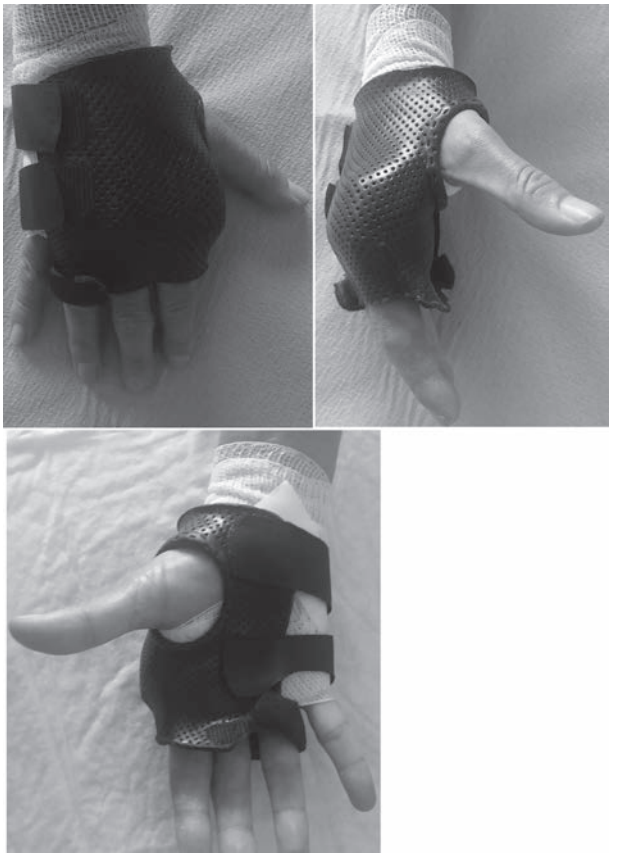

Figure 7. Custom-made splint applied during reahbilitation

after surgery. After that the cast has been replaced by a custom-made splint for other 5 weeks (figure 7).

Rehabilitation

Activity of daily living (ADL) demand that the joints of the hand have to be both stable and allow for mobility. The joint conformation of the hand is exceptionally designed to provide both stability, to intricately transmit power from the forearm musculature to fingertips, and mobility, to position the digits for countless tasks (16).

Although evidence-based literature is lacking, clinical studies recommend an early motion program, even following potentially unstable injuries (17, 18).

The benefits include improved connective tissue healing due to physiologic stress applied early on, and heightened soft tissue mobility around the injury site (17, 19).

The goal of an early motion program is to provide the minimum amount of stress to the healing tissue while allowing for the right amount of excursion of soft tissue to prevent motion-limiting adhesions. Minimum" and "right" amounts are different for each patient and injury (20).

The patient went to a private Occupational Therapy owned hand therapy service 13 days after surgery, wearing a plaster cast with the MP joints of the II and III fingers flexed at 30° and IP joints in full extension.

To maintain joint stability and allow proper injury healing, a custom LTTP (Low Temperature Thermo-Plastic) blocking and protective orthosis for continual wear was fabricated, with the adjacent finger (Index) included and with the MP joints of the II and III fin-

gers flexed at 45°. IP joints of the same fingers were left free to move through buddy taping placed on the middle phalanx (21).

Early edema control was accomplished through elevation, cold, compression and soft manual edema mobilization (22, 23).

Programmed follow-ups to assess and adjust if necessary the orthosis were done weekly as edema in the hand is known to fluctuate according to Gaffney Gallagher (20).

A within-orthosis exercise home program was performed 3 to 5 times per day and educational information were provided to the patient for the first 4 weeks.

Patient assessment included 1- active (AROM) and 2- passive range of motion (PROM) both recorded with a goniometer, 3- grip strength recorded with a standard dynamometer, 4- pinch strength recorded with a standard pinch meter, as well as a functional status of the hand recorded using 5- Patient-Rated Wrist and Hand Evaluation (PRWHE) (24).

Therapy sessions started at 3.5 weeks after surgery, once K-wire removal occurred. These bi-weekly therapy session lasted two hours and were devised personally for the patient's needs and included: hydrotherapy with specific and custom exercises, occupational activities aimed at the functional recovery of movement and strengthening, proprioceptive exercises, motor and sensory reintegration, functional neuro-muscular electrical stimulation and scar management.

- 3.5 weeks postop: AROM client-fitted activities, it was important to ensure that lateral stress was not placed on the MP joint (21); orthosis was worn between therapy sessions, home-exercises and at night.
- 6 weeks postop: gentle strengthening client-fitted activities and PROM was initiated; given the absence of pain at the MP joint, the orthosis was continued at night and for shock-risk situations (21).
- 7 weeks postop: increased strengthening, adapting loads on patient according to pain and capacities, pinch strengthening was initiated with the surgeon's approval.
- 8 weeks postop: the patient was discharged. The orthosis was discontinued. The patient was encouraged to continue buddy taping for sport and heavy activities until 10-12 weeks (21).
- Follow ups at 5 and 11 months postop were planned.

