Modified Eaton-Littler's Reconstruction for Traumatic Dislocation of the Carpometacarpal Joint of the Thumb—A Case Report and Review of Literature

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Abstract Isolated traumatic dislocation of the carpometacarpal joint of the thumb is an uncommon injury. Left untreated, resulting mechanical instability of this joint interferes with normal function of the hand and can lead to articular degeneration of the joint. Most are amenable to closed reduction with or without supplementary pinning. We present a case of a 21 year old female patient with continual instability of the carpometacarpal joint of her right thumb, following closed reduction and pinning. Surgical stabilization was achieved by anterior oblique ligament reconstruction using a Modified Eaton-Littler's technique. At 1 year follow-up evaluation the patient was pain free with no clinico-radiological evidence of instability.

Keywords Carpometacarpal joint · Dislocation · Thumb · Anterior oblique ligament · Ligament reconstruction

Introduction

Acute traumatic dislocation of the carpometacarpal (CMC) joint of the thumb is rare because of strong capsule-ligamentous structure. The anterior oblique ligament, also known as the beak or volar ligament has traditionally been described as the primary static stabilizer, preventing dorsal translation of the thumb metacarpal [1, 2]. Presently, however this view has been debated with more emphasis on the

Dorso-radial ligament as being the main restraint to dorsal subluxation of the CMC joint. [3–5].

Optimal treatment option is still controversial. Treatment options for acute CMC joint dislocation include closed reduction [6, 7], closed reduction with pinning [8], or open reduction with capsular repair and ligament reconstruction [9–11]. Continual instability following closed treatment necessitates surgery; however debate exists as to which ligaments are damaged and hence appropriate treatment approach. Whichever the ligament injury, the aim is to restore the stability of the CMC joint of the thumb.

Diagnosis of instability due rupture of the anterior oblique ligament is difficult. History and specific clinical tests are important in making a diagnosis [12]. Eaton and Littler have described a technique of ligament reconstruction of the CMC joint using a slip of flexor carpi radialis tendon [2]. In our patient, we were able to achieve stability of the CMC joint of the thumb using a Modified Eaton-Littler technique for anterior oblique ligament. The technique described simultaneously reinforces the anterior oblique ligament and the Dorso-radial ligament to achieve global stability.

Case Report

A 21-year-old, right hand dominant nursing home care assistant presented to accident & emergency (A&E) with an injury to her right thumb. She sustained the injury by sand-wiching her thumb between a bed and wall and forcefully hyper extending the digit.

Clinical examination revealed obvious deformity at the CMC joint of the thumb. Range of movement at this joint was greatly reduced and painful. Antero-posterior and oblique radiographs of the hand and thumb showed CMC

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joint dislocation of the thumb with no associated fracture (Fig. 1). An intra-articular injection of 2 % **Lignocaine** was then used for a closed reduction of this dislocation in the A&E but revealed persistent articular in-congruity and foreshortening of the right thumb metacarpal with anterior angulation at the CMC joint on check radiographs (Fig. 2). Hence a further reduction was undertaken under general anaesthesia. This was stabilized with two percutaneous cross Kirschner wires to maintain the reduction (Fig. 3). The patient was then placed in a scaphoid cast for 4 weeks. At 4 weeks the k-wires were removed and gentle hand therapy with intermittent use of a thumb brace was undertaken for 6 weeks. Unfortunately, the patient did not respond to this treatment and continued to have pain at the base of her thumb. Provocative stress tests for suspected rupture of the volar beak ligament were positive. These included the ‘Torque’ test described by Eaton and Littler [2] and Stress test described by Takwale et al. [12]. The instability was confirmed by examination of the thumb under anaesthesia with x-ray control. Reconstruction was undertaken using a modified Eaton-Littler technique (Figs. 4, 5, 6 and 7).

Surgical Technique

The thumb carpometacarpal joint was approached through an anterior curvilinear incision along the lateral margin of the thumb metacarpal, curving ulnar towards the distal wrist

Fig. 1 Showing the isolated carpometacarpal thumb dislocation suffered by the case study

Fig. 2 Post reduction check radiographs showing persistent articular in-congruity

crease as far as the flexor carpi radialis tendon (Fig. 7). The superficial sensory branches of the radial nerve, palmar cutaneous branch of the median nerve and the superficial branch of the radial artery were protected. The thenar muscles were reflected extra-periosteally from the metacarpal and the

Fig. 3 Kirschner wire stabilisation of thumb carpometacarpal joint following failed closed reduction

Fig. 4 Pictures showing range of movement and scar healing following modified Eatons Reconstruction

Fig. 5 Post operative radiographs following modified Eatons Reconstruction showing good joint congruency at the carpometacarpal joint of the thumb

Fig. 6 Traditional Eaton-Littler's technique

trapezium to expose the thumb carpometacarpal joint. In our patient the volar joint capsule was thinned out and lax. The anterior oblique ligament (beak ligament) was found to be torn; while the dorsoradial ligament was intact. Arthrotomy of the joint allowed inspection of the articular surfaces. These were not damaged.

