

## Original Research Article

# Clinical outcomes in management of dislocation of carpometacarpal joints of hand: a rare orthopaedic presentation

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## ABSTRACT

**Background:** Dislocation of carpo-metacarpal (CMC) joints especially involving the 2<sup>nd</sup> and 3<sup>rd</sup> or paired dislocations, presents a rare pattern of orthopaedics hand injuries. They are associated with high energy trauma usually involving motorbike accidents. Severe soft tissue inflammation over the affected hand and associated injuries often makes detection of these fractures difficult. They require prompt management at presentation. Failure to be diagnosed and treated at early stage leads to joint stiffness, restrictions of wrist movement, deformity and sometimes ruptures of tendons crossing the wrist. Most of them require open reduction and internal fixation for stabilization. The objective of the study was to clinically evaluate outcomes in management of carpometacarpal joint dislocations.

**Methods:** We prospectively studied 6 cases of CMC dislocation presenting at average of 1week from the original injury. All were clinically and radiologically evaluated. 3 cases were managed with open reduction and internal fixation with K wire and 1with closed manipulation and percutaneous k wire fixation and 1 case by arthrodesis of CMC joint. Functional assessment was done with Quick DASH score at 6 weeks, 3 months, 6 months and 1 year.

**Results:** All the patients went on to have good functional recovery. The average quick DASH score showed improvement from 77.39 to 4.07 over 1 year follow-up.

**Conclusions:** Careful and meticulous examinations of hands are necessary in high velocity trauma cases to avoid missing diagnosis of CMC dislocation. ORIF remains the gold standard treatment which can also be used for cases presenting late, followed by aggressive post-op physiotherapy can lead to excellent recovery of hand function.

**Keywords:** Carpometacarpal, Dorsal, Volar, Quick DASH

## INTRODUCTION

Dislocation at carpometacarpal (CMC) joints are rare patterns of hand injuries accounting for about 1% of orthopaedic hand injuries.<sup>1</sup> Multiple CMC dislocation and paired dislocations usually involving the 2<sup>nd</sup> and 3<sup>rd</sup> CMC joints and divergent dislocations are more uncommon patterns. Scientific literature mostly describes dislocations involving the 5<sup>th</sup> or 4<sup>th</sup> CMC joints. These dislocations can occur isolated or associated with

fractures of metacarpals and carpal bones. All the literature support that CMC dislocations are by a variety of different mechanisms which involves significant amount of force being transmitted through the metacarpals and carpals which includes high velocity trauma, crush injuries, fall from height on outstretched hand, but occur most commonly following motorbike accidents classically as a result of firmly gripping the handles prior to impact.<sup>2</sup>

Most of the CMC joints dislocations are missed at initial examinations due to urgent attention to associated more severe injuries on other parts of body and swelling and abrasions over affected hands which makes the deformity obscure. Overlaps of bones on standard lateral X-ray may also obscure the accurate delineation of the injury pattern.<sup>3</sup> Early diagnosis therefore involves a strong clinical suspicion and meticulous X-ray and clinical examination.

Dorsal dislocations are more common than volar dislocation, similarly divergent dislocation are far rarer.<sup>4,5</sup> One possible reason could be due to the relative strength of dorsal ligaments and dynamic restraint by wrist extensors which prevent failure of bone dorsally during force transmission causing failure and subsequent rupture of relatively weaker volar ligaments. Four ligaments provide inherent stability to CMC joints namely dorsal metacarpal, palmer metacarpal and medial and lateral interosseous ligaments. The middle fingers and index fingers are supported on either side and are relatively less mobile and for a very stable configuration with capitates and trapezoid respectively.<sup>6</sup> This causes there dislocation very unlikely.

These injuries are sometimes associated with compartment syndrome in hand and require prompt addressal to prevent complications. A thorough neurovascular examination should be done.<sup>6</sup> Damage to deep branch of ulnar nerve may be associated with dislocation of 5<sup>th</sup> and 4<sup>th</sup> CMC joints while a volar dislocation may cause be associated with affection of median nerve. Cases which are untreated or neglected are associated with significant disability of hand and chronic residual pain and poor functional outcomes. Though these dislocated can be variedly managed results with open reduction and internal fixation with K-wires are reported to be excellent.<sup>7</sup>

### Objective of the study

To determine the outcomes of management of carpometacarpal dislocation by evaluating the clinical and radiological parameters and to determine whether closed reduction or open reduction is a better option in the management of CMC dislocations.

