Ligament Reconstruction of Traumatic Pure Dislocation of Carpometacarpal Joint of the Thumb: A Series of Acute and Chronic Cases

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Abstract

Background Traumatic instability of carpometacarpal (CMC) joint of the thumb without a fracture (pure dislocation of CMC joint) is an uncommon injury, and a universally accepted protocol has not yet been developed for its management. Here, we aim to evaluate the outcome of this injury managed with ligament reconstruction technique, in a series of acute and chronic injuries.

Patients and Methods Total nine patients (six acute and three chronic) with pure dislocation of CMC joint who underwent ligament reconstruction surgery were included in this retrospective study. Outcome measures included disabilities of the arm, shoulder, and hand (quick-DASH) questionnaire; visual analog scale (VAS) scoring system; patient-rated wrist/hand evaluation (PRWHE) system; pinch and grip strength; and Kapandji thumb opposition scores.

Results The patients' mean age was 32.55 ± 11.4 years. Their mean follow-up period was 27 ± 12.8 months. The mean postoperative pinch and grip strength was equivalent to 91.5% and 108% of the contralateral hand, respectively. The mean Quick-DASH score was 14.7 ± 19.4 . The mean PRWHE score was 18.7 ± 22.4 . The mean VAS was 1.1 ± 1.5 . The mean Kapandji score was 8.3 ± 1.4 . The pinch and grip strength were considerably superior in acute injuries. Degenerative changes were seen in all joints at the latest follow-up. None of our patients needed a revision surgery.

Conclusion Ligament reconstruction method could result in favorable outcome in the management of pure dislocation of CMC joint. However, delayed surgery of this injury might adversely affect the outcome measures.

Keywords

- carpometacarpal joint
- thumb
- pure dislocation
- ligament reconstruction

Introduction

The trapeziometacarpal joint, also known as the first carpometacarpal (CMC) joint, is a unique biconcave-convex “saddle” joint. Considering CMC joint as the only joint of the thumb normally capable of multidirectional movements, preserving its proper function is of particular value.¹ Similar to the most synovial articulations, excessive mobility of the thumb CMC joint predisposes premature degenerative changes.²

Traumatic instability of the thumb CMC joint without a fracture, introduced as traumatic isolated or pure dislocation of CMC joint, is an uncommon injury.³ Although improper management of this injury permits significant joint incongruity, giving rise to a hypermobile CMC joint prone to degenerative joint disease (DJD), adequate reconstruction of ligament stability prior to the onset of the chondral damage prevents or at least delays subsequent joint degeneration.¹

So far, several treatment options, including closed reduction and casting,⁴ closed or open reduction and fixation with

Kirschner wires (KW),⁵ and reconstruction of ligament with flexor carpi radialis (FCR) tendon,¹ have been introduced for the management of these injuries.

Some authors believe that the dorsoradial ligament is the critical factor in this injury, so that impairment of this ligament is solely responsible for dislocation even if the other ligaments are intact.^{6,7} Subsequently, dorsoradial ligament repair with anchor suture has been recently proposed by some surgeons, particularly in young athletes with considerable upper extremity demand.^{8,9}

However, because of the rare occurrence of this injury, only few reports are available regarding the potential healing power of each procedure and a universally accepted protocol has not been developed yet. Consequently, the optimal therapeutic strategy for traumatic pure dislocation of the thumb CMC joint still remains as a subject of debate.

Here, we aim to evaluate the outcome of traumatic pure dislocation of the thumb CMC joint managed with Eaton and Littler's ligament reconstruction method in a series of nine cases, including six acute and three chronic injuries.

Patients and Methods

From 2011 to 2016, patients with pure dislocation of the thumb CMC joint who were referred to our center and underwent ligament reconstruction were evaluated for inclusion/exclusion criteria of this retrospective study.

The inclusion criteria for enrolment in the study included traumatic nature of the injury, age of older than 18 years, and follow-up period of more than 6 months. The exclusion criteria consisted of positive history of any inflammatory diseases such as rheumatoid arthritis, positive history of previous trauma, or surgery of the wrist or hand of both upper extremities.

Accordingly, Total 12 patients who met the eligibility criteria and underwent ligament reconstruction for the management of their injury were enrolled to the study. Three patients were referred from distant areas and did not return for final follow-up assessments. Consequently, final study was performed on the remaining nine patients.

