Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jcot

Original Article

Primary repair of capsuloligamentous structures of trapeziometacarpal joint: A preliminary study

Mohammed Tahir Ansari M.S.^a, Prakash P. Kotwal M.S.^a,
Vivek Machhindra Morey M.S.^{b,*}

^a All India Institute of Medical Sciences, New Delhi, India

^b Senior Resident, Department of Orthopaedics, All India Institute of Medical Sciences, Aurobindo Marg, New Delhi 110029, India

ARTICLE INFO

Article history:

Received 10 April 2014

Accepted 19 September 2014

Available online 24 October 2014

Keywords:

Carpometacarpal joint

Suture anchors

Dislocation

Ligament

ABSTRACT

Background: Isolated trapezio-metacarpal joint dislocation is uncommon and challenging since controversy still exists regarding its management.

Description: We present a short case series in which direct repair of trapezio-metacarpal ligaments was done in three patients who had isolated, unstable dislocation of the thumb carpometacarpal joint. All of them were engaged in tasks where no compromise in hand functions and grip strength was affordable. The dislocation was addressed primarily by repair of volar oblique and dorsoradial ligaments with suture anchors. The joint was immobilised in a cast for 4 weeks followed by gradual mobilisation.

Results: At an average follow up of 15 months, all the three patients have no restriction in the range of motion. There are no symptoms and signs of instability. In two patients, there is no pain at all; while one patient has occasional pain which is mild and does not interfere with the hand function. Radiographic examination showed normal joint alignment and no signs of subluxation or early osteoarthritis.

Conclusion: Repair of the capsuloligamentous complex with suture anchors may be considered as a treatment option in unstable trapezio-metacarpal joint dislocations in high demand patients.

Copyright © 2014, Delhi Orthopaedic Association. All rights reserved.

1. Introduction

Isolated dislocation of the Trapezio-metacarpal (TMC) joint is an uncommon and challenging injury. Usually, it is a consequence of a trauma with axial force transmitted through partially flexed thumb. If left untreated or inadequately treated, it can lead to instability of TMC joint resulting

subsequently into joint arthritis, a condition with crippling pain and gross impairment of hand function.

In the past years, palmar oblique ligament was considered as the key ligament stabilizing the TMC joint.¹ This has been debated in the subsequent years and it has been proposed that the dorsoradial carpal ligament is the primary stabilizer of the TMC joint.^{2,3} The dorsoradial carpal ligament is presently considered as a main restraint to dorsal dislocation of the TMC joint.^{4–6}

* Corresponding author. Tel.: +91 9968859509.

E-mail address: morey.vivek123@gmail.com (V.M. Morey).

<http://dx.doi.org/10.1016/j.jcot.2014.09.009>

0976-5662/Copyright © 2014, Delhi Orthopaedic Association. All rights reserved.

There still exists a controversy regarding the optimal treatment of this injury. Acute dislocation of TMC joint is usually managed by three treatment modalities: closed reduction and casting,⁷ closed or open reduction along with transfixion with Kirschner wires⁸ and reconstruction or repair of ligament and capsulorrhaphy.^{9,10} In case of unstable closed reduction, surgery is usually required in the follow up period. We propose ligament repair with suture anchors as a primary treatment in all unstable dislocations, rather than waiting for the conservative management to fail and then operating them. Table 1 shows the ligament repair done in three cases of unstable TMC dislocations of thumb and their functional outcome after an average period of 15 months. All the three patients had full range of motion of thumb without any disability.

1.1. Case 1

A 18 years old male patient, **who was a regional cricket player** presented to us with a history of injury to his left thumb two days back while playing cricket; on examination there was tender swelling over the base of the thumb and the passive and active movements were painful. The length of the thumb was apparently shorter. Radiographs revealed trapezio-metacarpal dislocation (Fig. 1) which was reduced under general anaesthesia; but the reduction was found to be unstable. The joint was open reduced and the ligaments were repaired; the technique of which is described further after discussion of all three cases.

1.2. Case 2

A 22 years old male patient, **who was an ICU nurse in our institute** presented to us with a history of injury to his right thumb seven days after a fall on outstretched from a motorcycle; on examination there was tender swelling over the base of the thumb and the passive and active movements were painful. Radiographs revealed subluxation of the trapezio-metacarpal joint which was reduced under general anaesthesia; but the reduction was found to be unstable (Fig. 2). This was managed similarly as in case 1 by open reduction and ligament repair.