### METHODS

We treated 6 cases with CMC joint dislocation who attended the causality of Hi-tech Medical College, from August 2014- till October 2016. The average age of patient was 32 years, and all were males. All the cases had a history of road traffic accidents involving bikes where the patient was the driver. Average duration of presentation was 1 week. All gave history of attempted conservative management with icepack application and analgesics. Clinical examination and radiological evaluation was done upon presentation. Digital X-rays were taken at Dept. of Radiodiagnosis, Hi-tech medical

college. X-ray evaluation confirmed 1 case had a divergent dislocation of 5<sup>th</sup> CMC joint (Figure 10), three with dorsal dislocation of 4<sup>th</sup> and 2 with a paired dorsal dislocation of 2<sup>nd</sup> and 3<sup>rd</sup> CMC joint (Figure 3). There was no associated fracture of radius or ulna or carpal bones. After confirmation demographic data, radiological data and quick DASH scores were calculated and recorded. Temporary Cock up splints was used to relieve pain in fresh dislocations and cases were posted for OT within 24-48 after necessary investigations and clearance.

### Inclusion criteria

All closed CMC injuries presenting at any length of time, irrespective of sex, age, mode of injuries and all persons who were willing to give written consent for the study.

### Exclusion criteria

All open and infected cases, cases with crush injuries or suspected vascular injuries requiring extensive plastic surgical procedures and cases not willing to give consent for the study.



**Figure 1: Preoperative diffuse swelling over dorsum of hand, increased AP diameter and maximum dorsiflexion of 0 degree.**



**Figure 2: Maximum palmar flexion- 60.**

All the surgeries were conducted under regional block (brachial block) and mild sedation. 1 case involving dislocation of 5<sup>th</sup> CMC joint was reduced closely under fluoroscopic guidance. After checking appropriate alignment, the dislocations were fixed with single number 1 mm K-wires under fluoroscopy (Figure 11 and 12) and

pop cast was given in 15 degrees of dorsiflexion at wrist. Closed reduction of 2 cases of 4<sup>th</sup> CMC joint dislocation was successful and it was stabilized by single 1.5 mm k wire. 1 case of 4<sup>th</sup> CMC joint dislocations was attempted but was unsuccessful, so open reduction was done with dorsal approach, the extensor tendon was retracted and soft tissue cleared, the dislocation reduced by traction and volar directed forced and reduction held in place by one number of 1.5mm k wire. Attempted closed reduction of both cases of paired 2<sup>nd</sup> and 3<sup>rd</sup> CMC joint dislocation was attempted. But since both cases were old dislocation of nearly 2 weeks, closed reduction failed and open reduction was attempted. One curvilinear incision was given was made over the base of 3<sup>rd</sup> and 4<sup>th</sup> metacarpals (Figure 4) taking care not to damage the underlying extensor tendons. CMC joint and fractures were exposed and reduction was visually achieved (Figure 5 and 6); subsequently, internal fixation was done with Kirschner wire (K-wire) (Figure 7). K-wires of 2 mm were passed antegradely from the base of metacarpal towards the head and then again retrogradely towards the carpals to stabilize the CMC joints. Reduction and stabilization of third metacarpal CMC joint was the key for reduction remaining CMC joints. Alignment of fracture and joint reduction was evaluated under image intensifier in AP, lateral and oblique views (Figure 8). The incision was closed in layers. Postoperative X-ray revealed excellent reduction (Figure 9). Patient was discharged with a below elbow pop cast. In the other case, extensive fibrosis and soft tissue adhesions prevented the reduction of 3<sup>rd</sup> CMC joint even after repeated attempted. So finally the articular margins were denuded on both sides, a very thin chunk of bone was nibbled out of the base of 3<sup>rd</sup> metacarpal and the joint was reduced and fixed with 2 mm k wire attempting future arthrodesis of the said joint. The hand was kept in a pop below elbow cast for 6 weeks, followed by gradual rehabilitation.