A separate 1 cm transverse incision was made proximally in the forearm to harvest a 10 cm long FCR tendon slip using Carroll's tendon forceps. An extra-articular bone tunnel was then prepared from the dorsum of the thumb metacarpal placed 7–8 mm distal and parallel to the thumb metacarpal articular surface.

In the traditional Eaton-Littler technique, the FCR slip, based distally is released in continuity till its insertion on the index metacarpal. It is then re-routed through a drill hole in the base of the thumb metacarpal, under the abductor pollicis longus insertion and secured on the radial side of the joint.

Fig. 7 Modified Eaton-Littler's technique

We have modified this classical technique by restricting the release of FCR slip 2 to 2.5 cm short of its insertion. This slip was then directed in an oblique manner to reproduce the direction of active action of the anterior oblique ligament. A couple of sutures were placed at this bifurcation point of the FCR slip to prevent further splitting of the slip towards the insertion of FCR on the index finger. The FCR slip was routed through the extra-articular bone tunnel and sutured in a taut position back to itself. The routed FCR slip covered both the dorsal (Dorso-radial ligament) and volar aspect (volar beak ligament) of the carpometacarpal joint by passing under the abductor pollicis longus tendon. An appropriate tension was created in the routed FCR slip by wrist tenodesis manoeuvre to avoid thumb contracture. The joint capsule was repaired in an end-to-end fashion using 4–0 polydioxanone (PDS) interrupted sutures. Wound was then closed and a thumb spica applied for 6 weeks. Hand therapy was commenced after removal of the plaster to allow active and passive mobilization of the thumb under hand therapist's supervision.

Follow-up was done regularly at 3 monthly intervals and at the end of 1 year. The patient was pain free and could undertake all of her pre-injury level of activity. There were no complications. The thumb revealed full range of joint mobility and there was no residual instability. The grip strength measured in kilograms (kg) by Jamar hand dynamometer improved from 10.6 kg pre-operatively to 20.8 kg post-operatively (opposite hand 22 kg). The pinch grip improved from 4.7 kg to 6.5 kg (opposite hand 8 kg). Radiographs demonstrated normal joint anatomy and congruity with no evidence of subluxation.

Discussion

The CMC joint of the thumb is a biconcave saddle joint, stability of which is provided by five main ligamentous structures during static pinch and grasp: (1) The anterior oblique ligament, (2) the dorsoradial ligament, (3) the first inter-metacarpal ligament, (4) the posterior oblique ligament, and (5) the ulnar collateral ligament [1].

Eaton and Littler believed that the anterior oblique ligament, also known as the beak or volar ligament, is a key stabiliser of the joint which prevents radio-dorsal subluxation of the thumb metacarpal during key and dynamic pinch [2, 13]. This ligament is ruptured by an extension-supination injury when the point of contact is the base of the metacarpal of the thumb which probably happened in our patient [12]. A non-functional anterior oblique ligament either because of injury or instability leads to progressive dorsal translation resulting in reduced contact area between thumb metacarpal and trapezium. This produces a pattern similar to that of cartilage degeneration seen in an osteoarthritic joint [14]. This research by Pelligrini et al. supports the hypothesis that pathological joint instability is the main cause of CMC joint osteoarthritis by the mechanism of abnormal translation of the joint.

However, there appears to be considerable debate in the literature about the principal restraint to dorsal dislocation. Strauch et al. [3] and van Brenk et al. [4] in separate cadaveric studies found the dorsoradial ligament complex to be the primary restraint to dorsal dislocation and was responsible for thumb stability. Shah and Patel [15] found the dorsoradial ligament complex torn in their case series of four patients. The volar structures were found to be intact. On the other hand, Simonian and Trumble found the volar beak ligament to be torn in all of their patients who underwent ligament reconstruction [11]. These differences of the site of rupture may be explained on the position of the thumb at the time of the injury.

Plain radiographs usually demonstrate CMC joint dislocation to confirm diagnosis. They should to be carefully evaluated to assess associated injuries such as a fracture of the trapezium [16, 17]. However, diagnosis of instability and

volar beak ligament injury can be difficult especially in presence of congruent joint on radiographs as in our patient.

Eaton and Littler described a ‘Torque test’ which involves axial rotation of a distracted thumb to evaluate CMC joint instability [2]. This test is mentioned to be more specific for synovitis. More recently Takwale et al. have described a two step clinical provocative test to detect instability of this joint [12]. The thumb first abducted in a palmar direction and pronated. The second step involves gradual abduction, supination of the retro pulsed thumb reproducing symptoms of instability in the patient.