1.3. Case 3

A 28 years old male patient presented to us with a history of injury to his right thumb five days after having a fall from motorcycle. The patient was a professional boxer and was operated two years back for fracture fourth metacarpal and was in active sports. On examination there was tender swelling over the base of the thumb and the passive and active movements were painful. There was a healed longitudinal scar mark over dorsum of the hand. In this case also, subluxation of the trapezio-metacarpal joint was evident on the radiographs and the attempted reduction was found to be unstable. Management was same as in above mentioned cases.

1.4. Surgical technique

Modified Wagner's surgical approach was used. The incision involved the junction of glabrous and nonglabrous skin at

Table 1 – Summary of the cases of CMC dislocation.

Serial number	Age of the patient	Mode of injury	Ligaments avulsed	Repaired ligaments	Follow-up period	Results
1	18	Fall while playing cricket	Dorsoradial + Palmar oblique	Dorsoradial + Palmar oblique	15 months	Excellent movements without pain or instability
2	22	Fall from bike	Dorsoradial + Palmar oblique	Dorsoradial + Palmar oblique	15 months	Excellent movements without pain or instability
3	28	Fall from bike	Dorsoradial	Dorsoradial	15 months	Excellent movements with occasional pain without limiting the daily activity

Fig. 1 – Preoperative radiographs of the first case showing dislocated trapeziometacarpal joint.

the thenar aspect of the involved hand and was curved medially at the proximal wrist crease. The dissection was carried out in the subcutaneous plane and the superficial dorsal branch of the radial nerve and cutaneous branch of the antebrachial nerve were identified and retracted. The abductor pollicis longus tendon was identified and retracted dorsally. The palmar oblique and dorsoradial ligaments were

identified. The dorsoradial ligament was found to be avulsed from base of first metacarpal in two cases and in one case it was found to be avulsed from trapezium ([Table 1](#)). The palmar oblique ligament was found to be avulsed from the base of first metacarpal in two cases ([Figs. 3 and 4](#)). Preoperative and postoperative stability was checked under image ([Fig. 5](#)). The joint was reduced and the ruptured ligaments were repaired.

Fig. 2 – Preoperative radiographs of the second case, stress views showing instability of trapeziometacarpal joint under image.

2.4 mm suture anchors (Mitek mini anchor sutures; Depuy Inc.) were used in one case while 2.8 mm suture anchors (Arthrex Inc.) were used in two cases. Initial drill was made through the preliminary drill and the suture anchors were applied. Two 1.8 mm K-wires were also used for added stability in all cases. All the patients were given antibiotics for 48 h and sutures were removed at two weeks. The K-wires were removed at two weeks and the repair was further protected in a POP cast for six weeks. The cast was removed at six weeks and mobilisation was started. Muscle strengthening was started at twelve weeks and all the patients returned to their previous job by sixteen weeks. The patients were kept under follow-up and radiographs were repeated at fifteen months (Figs. 6 and 7). Functional range of motion of thumb was noted and was found to be satisfactory (Fig. 8).

2. Discussion

The geometry of the TMC joint is that of a biconcave-convex universal joint, both concave and convex on each side of the joint.¹¹ The unique anatomy of this joint needs a special attention and different treatment strategy than other joints of the hand. The keys to its anatomy, function, and stability are the volar beak of the first metacarpal, the recess in trapezium (adjacent to the volar beak ligament) into which the volar beak inserts, and the dorsal ligament complex.¹¹ Although the joint is lax and incongruous in the resting position without rotation, it is stable and congruous with the screw home torque rotation phase of opposition.¹¹

The subject of principle restraints of the trapezio-metacarpal (TMC) joint has been debated considerably in the literature. Eaton et al proposed reconstruction of the anterior oblique ligament, because they considered it as a key

stabiliser of the joint which prevents radio-dorsal subluxation of the thumb metacarpal during key and dynamic pinch.¹² In the years ahead, Shah and Patel, in their four cases of thumb carpometacarpal dislocations found that the dorsal structures was disrupted, while the volar ligament was intact.¹³ Strauch et al studied 38 cadaver thumbs, and asserted that the dorsoradial ligament complex was the primary restraint to dorsal dislocation. In his study, on cutting all ligaments of the thumb carpometacarpal joint except the dorsoradial ligament, the least joint dislocation was found.⁵ On the other hand, when all ligaments were intact and the dorsoradial ligament was cut, the largest degree of joint subluxation occurred. His study was later supported by several anatomic and biomechanical studies.^{14,15} In another study, the volar beak ligament was found to be torn 17 patients.¹⁰ These differences of the ligament damaged may be explained by the position of the thumb at the time of the injury.¹⁶ Axial loading with flexion of the thumb metacarpal base will force the joint to dislocate in a dorsal direction with rupture of the thin dorsal capsule.⁷

