

# Ligament injuries of the hand

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## Abstract

Ligament injuries of the hand are fairly common. Most of these injuries are diagnosed clinically. Clinicians must have awareness and diagnostic skills to identify these injuries accurately and without delay. This is key to achieving the best possible outcome from these injuries. This article presents a succinct summary of current concepts and management principles of these injuries.

**Keywords** beak ligament; gamekeeper's thumb; sagittal band injury; skier's thumb; Stener lesion; ulnar collateral ligament; volar plate injury

## Introduction

Acute ligamentous injuries of hand are not uncommon. Most of these injuries are seen in relation with sports-related activities although there are other causes. It can also be seen as a result of repetitive microtrauma. It is very important to have the correct diagnosis for appropriate management and rehabilitation following that. Treatment options available to manage the isolated hand ligamentous injuries vary according to the severity of injury, patient's requirement and expectations.

## Ulnar collateral ligament injury of the thumb

### Background

An ulnar collateral ligament (UCL) injury of the thumb metacarpophalangeal joint (MCPJ) is a commonly missed injury with debilitating consequences. UCL injuries are 10 times more common than injuries to the radial collateral ligament (RCL).<sup>1</sup> The acute form of this injury is most commonly associated with recreational activities like skiing, ball-throwing sports and biking. Modification in the ski poles still has not been able to reduce the incidence of this injury.<sup>2</sup> Campbell in 1955<sup>3</sup> described chronic laxity of the thumb in Scottish gamekeepers and attributed this to UCL attenuation from repetitive valgus force as gamekeepers used to fracture the neck of rabbits between their thumbs and index fingers. In 1962 Stener<sup>4</sup> described displacement of the UCL after acute complete rupture with interposition

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of Adductor aponeurosis. A total of 25 out of 39 cases he observed had this lesion and he concluded that healing would be imperfect with conservative measures when Stener's lesion is present. The importance of diagnosing acute complete ruptures of UCL in a timely manner has remained pivotal for adequate management of this injury. In this article we will review the literature about current concepts in the management of UCL injuries.

## Anatomy

The thumb MCPJ has little intrinsic stability and the range of motion of this joint is most variable of all the joints in the body.<sup>5</sup> Various dynamic and static restraints confer stability to the joint. Static stabilizers of the MCPJ are the:

1. Ulnar and radial collateral ligaments
2. Dorsal joint capsule
3. Volar plate

See [Figure 1](#).

Both collateral ligaments are made of a proper and an accessory collateral ligament. The proper ulnar collateral ligament runs from the ulnar condyle of the metacarpal passing obliquely to the volar third of the proximal phalanx. The accessory collateral arises from a more volar site on the metacarpal head inserting into the volar plate and ulnar sesamoid distally. The proper collateral ligament is tight in flexion and along with the dorsal capsule it prevents volar subluxation of the phalanx on the metacarpal as well as resisting radially directed valgus force through the MCPJ.<sup>6</sup> The accessory collateral ligament on the other hand is tight in extension. This particular arrangement explains the basis of clinical examination of the UCL.

Dynamic stabilizers of the MCPJ include intrinsic and extrinsic muscles of the thumb. The adductor pollicis inserts primarily onto the ulnar sesamoid and contributes to the extensor mechanism via its aponeurosis. This aponeurosis lies superficial to the UCL in anatomical position conferring dynamic stability against valgus stress.

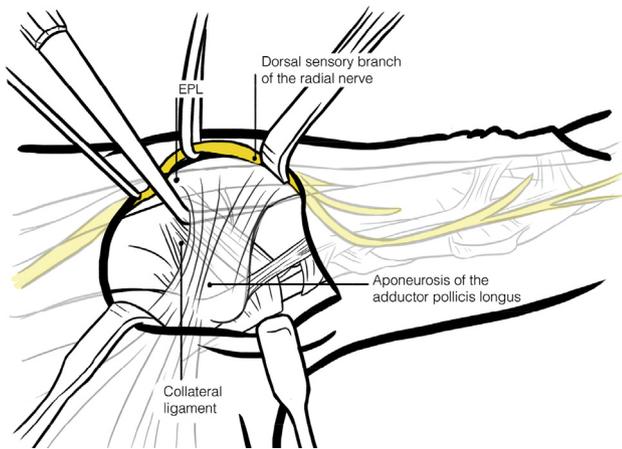
## Mechanism of injury

Acute UCL injury (also known as skier's thumb) occurs after a sudden radial deviation force. Most commonly UCL is avulsed from its distal insertion at the phalanx base. Following are the types of injuries described after a sudden radial deviation force at the thumb MCPJ:

1. Distal avulsion of the UCL which could be complete or partial
2. Intra-substance tear
3. Proximal avulsion (rare)
4. Avulsion fracture of the proximal phalanx base which could be displaced or un-displaced
5. Avulsion fracture of metacarpal head with UCL avulsion
6. Avulsion intra-articular shear fracture of phalangeal base with UCL avulsion. This is a potentially problematic injury.
7. Associated tear of adductor aponeurosis and dorsal capsule, which causes volar subluxation of the phalanx.

## Stener lesion

The reported incidence of associated Stener lesion can be as high as 70%.<sup>7</sup> Stener described the mechanism in his pictorial essay in 1962.<sup>4</sup> Adductor aponeurosis being a dynamic restraint is



**Figure 1** Ulnar collateral ligament of the thumb. EPL, extensor pollicis longus. Illustration by Nila Murali.

stretched out on a sudden radial deviation and exposes the UCL, which usually lies under its cover. When UCL ruptures completely from its distal insertion at an extreme angulation the adductor aponeurosis displaces distal to its proximal limb allowing the proximal limb of the ligament to escape superficial to the aponeurosis. When the MCPJ realigns in normal anatomic position the free edge of the adductor aponeurosis interposes between the torn UCL and its distal insertion point. Healing becomes improbable without surgical intervention. See [Figure 2](#).

#### Gamekeeper's thumb

Chronic UCL injury due to repetitive trauma or missed acute injury with progressive attenuation causes this condition.

#### Clinical diagnosis

UCL injury is essentially diagnosed clinically. Despite modern imaging advances there are no reports in the literature that favour imaging studies over clinical diagnosis. Patients with UCL injury present with pain, swelling and bruising over the ulnar side of the thumb MCPJ. The main objective of clinical testing is to answer the two most important questions:

1. Is it a complete or partial ligament rupture? This is best confirmed by clinical examination of the MCP joint by stressing the ulnar collateral ligament. This is done by stabilizing the metacarpal with fingers of one hand, and opening the joint with the fingers of the other hand. This is done with the joint in extension and in about 30° of flexion. A firm end point, which means that a point has reached where the joint does not open up any further, indicates that the ligament tear is partial. If the ligament has ruptured completely, then it would be possible to open the thumb significantly ([Figure 3](#)). Radiographs are useful to identify bony avulsion of the base of the proximal phalanx. Stress radiographs have been advocated as a method of diagnosing a complete tear<sup>5</sup> ([Figure 4](#)), but these are cumbersome, painful to perform and have significant inter-observer error.
2. Is there a Stener lesion? It is not possible to diagnose a Stener lesion clinically accurately. A bony avulsion is less likely to be associated with a Stener lesion. Abrahamsson et al.<sup>8</sup> described palpation of the displaced ligament as a reliable method of diagnosis. Imaging with MRI may demonstrate the Stener lesion<sup>5</sup>

#### Treatment

**Partial ruptures:** acute partial ruptures are generally treated conservatively keeping the MCPJ immobilized in a thumb spica cast leaving the interphalangeal joint free for 4 weeks, followed by 2 weeks of splinting with active range of motion.