The outcome measures showed a rapid and progressive improvement in AROM and PROM flexion of the MP joints, which at discharge were only slightly lower than the healthy contralateral joint, whereas extension was fully recovered. PIP joint ROM was fully recovered at 6 weeks postop. At 5 and 11 moths follow ups AROM showed a full recovery.

Grip strength, compared with the healthy side, increased from 25% at baseline to 50% at discharge. The functional limit of 20 pounds (9.1 Kg) to perform most daily activities according with Terrono et al. (25). At 5 months follow up, grip strength reached 90% of the unaffected side while at 11 months reached 95%.

Pinch strength was assessed at 7 weeks postop. Lateral and three-jaw chuck pinch were recorded. Results shows 66% of strength in comparison with the unaffected side at 7 weeks postop baseline, again reaching the functional limit strength of 5-7 pounds necessary to accomplish most daily activities. (25). At discharge, pinch was 75% in comparison to the healthy side. At 5 months follow up pinch strengths reached 95% of the unaffected side, while at 11 months follow up was 105%.

Pain and function, according to the PRWHE (24), decreased from a value of 32/100 (Pain: 7 – Function: 25) to a value of 5/100 (Pain: 2 - Function: 3) at patient discharge. At 5 and 11 months follow up a value of 2/100 (Pain: 2 - Function: 0) and 0/100 (Pain: 0 - Function: 0) respectively was recorded.

Patient was extremely satisfied and she went back to her normal life with no limitation (figure 8).

Discussion

Injuries of collateral ligaments of MCP joint are often underdiagnosed but have to be considered serious traumas of the hand (6).

The injury should be diagnosed mainly by clinical investigation. To confirm the diagnosis radiographs, US and/or MRI imaging may be performed (26).

Symptoms include local pain, swelling, ecchymosis, and tenderness.

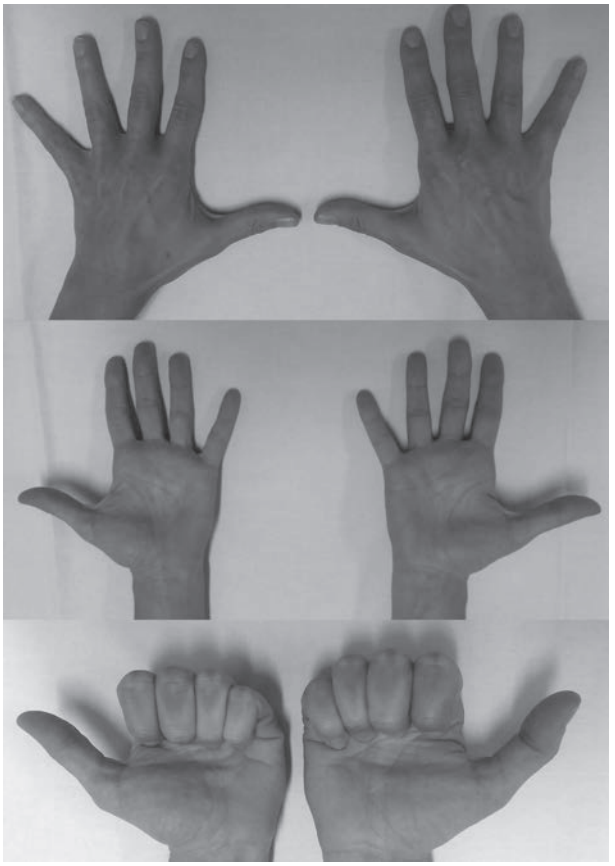

Figure 7. Joint alignment, stability, and full range of motion were restored comparing to contralateral hand at the end of the rehabilitation programme

Lateral stress test with the metacarpophalangeal joint fully flexed evaluates collateral ligament; on the contrary full extension tests examine the integrity of the accessory collateral ligaments. Local anesthesia may be necessary to perform these maneuvers (27).

Closed rupture of the DTML is an unusual injury and the findings of these lesion can be confused with a collateral ligament injury (28).

The collateral ligament may tear most commonly from its insertion or rarely from its origin (in both cases with or without avulsion fragment) or within its substance (7). The accessory collateral ligament may be involved in more severe cases.

These lesions are commonly classified according to Gaston (8-10) which divided these ruptures in 3 grades. Grade I is characterized by small partial tears with joint stability preserved. In Grade II injuries a laxity caused by incomplete tear is present. Finally in Grade III injuries the joint is unstable as a result of tearing ligament and joint capsule.

Literature shows different approaches to these lesions either close reduction with metacarpophalangeal split (with or without K-wire pinning) or open reduction with direct suture or anchor suture repair. Rarely is required a tendon graft (7-11).

We performed combined technique because of the III grade lesion of collateral ligaments and the dorso-volar instability due to DTML rupture (15).

Conclusion

Tears of collateral ligaments with parallel lesions of the deep transverse metacarpal ligament (DTML) is a severe conditions that can lead to a multiplanar instability of MCP and cause deformity and dysfunction over time. In these cases, acute surgical reconstruction and prompt rehabilitation is necessary for a full recover.