The diagnosis of TMC joint dislocation is usually made on the plain radiographs. A high index of suspicion is necessary to rule out fracture of the metacarpal base, as its avulsion can occur because of pull of strong volar capsule in case of axial loading force on a flexed thumb, dislocating it in dorsal direction.⁷ For clinical evaluation of the instability, a 'Torque test' has been described by Eaton and Littler which consist of axial rotation of a distracted thumb.¹ In another test, Takwale et al described a two step clinical provocative test in which the thumb is first abducted in a palmar direction and pronated while in the next step gradual abduction and supination of the retropulsed thumb is done reproducing symptoms of instability.¹⁷ In addition to clinical examination and radiographs, Magnetic Resonance Imaging (MRI) and Magnetic Resonance Arthrography can help in reaching to the precise diagnosis. Connell et al studied trapezio-metacarpal joint ligamentous injuries using conventional MRI and recommended coronal and axial imaging with fat suppression and a coronal STIR sequence to look for the integrity of stabilizing ligaments.¹⁸ MR arthrography provides detailed information of the anatomy of the ligaments in addition to better visualisation.

The TMC joint dislocation in the literature is managed by three treatment strategies: (1) casting, (2) pinning and (3) ligamentous reconstruction or repair. Table 2 shows different studies about management of TMC joint dislocation that has been reported in English literature. Closed reduction and plaster application have been shown to produce good results by various authors.^{7,19,20} Watt and Hooper in a series of 12 joint injuries reported that seven joints were stable after initial closed reduction on the day of injury, obtaining good results from treatment of cast immobilizations.²¹ In contrast, five joints were unstable after closed reduction at 3 days and 3 weeks after the injury. In all of these cases (three casting immobilizations and two pinnings), unsatisfactory results were seen with subluxation and instability of the joint. On the other hand, closed reduction with pinning has been applied with variable results.^{8,21} Some instability was noted following both these methods of treatment on follow-up evaluation. An unpredictable outcome of conservative or minimally invasive methods was pointed out by Fotiadis et al in his case report, switching to repair of the ruptured dorsoradial ligament with

Fig. 3 – Intraoperative photograph of first case showing avulsed dorsoradial ligament (a) and palmar oblique ligament (b).

Fig. 4 – Intraoperative photograph of second case showing avulsed palmar oblique ligament from the base of metacarpal (a) and dorsoradial ligament from the trapezium (b).

suture anchor and joint capsule with fruitful result.²² Simonian and Trumble compared early ligamentous reconstruction with closed reduction and pinning in two groups.¹⁰ Their data in this retrospective study suggested that early open reduction and ligamentous reconstruction results in a better outcome. Small sample size and retrospective design were disadvantage of the study. Residual instability in the studies described above can be attributed to the significant ligament damage, which if not addressed can lead to articular degeneration of the joint compromising the hand functions.

In the past, TMC dislocations have been treated with free tendon grafts with good to excellent results. Many ligamentoplasty techniques have been described in the literature. In the recent years, few authors have reported good functional results of ligament repair with suture anchors. Fotiadis et al

successfully repaired the ruptured dorsoradial ligament with suture anchors and repaired the joint capsule in an end-to-end fashion in one patient with 3-year follow up.²² The patient was pain free and returned to his previous level of activity. No restriction of carpometacarpal movements or residual instability was noticed. Radiographic examination showed normal joint alignment and no signs of subluxation or early osteoarthritis. They concluded that surgical stabilization of the dorsal capsuloligamentous complex may be considered as the selected treatment option in isolated TMC joint dislocations that remain unstable after closed reduction. In a similar case, Okita G et al repaired volar beak ligament and dorsoradial ligament with suture anchors with good functional outcome at one year.⁹ We are presenting three cases of unstable TMC joint dislocation, where we have restored the

Fig. 5 – Intraoperative stress views of case 3 showing (a) subluxation of the joint preoperatively and stability after repairing the ligament (b).