The role of complementary imaging such as Ultrasonography (USS), Magnetic Resonance Imaging (MRI) and Magnetic Resonance Arthrography in assessing CMC joint instability and other pathologies is still evolving. Chiavaras et al. used high-resolution ultrasound to identify and measure the thickness of the anterior oblique ligament in a cadaveric study [18]. Though they conclude that dynamic ultrasound imaging can depict volar translation of the metacarpal, which may facilitate diagnosis of ligamentous injury, presently, there are no clinical reports of ultrasound evaluation of the anterior oblique ligament (or dorsoradial ligament) in assessing traumatic instability of CMC joint. In their recent study, Connell et al. [19] evaluated trapezio-metacarpal joint ligamentous injuries using conventional MRI. They recommend coronal and axial imaging with fat suppression and a coronal STIR sequence to assess the integrity of stabilizing ligaments. MR arthrography further improves visualization and provides detailed information about the anatomy of the ligaments around the trapeziometacarpal joint. However, guidelines are still being developed to provide accurate diagnosis on MRI. Hence at present a good clinical history, high index of suspicion and clinical examination are a key to a correct diagnosis.

Traditionally traumatic CMC dislocation of the thumb has been treated with closed reduction (CR) with or without pinning. Conservative methods of CR and plaster application have been shown to produce good results by various authors [6, 20, 21]. In spite of this, healing of peri-articular ligamentous structures and stability of the CMC joint has not been evaluated in long term studies following such injuries. On the other hand, CR with pinning has been applied with variable results [8, 22]. Both set of authors noticed features of instability following this method of treatment in their patients on follow-up evaluation. Fotiadis et al. point out the unpredictable outcome of conservative or minimally invasive methods in achieving stability CMC joint of the thumb [23].

Continual instability following above methods of treatment should lead to a suspicion of a significant ligamentous injury. Left untreated, mechanical instability of the CMC joint of the thumb interferes with normal function of the hand and may lead to articular degeneration of the joint [24].

Techniques of Ligament Reconstruction

A variety of ligamentoplasty techniques to stabilise the CMC joint of the thumb have been described. These involve substituting the anterior oblique ligament, the dorsoradial ligament or the intermetacarpal ligament. Brunelli et al., Eggers and Slocum have described techniques which substitute the intermetacarpal ligament by using harvested slips of abductor pollicis longus, extensor carpi radialis longus and palmaris longus respectively [25–27]. Following the observation of predominant disruption of dorsal capsule-ligamentous structures; Chen and Fotiadis et al. [9, 23] have undertaken reconstruction of the dorsoradial ligament complex in their patients. Because the volar oblique ligament was torn in our patient, we used a modified version of the ligament repair described by Eaton-littler [2, 12].

Following Eaton-Littler's original description of ligament reconstruction for painful thumb CMC joint using FCR [2], other authors have found this procedure to be reliable, reproducible, durable, and found to retard future joint degeneration [11–13, 28]. The harvested portion of FCR is used as a substitute for the anterior oblique ligament. This had the advantage of reconstructing the joint in two planes, reconstituting the volar ligament and also creating a new ligament radially in a part of the joint capsule which was weak. In the traditional Eaton-Littler technique, the FCR slip, based distally is released in continuity till its insertion on the index metacarpal. It is then re-routed through a drill hole in the base of the thumb metacarpal, under the abductor pollicis longus insertion and secured on the radial side of the joint. The reconstruction was traditionally protected with Kirschner wire to be removed after few weeks.

We have modified this classical technique. By restricting the release of FCR slip 2 to 2.5 cm short of its insertion, this slip is then directed in an oblique manner to reproduce the direction of active action of the anterior oblique ligament. By passing the FCR through bony tunnel through the thumb metacarpal and then under the abductor pollicis longus and suturing it back on to itself, also ensured a reinforcement of the Dorso- radial ligament. This helps in achieving global stability of the joint.

We believe a good clinical history, high index of suspicion and clinical examination are the keys to a correct diagnosis of trapeziometacarpal joint instability. Early surgical ligament reconstruction with the modified technique presented here restores global stability of the thumb addressing reinforcement of volar beak and Dorso-radial ligament.