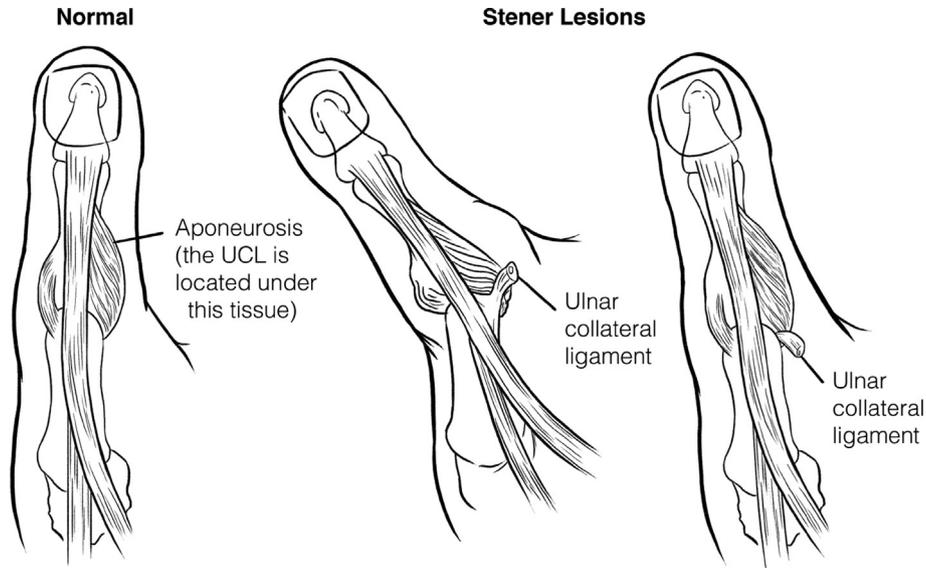
**Acute complete ruptures:** most authors agree that a complete rupture of UCL is best managed by surgical repair.<sup>5</sup> As described in the original Stener paper most of the complete ruptures were associated with Stener lesion, which made healing impossible with conservative measures. Pichora et al.<sup>9</sup> has described successful conservative treatment for complete ruptures with functional bracing but their findings have not been reproduced elsewhere.

Various surgical methods have been described in the literature all of which use either a bone anchor or pull out suture for distal avulsion. Intrasubstance tears are repaired with direct suturing. Bone anchors have become the most popular method of repairing the common distal avulsion injuries.<sup>10</sup> Arthroscopic assisted repair has also been described.<sup>11</sup> Suture anchor repair allows early active range of motion and improved outcome<sup>5</sup> ([Figure 5](#)). It is important to repair the ligament at 45° of MCPJ flexion to prevent over-tightening and stiffness. Neurapraxia of the dorsal sensory branch of the radial nerve is the most common complication of surgical intervention.

UCL injuries with fracture of the proximal phalanx are treated surgically either by fixing the fracture fragment or excising depending on its size.

**Chronic gamekeeper's thumb:** preoperative evaluation of the laxity and associated degenerative changes of the MCPJ are essential for planning treatment for this condition. Clinical diagnosis is less challenging compared to acute rupture. Symptomatic chronic tears without degenerative changes in the MCPJ can either be treated by repair or reconstruction unless the patient has a most sedentary lifestyle. Here is a brief description of surgical treatment available for this injury:

1. **Direct repair** with a bone anchor is possible if the remnant ligament tissue is not contracted and can be released to reach the proximal phalanx. There is no time-frame associated with chronicity and possibility of direct repair.
2. **Dynamic reconstruction** was described by Neviasser and colleagues<sup>12</sup> in 1971. This method replaces the UCL with advancement of the adductor pollicis tendon in to the base of proximal phalanx. There is no distinct biomechanical advantage of this method.
3. **Free tendon graft** was originally described by Smith<sup>13</sup> and is the most popular method of reconstruction. A palmaris longus free tendon graft is used to reconstruct UCL in an inverted triangle fashion with gouge holes and pull-out sutures.
4. **Bone tendon ligamentoplasty** – an extensor carpi radialis longus tendon with bone block is used.<sup>14</sup> Again no biomechanical advantage has been observed.
5. **Salvage procedure** – MCPJ arthrodesis is considered when the joint shows degenerative changes and/or volar subluxation with chronic UCL injury.



**Figure 2** Stener lesions. UCL, ulnar collateral ligament. Illustration by Nila Murali.



**Figure 3** Obvious opening up of the metacarpophalangeal joint on applying stress on the ulnar side.

**Radial collateral ligament injury of the thumb**

**Introduction**

RCL injuries of the MCPJ of the thumb are less common than UCL injuries. Like UCL injuries RCL injuries are commonly associated with recreational activities like rugby, American football and other contact sports. In a recent study published in

the *The American Journal of Sports Medicine*<sup>15</sup> combined injury of UCL and RCL have been found in 25% of MCPJ injuries in a National Football League (NFL) team. All of those combined injuries required surgical repair.

RCL injuries can be as debilitating as UCL if timely diagnosis and treatment is missed.