Fig. 6 – Postoperative radiographs of first case showing well reduced trapeziometacarpal joint; anchor sutures has been applied in two planes hence anchoring the torn ligaments.

Fig. 7 – Postoperative photographs of second case showing well reduced trapeziometacarpal joint. Anchor sutures applied at base of metacarpal and trapezium for anchoring the ligaments.

Fig. 8 – Functional range of motion of first case at fifteen month follow-up of case 1.

Table 2 – Literature with published cases of isolated TMC joint dislocation.

Investigators	Year	Cases	Treatment modality	Ligaments repaired/Reconstructed	Result
Shah J and Patel	1983	4	A. Open reduction + pinning (2 patients) B. Closed reduction pinning (1 patient) C. Open reduction + cast in (1 patient)	No ligaments addressed	A. Dorsal subluxation, mild arthritic changes. B and C. No subluxation – Normal range of motion
Watt N and Hooper G	1987	12	A. Closed reduction + cast (6 patients) B. Closed reduction + cast after 3–21 days (3 patients) C. Closed reduction + pinning + cast (3 patients)	No ligaments addressed	A. Asymptomatic instability B. Pain and instability C. No pain or instability
Chen VT ²³	1987	1	Ligament reconstruction	Dorsal ligament	Good functional outcome
Jacobsen CW and Elberg JJ	1988	1	Closed reduction + pinning	No ligaments addressed	Mild instability
Simonian PT and Trumble TE	1996	17	A. Closed reduction + pinning (8 patients) B. Early ligamentous reconstruction (9 patients)	Volar beak ligament	A. Revision surgery for recurrent instability in 4 patients (50%) B. Normal grip strength and range of motion
Kural C et al	2002	1	Closed reduction + cast	No ligaments addressed	No pain or instability
Khan AM et al	2003	1	Closed reduction + cast	No ligaments addressed	Good functional result
Bosmans et al	2008	2	Closed reduction + cast	No ligaments addressed	No instability-Normal range of motion
Fotiadis E et al	2010	1	Successfully reduced by closed means but due to inherent instability, repair of the ruptured dorsoradial ligament with suture anchor and joint capsule	Dorsoradial ligament	No pain, instability or signs of osteoarthritis
Okita G et al	2011	1	Ligament reconstruction with suture anchors and capsulorrhaphy	Volar beak ligament and dorsoradial ligament	No pain, instability or functional disadvantage
This study	2012	3	Ligament reconstruction with suture anchors and capsulorrhaphy	A. Dorsoradial and palmar oblique (2 cases) B. Dorsoradial (1 case)	A. No pain and good functional outcome B. Good ROM with occasional pain without limiting the daily activity

anatomy and in turn the ligamentous stability of TMC joint. All the three cases were high demand patients with unstable CMC joint dislocation, not ready to afford even a mild loss of hand function. Excellent movements without pain or instability were reported in two of the cases after 15 months. In the third case after a follow up of 15 months, excellent movements without instability but with occasional mild pain (not interfering with the hand functions or quality of life) were reported. There was no evidence of articular cartilage degeneration with subsequent follow up. The advantage of direct repair of the ligaments with suture anchors above the ligament reconstructions is that no tendon has to be sacrificed in case of suture anchor technique. Moreover, ligament reconstruction is more invasive and can be difficult for some surgeons with less experience. The only prerequisite for direct repair is that the ligamentous components should be fresh and should be able to hold the sutures. In addition, patients are not subjected to trial of closed reduction with casting, or to closed reduction with pinning and then going for open reduction and reconstruction in case of failure. Repair of the torn ligaments as a primary treatment is more anatomical. It reduces the psychological trauma of prolonged treatment to the patients and helps them to resume their work as early as possible. The shortcoming of this study is the limited number of the patients. As the injury is uncommon, a multicentre study may be conducted to study the further benefits of this surgery in a larger group of the patients.

3. Conclusion

We propose the use of suture anchor technique for all unstable dislocations of the trapezio-metacarpal joint and for all dislocations (stable or unstable) in young and high demand patients.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Level of clinical evidence

Level IV.