Follow-up was done at 6 weeks (Figure 10), 3 months, 9 months and 12 months with AP and lateral X-ray of the wrist joint and hand. In addition, functional assessment was conducted with quick disabilities of the arm, shoulder and hand score (Quick DASH score) at 6 weeks, 3 months, 9 months, and 12 months postoperatively.



**Figure 3: Preoperative X-ray showing dorsal displacement of 2nd and 3rd CMC.**



**Figure 4: Surgical incision on dorsal aspect for open reduction.**



**Figure 5: Retraction of extensor tendons to expose the CMC joints.**



**Figure 6: 3rd CMC joint dislocation visualised.**



**Figure 7: Dislocation reduced and stabilized by percutaneous K wire.**





**Figure 8: Intraoperative C-arm view to check reduction.**



**Figure 11: Dislocation 5th CMC joint.**



**Figure 9: Postoperative X-ray showing good reduction.**



**Figure 12: closed reduction and percutaneous K wire for 5th CMC dislocation.**



**Figure 10: 6 weeks postoperative good reduction and after removal of K wires increased grip and finger function.**

**RESULTS**

Average follow-up was 12 months (range, 12 to 14 months). In our series of 6 cases, 4 were dorsal CMC joint dislocation and 1 was a divergent dislocation. There were no associated fractures of metacarpal, carpal or distal radius (Table 1). Average Quick DASH score was 77.39 at 6 weeks, 36.92 at 3 months, 10.95 at 9 months, and 4.07 at 12 months. Average Quick DASH score was improved from 77.39 to 4.07 from 6 weeks to 12 months. 1 of 6 patients had a Quick DASH score of 0 at the end of 12 months (Table 2).

**Table 1: Patient data.**

S. no.	Age	Sex	Duration of fracture	Direction of displacement	Closed/open	Treatment	Associated fracture
1	22	Male	2 days	Divergent 5th	Closed	CRIF with K wire	Nil
2	34	Male	6 day	Dorsal 4th	Closed	CRIF with K wire	Nil
3	40	Male	13 days	Dorsal 4th	Closed	ORIF with k wire	Nil
4	32	Male	3 days	Dorsal 4th	Closed	CRIF with K wire	Nil
5	30	Male	10 days	Dorsal 2,3rd	Closed	ORIF with K wire	Nil
6	36	Male	22days	Dorsal 2,3rd	Closed	ORIF, excision & arthodesis	Nil

**Table 2: Quick DASH score.**

S. no.	Cases	6 weeks	3 months	9 months	12 months
1	22 m divergent 5th	62.2	22.4	0	0
2	34 m dorsal 4th	74.82	31.64	5.8	2.6
3	40 m dorsal 4th	82.4	42.8	16.56	5.2
4	32 m dorsal 4th	80.48	40.7	12.8	4.6
5	30 m dorsal 2, 3rd	80.2	41.46	12.1	3.82
6	36 dorsal 2, 3rd	84.24	42.5	18.44	8.2
<b>Average</b>		<b>77.39</b>	<b>36.92</b>	<b>10.95</b>	<b>4.07</b>

**Table 3: Complications.**

S. no.	Cases	Complications
1	22 m divergent 5th	Weakness of adduction of 5 <sup>th</sup> finger- 3 <sup>rd</sup> palmer interossei weakness
2	34 m dorsal 4th	Nil
3	40 m dorsal 4th	Nil
4	32 m dorsal 4th	Mild stiffness of wrist- inconsistent complains
5	30 m dorsal 2, 3rd	Carpal boss deformity base of 3 <sup>rd</sup> CMC joint
6	36 m dorsal 2, 3rd	Parasthesia at incision site. Mild stiffness at wrist during extension.

At the end of final follow-up, no signs of osteoarthritis of CMC joints were observed clinically and radiological in any of the patients.

In our series, one issue of paresthesia over the incision site with residual carpal boss deformity was seen in the case of paired CMC dislocation managed with ORIF. There was also complain of weakness of adduction of 5<sup>th</sup> finger in isolated 5<sup>th</sup> CMC dislocation case. There were no other significant postoperative complications (Table 3).