**Anatomy**

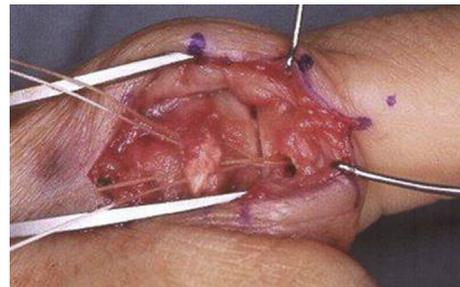
RCL anatomy is almost a mirror image of UCL. It is made of a proper and an accessory collateral ligament and arranged in a similar fashion like UCL. The major difference is in the abductor aponeurosis, which is much broader, compared to the adductor aponeurosis. This makes it less susceptible to interpose between the torn ligament and its footprint. But Stener-type lesion has been described on the RCL as well.<sup>16</sup>

**Mechanism of injury**

A sudden forced adduction on a flexed MCPJ tears the RCL. Mid-substance tears are more common than seen with the UCL.<sup>5</sup> Proximal and distal avulsion occurs with equal frequency. An RCL tear with dorsal capsular tear and abductor aponeurosis avulsion causes volar subluxation of the phalanx. Chronic attenuation of RCL happens after a missed diagnosis of acute injury.



**Figure 4** Stress X-ray revealing unstable metacarpophalangeal joint.



**Figure 5** Intraoperative picture demonstrating an anchor being used to repair the ligament.

### Clinical diagnosis

Like UCL it is extremely important to differentiate partial and complete ruptures. Clinical criteria are very similar to UCL. Laxity of more than 30° or 15° more than the other thumb and lack of a discrete end point to the joint opening are indicative of complete rupture. Volar subluxation of the phalanx is suggestive of a more extensive RCL tear extending to the dorsal capsule.

Imaging studies like MRI and ultrasound are only used as adjunctive procedures as the diagnosis is mainly clinical.

### Treatment

Acute partial ruptures are treated conservatively with 4–6 weeks of spica cast and hand therapy.

Most authors would agree that a complete RCL rupture demands surgical repair.<sup>17</sup> Direct repair of the ligament is done by either a pull-out suture or bone anchor. The bone anchor technique is more popular, as for UCL rupture.

Chronic RCL injuries are treated with either late repair or reconstruction. Reconstruction techniques are mainly dynamic and static. Dynamic technique utilises abductor advancement with capsular reefing. Static technique utilises a free tendon graft. Palmaris longus free graft is most commonly used when available and the technique is a mirror image of UCL repair. Free tendon graft static reconstruction seems to be the more favoured technique among the surgeons.

## First carpometacarpal joint ligament injuries

### Introduction

The thumb carpometacarpal joint (CMCJ) is a concavo-convex saddle joint. It has been described as ‘articulation by reciprocal reception’ in the seminal work of *Gray’s Anatomy*.<sup>18</sup> The thumb metacarpal is concave in the radioulnar axis and convex in the dorso–volar axis, while the trapezium is concave in the dorso–volar and convex in the radio–ulnar axes. Shallow articulating surfaces provide very little intrinsic stability to the joint. Joint reaction force increases exponentially from the tip to the CMCJ with grasp and forceful pinch. In the lateral pinch this joint reaction force multiplies up to 12 times greater than the tip and up to 120 kg compressive force can be generated at the CMCJ on forceful grasp.<sup>19</sup> All reported joint dislocations are dorsal and happened with axial force on a flexed thumb.<sup>5</sup>

### Ligamentous anatomy

Up to 16 ligaments have been described in the first CMCJ and there is no agreement about which ligament is the primary stabilizer of this joint.<sup>20</sup> There are four distinctly defined ligaments:<sup>5</sup>

1. Volar oblique ligament, also known as the beak ligament as it is attached to the anterior beak of the metacarpal.
2. Dorso-radial ligament.
3. Intermetacarpal ligament
4. Dorsal oblique ligament

See [Figure 6](#).

Traditionally the beak ligament has been considered as the primary restraint against dorsal dislocation but Strauch and colleagues found in cadaveric study<sup>21</sup> that the dorso-radial ligament has to be torn to cause dorsal dislocation. It is understood that stability is provided by the additive and synergistic effect of

these two ligaments. The most common mechanism of thumb CMCJ dislocation is axial loading of flexed thumb.