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References

1. Imaeda T, Kai-Nan A, Cooney W 3rd, Linscheid R (1993) Anatomy of the trapeziometacarpal ligaments. *J Hand Surg [Am]* 18:226–231
2. Eaton RG, Littler W (1973) Ligament reconstruction for the painful thumb carpometacarpal joint. *J Bone Joint Surg [Am]* 55-A:1655–1656
3. Strauch RJ, Behrman MJ, Rosenwasser MP (1994) Acute dislocation of the carpometacarpal joint of the thumb: an anatomic and cadaver study. *J Hand Surg* 19A:93–98
4. Van Brenk B, Richards RR, Mackay MB, Boynton EL (1998) A biomechanical assessment of ligaments preventing dorsoradial subluxation of the trapeziometacarpal joint. *J Hand Surg [Am]* 23:607–611
5. Edmunds JO (2011) Current concepts of the anatomy of the thumb trapeziometacarpal joint. *J Hand Surg Am* 36(1):170–182
6. Bosmans B, Verhofstad MHJ, Gosens T (2008) Traumatic thumb carpometacarpal joint dislocations. *J Hand Surg* 33A:438–441
7. Uchida S, Sakai A, Okazaki Y, Okimoto N, Nakamura T (2001) Closed reduction and immobilization for traumatic isolated dislocation of the carpometacarpal joint of the thumb in rugby football players. Two case reports. *Am J Sports Med* 29(2):242–244
8. Jacobsen CW, Elberg JJ (1988) Isolated carpometacarpal dislocation of the thumb. *Scand J Plast Reconstr Surg* 22:185–186
9. Chen VT (1987) Dislocation of the carpometacarpal joint of the thumb. *J HandSurg (Br)* 12(2):246–251
10. Okita G, Anayama S, Sato N, Haro H (2011) Surgical reconstruction using suture anchor for dislocation of the carpometacarpal joint of the thumb: a case report. *Arch Orthop Trauma Surg* 131(2):225–228
11. Simonian PT, Trumble TE (1996) Traumatic dislocation of the thumb carpometacarpal joint: early ligamentous reconstruction versus closed reduction and pinning. *J Hand Surg Am* 21(5):802–806
12. Takwale VJ, Stanley JK, Shahane SA (2004) Post-traumatic instability of the trapeziometacarpal joint of the thumb. *J Bone Joint Surg Br* 86(4):541–545
13. Eaton RG, Lewis B, Lane MD, Littler JW, Keyser JJ (1984) Ligament reconstruction for the painful thumb metacarpal: a long term assessment. *J Hand Surg [Am]* 9:692–699
14. Pellegrini VD Jr, Alcott CW, Hollenberg G (1993) Contact patterns in the trapeziometacarpal joint: the role of the palmar beak ligament. *J Hand Surg Am* 18(2):238–244
15. Shah J, Patel M (1983) Dislocation of the carpometacarpal joint of the thumb. A report of four cases. *Clin Orthop Relat Res* 175:166–169
16. Kukreti S, Harrington P (2004) Carpometacarpal joint dislocation of the thumb associated with fracture of the trapezium: a case report. *Eur J Orthop Surg Traumatol* 14:38–39
17. Mody BS, Dias JJ (1993) Carpometacarpal dislocation of thumb associated with fracture of trapezium. *J Hand Surg [Br]* 18:197–199
18. Chiavaras MM, Harish S, Oomen G, Popowich T, Wainman B, Bain JR (2010) Sonography of the anterior oblique ligament of the trapeziometacarpal joint: a study of cadavers and asymptomatic volunteers. *Am J Roentgenol* 195(6):W428–W434

19. Connell DA, Pike J, Koulouris G, van Wetering N, Hoy G (2004) MR imaging of thumb carpometacarpal joint ligament injuries. *J Hand Surg [Br]* 29:46–54
20. Khan AM, Ryan MG, Teplitz GA (2003) Bilateral carpometacarpal dislocations of the thumb. *Am J Orthop* 32:38–41
21. Kural C, Malkoc M, Ugras AA, Sen A (2002) Isolated carpometacarpal dislocation of the thumb: a case report. *Acta Orthop Traumatol Turc* 36(5):446–448
22. Watt N, Hooper G (1987) Dislocation of the trapezio-metacarpal joint. *J Hand Surg [Br]* 12B:242–245
23. Fotiadis E, Svarnas T, Lyrtzis C, Papadopoulos A, Akritopoulos P, Chalidis B (2010) Isolated thumb carpometacarpal joint dislocation: a case report and review of the literature. *J Orthop Surg Res* 5:16
24. Freedman DM, Eaton RG, Glickel SZ (2000) Long term results of volar ligament reconstruction for symptomatic basal joint laxity. *J Hand Surg [Am]* 25:297–304
25. Brunelli G, Monini L, Brunelli F (1989) Stabilization of the trapeziometacarpal joint. *J Hand Surg [Br]* 14:209–212
26. Eggers GWN (1945) Chronic dislocation of the base of the metacarpal of the thumb. *J Bone Joint Surg (Am)* 27:500–501
27. Slocum DB (1943) Stabilization of the articulation of the greater multangular and the first metacarpal. *J Bone Joint Surg* 25:626–630
28. Lane LB, Henley DH (2000) Ligament reconstruction of the painful, unstable, nonarthritic thumb carpometacarpal joint. *J Hand Surg [Am]* 26(4):686–691