At the final follow-up session, subjective evaluation of outcomes was performed by the Persian version of shortened disabilities of the arm, shoulder, and hand (Quick-DASH) questionnaire¹⁰; visual analog scale (VAS) scoring system; and patient-rated wrist/hand evaluation (PRWHE) system.¹¹ In all subjective measures, a higher value indicated a greater disability.

We used dynamometer (Hydraulic Hand Dynamometer, SH5001, Saehan Corporation, Korea) to evaluate the grip strength and pinch gauge (Hydraulic Pinch Gauge, SH5005, Saehan Corporation, Korea) to assess the pinch strength.

Besides, we used Kapandji thumb opposition scores rather than measuring the range of motion of each joint, in which a score of 0 indicates no opposition and 10 indicates maximal opposition.¹²

DJD staging was based on the original radiographic Eaton and Littler's classification.¹ Patients' medical files were used to review their demographic and clinical information.

Robert's and lateral radiographic views of the CMC joint were used to evaluate the severity of radiographic changes.¹³ All reconstructions were performed by the same hand surgeon (FNM). All postoperative assessments were undertaken by two fellowship-trained hand surgeons who were not involved in the surgery.

Surgical Technique

Prior to any treatment, we had a thorough consultation with our patients to review the treatment options and also the alternatives such as partial trapeziectomy if the CMC joint was arthritic. We assessed the articular surface of injured CMC and associated fractures, using plain X-rays as well as computed tomographic (CT) scan.

Reconstruction of CMC joint ligament with FCR was performed as previously described by Eaton and Littler in 1973.¹ We used modified Wagner's incision. Surgeries were conducted after general or intravenous regional (Bier block) anesthesia¹⁴ and under the control of pneumatic tourniquet. After preserving the sensory branches of the radial nerve, we elevated the thenar muscles to expose and inspect the CMC joint and to evaluate the articular surface as well as the concomitant possible fracture of the joint. Then we made an oblique tunnel from dorsal surface of the thumb metacarpal base perpendicular to the nail plate surface toward the volar beak ligament insertion footprint. After harvesting a distally based 6- to 8-cm slip of the ulnar half of the FCR tendon by multiple transverse incision, we passed the tendon through the tunnel from volar to dorsal direction, using a looped KW. Then we sutured the tendon under tension to the adjacent periosteum. After passing it deep to the abductor pollicis longus tendon and suturing it to the tendon, we passed the FCR slip volarly under the intact part of the FCR tendon and sutured to it. Finally, the end of the tendon was sutured to the dorsal part of it. The joint was fixed with one or two 1.5 mm in diameter transarticular KW (►Fig. 1).

Postoperative Protocol

A short thumb spica splint was applied for 2 weeks. After this period, sutures were removed and the thumb was stabilized in a short thumb spica cast for another 4 weeks. Subsequently, we removed the cast and KW, and patients were referred to physical therapy to improve the range of motion of their injured CMC joint.

Results

The outcome of pure dislocation of the thumb CMC joint managed with ligament reconstruction was evaluated in nine patients including eight males and one female. Falling down was regarded as the most frequent mechanism of injury. In six patients, the surgery was performed in acute phase of injury, whereas in the other three patients, it was done at least 1 month after the occurrence of the injury. None of our patients had arthritic CMC joint in their preoperative radiographic assessment.

The patients' mean age was 32.55 ± 11.4 years (range: 22–50). Their mean follow-up period was 27 ± 12.8 months (range: 9–48). The mean time to surgery was 40.1 ± 77.3 days (range: 3–240). The dominant hand was involved in six patients. Clinical and demographic characteristics of patients are demonstrated in ►Table 1.

The mean postoperative grip strength of the injured hands was 97.8 ± 26.5 lb (range: 45–125), which was equivalent to 108% of the mean grip strength of contralateral hand. The mean postoperative pinch strength of the injured hands was 31.2 ± 24.9 lb (range: 7–93), which was equivalent to 91.5% of the mean pinch strength of contralateral hand.

Fig. 1 (A) Anteroposterior radiograph showing a pure first carpometacarpal joint dislocation. (B) Intraoperative surgical approach, Wagner's incision, harvesting 6 to 8 cm of flexor carpi radialis tendon. (C) Fixation of the joint by transarticular pin. (D) Postoperative radiograph of 34 months after the surgery.

The mean Quick-DASH score was 14.7 ± 19.4 (0–50). The mean PRWHE score was 18.7 ± 22.4 (0–59). The mean VAS was 1.1 ± 1.5 (0–4). The mean Kapandji score was 8.3 ± 1.4 . Subjective and objective outcome measures of each patient are demonstrated in ►Table 2.