### Clinical diagnosis

Thumb CMCJ dislocations are relatively rare injuries. Bennett fracture dislocations are far more common. It is extremely difficult to distinguish between complete and partial ruptures of the ligament complex. Most cases are presented either after acute dislocation or with persistent pain after injury. As the joint is well enveloped by thenar muscles clinical examination for instability is difficult. Radiographs are quite helpful. Apart from the standard postero-anterior and lateral views one must obtain a postero-anterior stress view with tips of thumbs pressing against each other. An underlying ligament injury will manifest as dorso-radial shift of the metacarpal and joint incongruity.

### Treatment

**Acute post-traumatic painful joint (no documented dislocation):** in absence of documented dislocation and any signs of clinical or radiological instability, conservative treatment with thumb spica cast for 4–6 weeks is well recommended.

**Documented dislocation and/or clinical/radiological instability:** according to Simonian and Trumble<sup>22</sup> early surgical management with open anterior ligament reconstruction gives the best result. There is a lack of strong clinical evidence due to the relative rarity of this injury. Closed reduction and K-wire fixation is indicated if a stable and congruous reduction can be achieved. In absence of stability and congruity it is assumed that there is soft tissue interposition and open repair is advised. Open repair techniques reconstruct the anterior oblique ligament using either the flexor carpi radialis as described by Eaton and Littler<sup>23</sup> or using the abductor pollicis longus as described by Brunelli and colleagues.<sup>24</sup> The Eaton and Littler method seems to be more commonly utilized. There are no available data proving superiority of one technique over the other.

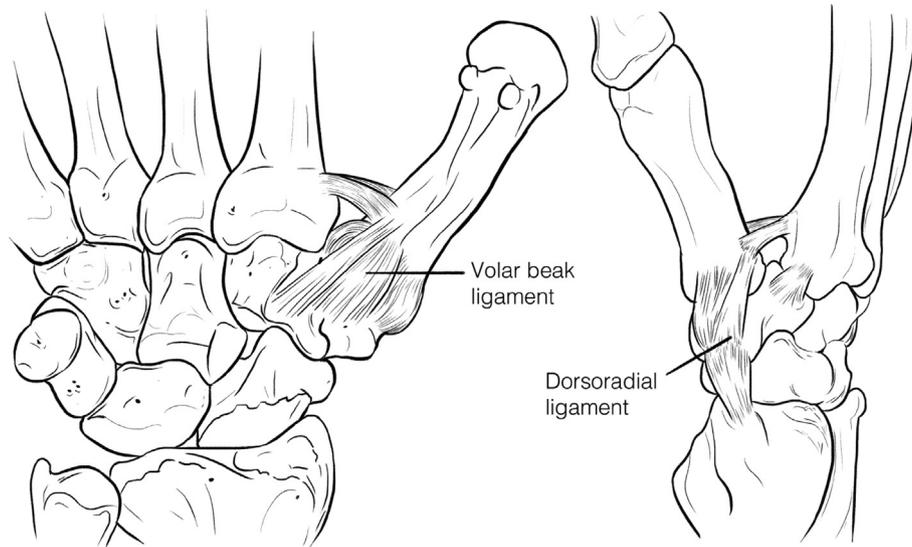
## Ligament injuries of digits other than thumb

### Proximal interphalangeal joint (PIPJ)

**Introduction:** The PIPJ is a hinge joint. A box-like complex made of collateral ligaments, bony contours and the volar plate confers PIPJ stability. For joint dislocation to happen at least two sides of this box-like complex will have to fail.

**Collateral ligaments:** these are the primary restraint for radio–ulnar stability. The proper collateral ligament originates from the lateral fossa of proximal phalanx condyles and inserts in to the volar third of the middle phalanx base. It provides maximal stability in flexed PIPJ. Accessory collaterals are mostly confluent with proper ligaments but inserts in to the volar plate.

**Volar plate:** this is a fibrocartilaginous structure, which is thin centrally, and thick at the periphery. It blends into the periosteum of the middle phalanx. It is suspended by the accessory collateral ligaments and it is thickened laterally to form a pair of



**Figure 6** Ligamentous anatomy of the first carpometacarpal joint. Illustration by Nila Murali.

checkrein ligaments. Volar plate acts as a secondary stabilizer to lateral deviation especially in extension but only confers stability when collateral ligaments are torn.

