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2nd Metacarpophalangeal joint fracture dislocation [Kaplan's Lesion] operated by open reduction with dorsal approach: A case report

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Abstract
Kaplan's injury is the dislocations of metacarpophalangeal (MCP) joint dorsally. It may be seen in all five fingers but usually index finger is more prone to such injury. In Kaplan dislocation the head of the metacarpal button-holed through the constraint soft tissue surroundings and the volar plate goes dorsal to the metacarpal head which makes it irreducible by closed method. Both dorsal & volar approaches have been described in many literature for open reduction for the dislocation. Though, the right approach to treat such lesions is still a debate, it is the volar approach which is widely used & described more in literature. Some prefer dorsal approach. Volar approach is very prone to iatrogenic neurovascular injure.
Surgical Procedure: Dorsal approach was used. This volar plate was completely dorsally dislocated. Head of metacarpal found fractured. A longitudinal incision was made over the plate & the head of the metacarpal was gently elevated & allowed to relocate. K wire was inserted through fracture fragment into the metacarpal head.
Result: As follow-up after 6 weeks, the patient's active range of motion consisted of metacarpophalyngeal joint hyperextension to 10° and 75° of flexion, proximal interphalangeal joint extension to 0° and flexion to 70°, and distal interphalangeal joint extension to 0° and flexion to 60°. Neurovascular evaluation was within normal limits. X-rays confirmed maintenance of reduction.

Keywords: Metacarpophalangeal, Kaplan's Lesion, dorsal approach

Introduction
Kaplan's injury is the dislocations of metacarpophalangeal (MCP) joint dorsally. It may be seen in all five fingers but usually index finger is more prone to such injury [1]. It is important to identify this lesion from subluxation as the latter can be reduced by closed methods whereas dislocations most often need an open reduction [2]. The term complex dislocation was first coined by Farabeuf [3] & later Kaplan published his article describing the numerous anatomical interposing structures which prevents reduction by closed methods which necessitates open reduction [4]. In Kaplan dislocation the head of the metacarpal button-holed through the constraint soft tissue surroundings and the volar plate goes dorsal to the metacarpal head which makes it irreducible by closed method.
The capsule on the volar side is attached to the metacarpal neck proximally & at base of proximal phalanx distally. It is reinforced by the volar plate. On the radial side, the deep transverse metacarpal & collateral ligaments provide protection, while ulnar wards it is the extrinsic & intrinsic tendons along with the sagittal bands providing additional support thus preventing dislocation [5]. The volar plate & capsule have thin attachment to the metacarpal, which torn due to extra force of injury & metacarpal head dislocation occurs. Hyperextension of the metacarpophalangeal (MCP) joint is common mode of injury in Kaplan dislocation. The volar plate detaches from its proximal attachment at metacarpal neck but the attachment to deep transverse ligament is maintained. The volar plate interposes between the dislocated metacarpal head & proximal phalanx, which leads to formation of a primary impediment for closed reduction. Further, three more structures, flexor tendons on ulnar side, pre-tendinous band of palmar fascia & the lumbricals on radial side form a tight constriction noose or a button hole like phenomenon for the head of the metacarpal which prevents its reduction [6-10]. Attempt to do closed reduction, tighten the noose around the neck of metacarpal and vigorous multiple attempts may lead to fracture of metacarpal head.

The index finger is most commonly injured [11, 12] followed by little finger. However the ring & the middle fingers escape isolated injuries due to support from neighbouring digits & strong deep transverse metacarpal ligaments [13].
Both dorsal & volar approaches have been described in many literature for open reduction for the dislocation. Though, the right approach to treat such lesions is still a debate [10, 16, 17], it is the volar approach which is widely used & described more in literature [6, 8, 14, 15]. Some prefer dorsal approach [7, 9, 13]. Volar approach is very prone to iatrogenic neurovascular injure.

A case report
A 13 year old female, presented with pain and swelling over right hand, around index finger, when she sustained injury to volar aspect of outstretched finger while fall from standing due to slip at home. On examination, there was hyperextension at 2nd metacarpophalyngeal joint (figure 1), and distal digit was slightly deviated towards middle finger. The distal and middle IP joints were flexed, and extensor tendons were relaxed. There was a smooth round shaped bony mass formed by the head of 2nd metacarpal on volar aspect of hand with puckering bilaterally.

Fig 1: clinical photographs

There was no distal neurovascular deficit. X-rays (figure 2) was suggestive of dorsal dislocation of proximal phalanx of the right index finger with fractured metacarpal head with dorsal displacement of the fracture fragment. Based on this picture, dorsal open reduction was attempted for this complex metacarpophalyngeal joint dislocation.