The mean grip strength was 101.7 ± 20.2 lb in acute and 90 ± 41 lb in chronic injuries. The mean pinch strength was 33.5 ± 30.3 lb in acute and 26.7 ± 11.9 in chronic injuries. The mean Kapandji score was 8 ± 1.5 in acute and 9 ± 1 in chronic injuries.

The mean DASH score was 14 ± 18.3 in acute and 16 ± 25.6 in chronic injuries. The mean PRWHE was 18.5 ± 21 in acute and 18.9 ± 30 in chronic patients. The mean VAS was 1 ± 1.1 in acute and 1.33 ± 2.3 in chronic injuries. Partial trapezoidectomy was performed in one patient due to the intraoperative detection of cartilage destruction. Surprisingly, the most satisfactory outcome was observed in this patient (case 7) (►Fig. 2).

At the latest follow-up session, DJD was observed in all patients, at different degree. In this regard, stage III DJD was observed in only one patient (case 1). This patient had a disabling restriction of CMC range of motion. However, he refused to accept revision surgery. Stages I and II of DJD were observed in six and two patients, respectively. None of our patients needed a revision surgery.

Discussion

Hypermobility of CMC joint may cause clinically significant and eventually intractable pain. Although idiopathic hypermobility of CMC joint is not uncommon, traumatic CMC joint dislocation, which produces varying degrees of hypermobility, is less common. Inflammatory disease may cause ligament laxity as well, leading to instability and degenerative arthrosis.³

Traumatic isolated thumb CMC joint dislocation is associated with various degrees of joint capsule and ligament damage. There is an ongoing controversy concerning the ligaments that are the true key stabilizers of this joint, and, therefore, the optimal treatment strategies for dislocations of

Table 1 Clinical and demographic characteristics of patients with isolated thumb carpometacarpal joint dislocation

ID	Age (y)	Sex	Injured hand	Mechanism of injury	Delay in surgery (d)	Acute/Chronic	Follow-up (mo)
1	47	Male	Nondominant	Falling down	3	Acute	24
2	50	Female	Dominant	Falling down	30	Chronic	38
3	23	Male	Nondominant	Falling down	3	Acute	9
4	25	Male	Dominant	Volley ball	5	Acute	12
5	27	Male	Dominant	Foot ball	240	Chronic	48
6	22	Male	Nondominant	Falling down	7	Acute	34
7	30	Male	Dominant	Direct trauma	60	Chronic	17
8	45	Male	Dominant	Falling down	7	Acute	33
9	24	Male	Dominant	Martial art sport trauma	6	Acute	28

Table 2 Subjective and objective outcome measures and postoperative complications of patients with isolated thumb carpometacarpal joint dislocation

ID	Grip strength injured/ contralateral (%)	Pinch strength injured/ contralateral (%)	Kapandji score	Quick- DASH score	PRWHE score	VAS	Postoperative DJD stage
1	65/80 (81)	7/30.4 (23)	5	50	59	20	III
2	45/42 (107)	13/18 (72)	8	45.5	53.5	40	II
3	100/105 (95.2)	93/101 (92)	8	6.8	23.5	20	I
4	120/140 (85.7)	28/27.2 (103)	9	15.9	10	0	I
5	125/125 (100)	32/25 (128)	9	2.3	3	0	I
6	105/100 (105)	20/25 (800)	9	2.3	11	0	I
7	100/60.2 (166)	35/25 (140)	10	0	0	0	II
8	120/90.2 (133)	23/25 (92)	9	6.8	4	20	I
9	100/100 (100)	30/32 (94)	8	2.3	4	0	I

Abbreviations: DASH, disabilities of the arm, shoulder, and hand; DJD, degenerative joint disease; PRWHE, patient-rated wrist/hand evaluation; VAS, visual analog scale.