References

1. Dubousset JF. The digital joints. In: Tubiana R, ed. The Hand. Philadelphia, Pa: WB Saunders; 1981: 191-201
2. Schultz RJ, Storace A, Krishnamurthy S. Metacarpophalangeal Joint motion and the role of the collateral ligaments. Int Orthop 1987; 11: 149-55.
3. Tamai K, Ryu J, An K, Linscheid RL, Cooney WP, Chao EY. Three-dimensional geometric analysis of the metacarpophalangeal joint. J Hand Surg Am 1988; 13: 521-9.
4. Landsmeer JMF. Anatomical and functional investigations on the articulation of the human fingers. Acat Ant 1955; 25 (suppl 24).
5. Minami A, An KN, Cooney WP III, Linscheid RL, Chao EY. Ligamentous structures of the metacarpophalangeal joint: a quantitative anatomic study. J Orthop Res 1984; 1: 361-8.
6. Doyle JR, Atkinson RE. Rupture of the radial collateral ligament of the metacarpophalangeal joint of the index finger: a report of three cases. J Hand Surgery 1989; 14B: 248-50.
7. Delaere OP, Suttor PM, Degolla R, Leach R, Pieret PJ. Early surgical treatment for collateral ligament rupture of the metacarpophalangeal joints of the fingers. J Hand Surg Am 2003; 28: 309-15.
8. Gaston G, Lourie GM, Peljovich AE. Radial collateral ligament injury of the index metacarpophalangeal joint: an underreported but important injury. J Hand Surgery 2006; 31A: 1355-61.

9. Lourie GM, Gaston RG, Freeland AE. Collateral ligament injuries of the metacarpophalangeal joints of the fingers. Hand Clin 2006 August; 22(3): 357-64.
10. Pillukat T, Schadel-Hopfner M, Windolf J, Prommersberger KJ. Collateral ligament injuries of the metacarpophalangeal joints, Unfallchirurg 2012 Jul; 115 (7): 616-22.
11. Schubiner JM, Mass DP. Operation for collateral ligament ruptures of the metacarpophalangeal joints of the fingers. J Bone J Surg 1989; 71: 388-9.
12. Bade H, Schubert M, Koebke J. Functional morphology of the deep transverse metacarpal ligament. Annals of Anatomy 1994; 176 (5): 443-50.
15. Vigasio A, Marcoccio I. Surgical treatment for metacarpophalangeal joints collateral ligament chronic rupture in long fingers. Riv chir Mano 2007; 44(3): 171-9.
16. Glickel SZ, Barron A, Catalano LWIII: Dislocation and ligament injuries in the digits. in Green DP Hotchkiss R Pederson WC Wolfe SW Green's Operative Hand Surgery. 5th ed 2005 Elsevier Philadelphia.
17. Feehan L. Early controlled mobilization of potentially unstable extra-articular hand fractures. J Hand Ther 2003; 16 (2): 161-70.
18. Ip WY, Ng KH, Chow S: A prospective study of 924 digital fractures of the hand. Injury 1996; 27: 279-85.
19. Stern PJ. Fractures of the metacarpals and phalanges. in Green DP Hotchkiss R Pederson WC Wolfe SW Green's Operative Hand Surgery. 5th ed 2005 Elsevier Philadelphia.
20. Gaffney Gallagher K, Blackmore SM. Intra-articular Hand Fractures and Joint Injuries: Part II - Therapist's Management, in Skirven's Rehabilitation of the hand and upper extremit., 6th ed. 2011, Mosby, Philadelpia.
21. Cannon MC. Diagnosis and Treatment Manual for Physicians and Therapists. 4th ed, 2001, Indianapolis.
22. Howard SB, Krishnagiri S. The use of manual edema mobilization for the reduction of persistent edema in the upper limb. J Hand Ther 2001; 14: 291-301.
23. Priganc VW, Ito MA. Changes in edema, pain, or range of motion following edema mobilization: a single-case design study. J Hand ther 2008; 21: 326-35.
24. MacDermid JC, Tottenham V. Responsiveness of the DASH and Patient rated Wrist and Hand Evaluation (PRWHE) in evaluating change after hand therapy. J Hand Ther 2004; 17(1): 18-24.
25. Terrono AL, et al. The Rheumatoid thumb, in Skirven's Rehabilitation of the hand and upper extremit., 6th ed. 2011, Mosby, Philadelpia] was reached at 7 weeks postop.
26. Clavero JA, Alomar X, Monill JM, et al. MR imaging of ligament and tendon injuries of the fingers. Radiographics 2002; 22: 237-56.
27. Freeland AE, Hobgood ER. Complete Tear of the radial Collateral Ligament of the third metacarpophalangeal Joint. Orthopedics 2004; 27: 733-6.
28. Wheatley MJ, Laymanm C, et al. Closed rupture of the deep transverse metacarpal ligament: Diagnosis and management. The Journal Of Hand Surgery 1998; 23(3): 524-8.

Received: 29 July 2017
Accepetd: 10 August 2017
Correspondance:
Alessio Pedrazzini
Orthopaedic Unit, Oglio Po Hospital
Via Staffolo 51 – 26041 Vicomoscano (CR), Italy
E-mail: alessio.pedrazzini@asst.cremona.it