REFERENCES

- Eaton RG, Littler JW. Ligament reconstruction for the painful thumb carpometacarpal joint. *J Bone Joint Surg.* 1973;55A:1655–1666.
- Harvey FJ, Bye WD. Bennett's fracture. *Hand.* 1976;8:48–53.
- Pagalidis T, Kuczyński K, Lamb DW. Ligamentous stability of the base of the thumb. *Hand.* 1981;13:29–35.
- Strauch RJ, Behrman MJ, Rosenwasser MP. Acute dislocation of the carpometacarpal joint of the thumb: an anatomic and cadaver study. *J Hand Surg.* 1994;19A:93–98.
- Van Brenk B, Richards RR, Mackay MB, Boynton EL. A biomechanical assessment of ligaments preventing dorsoradial subluxation of the trapeziometacarpal joint. *J Hand Surg [Am].* 1998;23:607–611.
- Edmunds JO. Current concepts of the anatomy of the thumb trapeziometacarpal joint. *J Hand Surg Am.* 2011;36:170–182.
- Bosmans B, Verhofstad MHJ, Gosens T. Traumatic thumb carpometacarpal joint dislocations. *J Hand Surg.* 2008;33A:438–441.
- Jacobsen CW, Elberg JJ. Isolated carpometacarpal dislocation of the thumb. *Scand J Plast Reconstr Surg.* 1988;22:185–186.
- Okita G, Anayama S, Sato N, Haro H. Surgical reconstruction using suture anchor for dislocation of the carpometacarpal joint of the thumb: a case report. *Arch Orthop Trauma Surg.* 2011;131:225–228.
- Simonian PT, Trumble TE. Traumatic dislocation of the thumb carpometacarpal joint: early ligamentous reconstruction versus closed reduction and pinning. *J Hand Surg Am.* 1996;21:802–806.
- Edmunds J Ollie. Current concepts of the anatomy of the thumb trapeziometacarpal joint. *J Hand Surg.* 2011;36A:170–182.
- Eaton RG, Lewis B, Lane MD, Littler JW, Keyser JJ. Ligament reconstruction for the painful thumb metacarpal: a long term assessment. *J Hand Surg [Am].* 1984;9:692–699.
- Shah J, Patel M. Dislocation of the carpometacarpal joint of the thumb. A report of four cases. *Clin Orthop Relat Res.* 1983 May;175:166–169.
- Bettinger PC, Linscheid RL, Berger RA, Cooney III WP, An KN. An anatomic study of the stabilizing ligaments of the trapezium and trapeziometacarpal joint. *J Hand Surg.* 1999;24A:786–798.
- Colman M, Mass DP, Draganich LF. Effects of the deep anterior oblique and dorsoradial ligaments on trapeziometacarpal joint stability. *J Hand Surg.* 2007;32A:310–317.
- Karthikeyan Iyengar, Surya Gandham, Jayant Nadkarni, William Loh, Modified Eaton-Littler's Reconstruction for Traumatic Dislocation of the Carpometacarpal Joint of the Thumb—A Case Report and Review of Literature, *J Hand Microsurg*, DOI 10.1007/s12593-012-0067.
- Takwale VJ, Stanley JK, Shahane SA. Post-traumatic instability of the trapeziometacarpal joint of the thumb. *J Bone Joint Surg Br.* 2004;86:541–545.
- Connell DA, Pike J, Koulouris G, van Wetering N, Hoy G. MR imaging of thumb carpometacarpal joint ligament injuries. *J Hand Surg [Br].* 2004;29:46–54.
- Kural C, Malkoç M, Uğraş AA, Sen A. Isolated carpometacarpal dislocation of the thumb: a case report. *Acta Orthop Traumatol Turc.* 2002;36:446–448.
- Khan AM, Ryan MG, Teplitz GA. Bilateral carpometacarpal dislocations of the thumb. *Am J Orthop.* 2003 Jan;32:38–41.
- Watt N, Hooper G. Dislocation of the trapezio-metacarpal joint. *J Hand Surg Br.* 1987 Jun;12:242–245.
- Fotiadis E, Svarnas T, Lyrtzis C, Papadopoulos A, Akritopoulos P, Chalidis B. Isolated thumb carpometacarpal joint dislocation: a case report and review of the literature. *J Orthop Surg Res.* 2010;5:16.
- Chen VT. Dislocation of the carpometacarpal joint of the thumb. *J Hand Surg Br.* 1987 Jun;12:246–251.