Fig. 2 (A) An unstable subluxed first carpometacarpal joint. Although preoperative radiography did not show DJD in the involved joint, severe cartilage damage was observed in intraoperative assessment and partial trapeziectomy was done beside ligament reconstruction. (B) Radiograph of the last follow-up, 17 months after the surgery (case 7). DJD, degenerative joint disease.

the thumb CMC joint are the subject of continuing debate. Although closed reduction and casting could be the definitive therapeutic option in injuries that thumb CMC joint remains stable after anatomic reduction, early reconstruction of the unstable thumb CMC joint dislocation may reduce the incidence of recurrent instability and posttraumatic DJD.^{4,15}

In 1984, Eaton et al first described the outcome of ligament reconstruction in 38 thumbs from 36 patients, at an average follow-up period of 7 years. The etiology of injury was idiopathic in 18, trauma in 18, and mild rheumatoid arthritis in 2 patients. Poor outcome was observed in none of their patients. They suggested that ligament reconstruction will restore stability and reduce pain in a large proportion of patients with painful instability of the thumb CMC joint.³

Because traumatic isolated thumb CMC joint dislocation is a rare condition, the reports on the outcome of ligament

reconstruction of this injury are scarce and the majority of available literature concerns case studies.^{8,15}

Simonian and Trumble compared the results of early ligament reconstruction of traumatic isolated thumb CMC joint dislocation with closed reduction and pinning. Although 50% of injuries managed with closed reduction and pinning needed a revision surgery for recurrent instability, patients managed with ligament reconstruction had normal grip strength in addition to the acceptable range of motion and pain level.¹⁶

Lane and Henley reported the results of 37 ligament reconstruction in 35 patients with nonarthritic thumb CMC joint dislocation after a mean follow-up period of 5.2 years. Etiology was traumatic in 23 and nontraumatic in 12 patients. Poor result was recorded in only one patient. Stability, function, and pinch strength were reported to be good in all patients. Postoperative abduction-extension was reported to be reduced in 70% of the patients of their series.¹⁷

Schoenaers et al reported the results of Eaton and Littler's reconstruction method used to restore the stability of the CMC joint of the thumb in 33 patients with different etiologies and a mean follow-up period of 7 years. From 11 patients with traumatic etiology, 6 needed a reoperation. In total, only 45% of the patients were satisfied with the results of the surgery.¹⁸

According to the aforementioned reports, it could be concluded that indications for ligament reconstruction of thumb CMC joint dislocation have not been well defined, and the inconsistent results of earlier investigations urge a more clear codification in this regard.

Van Giffen et al evaluated the results of Eaton and Littler's method in 18 patients with painful CMC joint, with 6 having a traumatic etiology. According to their study, traumatic instability had worse results and probably is a contraindication to this technique.¹⁹

To further evaluate the different aspects of this technique, we assessed the outcome of ligament reconstruction in the management of traumatic isolated thumb CMC joint dislocation in a series of chronic and acute injuries.

According to our results, the mean postoperative grip and pinch strengths were equivalent to 108% and 91.5% of contralateral hand and none of our patients needed a revision surgery at a mean follow-up period of 26.8 months. Moreover, our results showed considerably better results in outcome measures of patients with acute injuries. It could be concluded that the early ligament reconstruction of traumatic pure dislocation of the thumb CMC joint might result in more favorable outcomes. Even so, considering the significant postoperative improvement in stability and pain level of chronic injuries, surgical reconstruction of chronic injuries using Eaton and Littler's method cannot be questioned.

Recent studies suggest a critical role for dorsoradial ligament repair in the successful management of isolated thumb CMC joint dislocation. In this respect, Fotiadis et al reported a case of acute isolated thumb CMC joint dislocation that was successfully managed with the reconstruction of dorsal capsuloligamentous complex. At a 3-year follow-up period, the patient was pain free and no restriction of CMC movements was noticed. Moreover, no signs of subluxation or early osteoarthritis were present in radiographic examinations.⁸

In chronic cases and in the absence of DJD, reconstruction method is suggested. In the presence of DJD, other therapeutic options such as fusion and arthroplasty are considered.⁹

To the best of our knowledge, this is the first study comparing the results of Eaton and Littler's method in a series of chronic and acute traumatic pure dislocation of the thumb CMC joint and further studies are needed to confirm our results. Our study has some limitations that should be pointed out. The small patients' number could be regarded as the main limitation of this study, which made us unable to statistically analyze the difference of outcome between chronic and acute injuries. The nearly short-term follow-up period of this study could be regarded as the other limitation of this study. Moreover, considering the retrospective nature of the study, the preoperative clinical and functional data of the patients were not documented in their medical files. Thus, evaluation of postoperative improvement of the patients was not feasible.

Conclusion

Traumatic isolated thumb CMC joint dislocation can be satisfactorily managed with Eaton and Littler's ligament reconstruction method. According to our results, early management of these injuries with ligament reconstruction technique results in more favorable outcomes, whereas delayed surgery might adversely affect the outcome measures.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by ethic committee of our institute. For this type of study, formal consent is not required.

Conflict of Interest

None declared.

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