Fig 2: Roentgenogram

Surgical Procedure
With the patient in supine position, in regional anaesthesia in the form of brachial block, Patient was positioned with tourniquet, used to obtain bloodless field during surgery. Painting and draping was done in usual fashion to have an aseptic field. Dorsal approach was used. For that, curvilinear incision was made in dorsal aspect of index finger extending in the 2nd web space. The extensor mechanism was identified & incised on the ulnar side. The visible part of capsule, thus exposed was carefully incised longitudinally with a 11 number blade. The collateral ligaments were found caught within the joint which were released. We were able to gently retract them aside. Then the volar plate was visible which was strong, taut, shiny & glistening white in colour resembling the capsule. This volar plate was completely dorsally dislocated. Head of metacarpal found fractured. A longitudinal incision was made over the plate in the centre & with a small retractor or a curved small artery forceps the head of the metacarpal was gently elevated & allowed to relocate between the cut ends of the plate. The leaflets of the plate move away ulnar & radial ward allowing the relocation to occur concentrically. Stability & adequacy of the reduction was noted by moving the finger in flexion & extension & by direct visualisation under naked eye. K wire was inserted through fracture fragment into the metacarpal head (figure 3) . fragment was found to be stable & the metacarpophalangeal joint was also found to be stable enough.

Fig 3: post operative radiograph

Following reduction. The capsule was re-sutured & the ulnar part of the extensor mechanism was reconstructed using vicryl sutures. This is to prevent instability & iatrogenic subluxation or dislocation. The wound was washed thoroughly & sutured. Puckering of the skin on the volar side & void on the dorsal side disappeared as joint

relocated post operative straight cock up slab applied up to proximal interphalangeal joints. No neurovascular damage was noted postoperatively.

Follow up

Patient was discharged on the 3rd Post-Operative day. The sutures were removed on 14th post- operative day. The wire and the splint were removed at 3 weeks allowing gradual active mobilisation.

Patient was followed weekly for the first 3 weeks & later once a month for 3 visits. Total visits were 6 & the duration of follow-up were 3.5 months. Check X-ray was done once post-operatively and at 3 and 6weeks. Physiotherapy in the form of strengthening exercises was started after 6 weeks, once patient had regained >70% of previous movement.

Result

As follow-up after 6 weeks, the patient's active range of motion consisted of metacarpophalyngeal joint hyperextension to 10° and 75° of flexion, proximal interphalangeal joint extension to 0° and flexion to 70°, and distal interphalangeal joint extension to 0° and flexion to 60°. Neurovascular evaluation was within normal limits. X-rays confirmed maintenance of reduction.

Discussion

Out of the two main approaches described for open reduction - volar & dorsal, extensive literature has been written on volar approach by Kaplan & other authors [6, 8, 10, 15-21]. In this approach volar structures are required to release along with the volar plate, which increase the risk of injury to radial neurovascular bundle (digital nerve & vessel). That's how made dorsal approach was popularized [7, 9, 13] in which dorsal approach the risk of injury to the neurovascular bundle is much less as it lies between the metacarpal head & skin volar aspect. Becton *et al*. [7] reported in a series of 9 cases where complex MCP joint dislocations was treated by both approaches. He reported that by volar approach some patients developed sensory loss on the radial aspect of the operated finger in comparison to the dorsal approach. In conclusion of the study by Becton, dorsal approach should be the preferred approach to treat such injuries. Kaplan advocated that, the superficial transverse metacarpal ligament & distal transverse fibers (i.e. Notatory ligament) need to be released for easy reduction of the dislocation. In contrary De Coster [22, 23] advised not to release those important structures, unless they interfere in the reduction. Because, the risk of re-dislocation is also reported where above ligaments were released. In our case, reduction was achieved without release of the above ligaments hence, no re-dislocation occurred in post-operative period.

Deep transverse ligament is also a culprit for reduction of MCP joint in many cases. Murphy[18] reported the role of volar subluxation of deep transverse metacarpal ligament which forms a part of the noose around the head of MC & prevents reduction. Deep transverse ligament needs release if it prevents reduction. We did not face such problem, hence this ligament was not released. In our case, by dorsal approach, management of osteochondral fractures was much easier. Becton *et al*. reported association of Osteochondral fractures in nearly half of these injury [7, 9]. Commonly, the osteochondral fragments are on the dorsal aspect of metacarpal head & are ideally addressed by dorsal approach. We also had small osteochondral fracture of the metacarpal head which was managed with dorsal approach with ease.

In Kaplan injury, main culprit for closed reduction of MCP joint is the volar plate. It dislocates dorsally & lies between the MCP joint. By dorsal approach the volar plate can be visualised directly, as a glistening white structure which is very similar to the capsule. Hence, care should be taken to identify it properly, incise the plate longitudinally & not to damage the capsule.

As volar plate is an important stabiliser to the joint; longitudinal splitting of this volar plate is criticised in many past studies as it causes delay in recovery & leads to instability of the joint which may result in iatrogenic dislocation or subluxations later [24].

In a case report by Sandeep *et al*., reported about a needling technique where by percutenous needling from dorsal aspect volar plate was incised longitudinally, which facilitated the easy reduction of dislocation by closed means [25].

Conclusion

Both dorsal and volar approaches can be used for the treatment of complex dislocations of MCP joint. As discussed above the Dorsal approach is preferred in view of reducing the possibility of iatrogenic neurovascular injury. Extensive follow-up and clinical evaluation should be done to thoroughly assess the effectiveness and complications of both the approach.

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