## DISCUSSION

Carpometacarpal dislocations are rare orthopaedic injuries accounting for 1% of all injuries of hand.<sup>8</sup> The carpometacarpal joints are configured such that there is an increase in the degree of concavity on the radial aspect of each joint. Ligamentous scaffolding is provided by dorsal and volar ligaments, transverse metacarpal ligaments and long flexors and extensors of hand along with the intrinsic muscles. Dorsal ligaments are stronger and ulnar side CMC joints are more mobile than the radial CMC joints.<sup>9</sup> The third metacarpal articulates with the capitates more proximally than the other carpometacarpal joints, thus acting as a keystone to the framework. As a result the ring and small fingers CMC joints are most commonly dislocated. CMC dislocations of 2<sup>nd</sup> and 3<sup>rd</sup> fingers are rare due to profound ligamentous and bony articulation providing stability.<sup>10</sup>

Significant amount of force is required to achieve dislocations of CMC joints. Shih et al demonstrated that the most likely mechanism causing these dislocations is a large deceleration force transmitted longitudinally and dorsally through the metacarpals from the handle bars of motorcycle riders causing dislocation of the CMC joints.<sup>11</sup> Since the directions of force transmitted is usually dorsally directed, dorsal displacements are more common than volar. These injuries may be associated with oblique or spiral fractures of the metacarpals.

These cases are usually diagnosed by standard anterior-posterior, lateral or sometimes oblique X-rays. Computer tomography is used for occult and missed carpal bone fracture and dislocation cases.

Management of CMC dislocations remains controversial. Various treatment modalities include closed reduction and cast immobilization, close reduction and internal fixation or open reduction and internal fixation with k wires and excision of articular ends with arthrodesis have been described. Cases presenting very late and or features of degenerative changes may have to be fused. Closed reduction carries high risk of redislocation and soft tissue interposition and may be preferred for fresh cases involving the 4<sup>th</sup> or 5<sup>th</sup> CMC joints. More complex dislocations, multiple joint dislocations or cases presenting late warrant Open reduction and inter-fixation. Prokuski et al, published a large series of injury complex and stated prompt open reduction and internal fixation helps to achieve good functional outcomes.<sup>12</sup> Open reduction and internal fixation is best achieved by dorsal approach, with stability of 3<sup>rd</sup> CMC being crucial to any form of CMC injuries. Advantages of open reduction include direct reduction under vision, removal of any soft tissue interposition, avoiding pinning the tendons, and drainage of any local hematoma. If the articular integrity and stability of affected joint is doubtful, open method allows excellent exposure to remove the offending soft tissue block, denudation of articular cartilage and plan for arthrodesis to provide future stability and prevent the carpal boss deformity and prevent restriction of movement. Although prompt management is warranted, delay in reduction for a period of 4 weeks doesn't seem to compromise results of surgical outcomes.<sup>12</sup>

Closed observation is essential after reduction on serial follows to check for any early signs of loss of reduction. After removal of k wires physiotherapy of hand and wrist joints is crucial to avoid postoperative stiffness and improved grip strength, prevent arthritis and improve muscle function. Postoperative physiotherapy had a significant impact of functional recovery as evident by gross improvement in quick DASH scores.

## CONCLUSION

CMC joint dislocations involving 2<sup>nd</sup> to 5<sup>th</sup> CMC joints are rare orthopaedic hand injuries needing prompt attention, evaluation and treatment. Diagnosis are often missed as associated more serious injuries takes priority and makes clinical finding obscure. Hence, careful and meticulous hand examination is necessary in any high velocity trauma case. Doubtful cases must be subjected to

radiological evaluation. Whether patients are treated with closed or open fashion, either way appropriate treatment usually leads to excellent outcomes. Closed reduction may be attempted in fresh cases involving the 4<sup>th</sup> and 5<sup>th</sup> CMC joints but open reduction and internal fixation is often required to achieve good reduction and is our preferred method for achieving excellent hand function. Open reduction is the preferred choice in cases presenting late.

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