**Mechanism of injury:** PIPJ injury is the most common ligamentous injury of the hand.<sup>5</sup> Collateral ligament sprain is the mildest form in a spectrum of injury. On the other end of the spectrum lies fracture dislocation of the PIPJ.

Ligament sprain is classified as:

1. Grade I – pain but no laxity
2. Grade II – laxity with a firm end point and stable arc of motion
3. Grade III – laxity with no firm end point

PIPJ dislocation without fracture can be of three main types:

1. Dorsal dislocation is the most common variety
2. Lateral dislocation almost always happens at the expense of one collateral ligament failure
3. Volar dislocation with or without rotatory component

**Clinical evaluation:** concentric joint reduction with an active arc of motion determines joint stability. Clinical examination is performed under local anaesthetic digital block. There are two phases of this examination:

1. Active stability in which the joint remains congruently reduced through the active range of motion after digital block
2. Passive stability in which gentle lateral stress is applied in extension and 30° flexion to test the integrity of the collaterals. Stress in flexion determines the integrity of the proper collateral ligament.

Radiographs aid in determining fractures when associated with collateral ligament injuries.

MRI has a role in determining chronic collateral ligament injuries.

**Treatment:** dislocation or subluxation of the joint in an active stability test determines the flexion angle of instability. The joint is splinted with extension block splinting at 10° more than the flexion angle of instability for 3 weeks<sup>5</sup> extending the joint by 10°

every week. If the flexion angle required to stabilize the joint is more than 30°, surgical treatment is considered. It is observed that the volar plate fails distally and collateral ligaments avulses from the proximal insertion point. Surgical repair of collateral ligaments is usually complicated by postoperative stiffness and thereby conservative treatment is mostly favoured.

When the joint is stable throughout the arc of motion, early motion is commenced with buddy strapping.

An acute dislocation is commonly reduced with manipulation under digital block. It is important to note that ruptured volar plate can interpose in the joint resulting in irreducible dislocation. A dorsal V sign in lateral radiograph is a subtle clue to failed reduction attempt. Open reduction can be done with either dorsal or volar approach.

Surgical repair of the collateral ligament is reported frequently after dorsal or lateral dislocation mostly in athletes.

### Distal interphalangeal joint (DIPJ)

Ligamentous anatomy of the DIPJ is very similar to the PIPJ. DIPJ dislocation and collateral ligament injury is much less common due to a shorter lever arm of distal phalanx. Management principles are very similar to PIPJ. Unless it is an irreducible dislocation most injuries are treated conservatively.

### Metacarpophalangeal joint (MCPJ)

**Introduction:** finger MCPJs are intrinsically stable due to their position at the base of the fingers and due to the reinforcing structures around them. The capsule of the MCPJ is reinforced by the following structures:

1. Volar plate
2. Transverse metacarpal ligament
3. Sagittal bands
4. Flexor tendons
5. Intrinsic attachments
6. Extensor tendons
7. Flexor digiti minimi for the little finger

Ulnar collateral ligament injuries of the MCPJ are extremely rare. Isolated RCL injuries are not rare. Only small case series

have been described in the literature and most are about index finger RCL injury.

**Anatomy and mechanism of injury:** MCPJs are condyloid joints. The diameter of the metacarpal head is wider on the volar aspect, which confers maximum stability in flexion. Collateral ligaments are taut in flexion as well. MCPJs are always splinted in at least 50° flexion to stretch the collateral ligaments and prevent contracture. MCPJs are most vulnerable to ulnar and dorsal directed force and index finger is the most commonly injured. Ligaments avulse from either proximal or distal insertion in equal measures.<sup>25</sup>

**Clinical examination:** stress test in flexion after digital nerve block can reliably diagnose collateral ligament sprain. A grade III sprain will show laxity without a firm end point.

Radiographic evaluation with Brewerton view is helpful to diagnose associated avulsion fractures.

MRI can be used to diagnose chronic injuries but clinical diagnosis is usually conclusive.

**Treatment:** grade I and II injuries are treated conservatively with splinting in flexion. Grade III sprains in young active individuals are mostly treated surgically in published case series.<sup>25,26</sup> Suture anchor repair is the most popular method.

Chronic injuries when presented as on-going pain with instability are best managed surgically. Primary repair is usually possible.<sup>26</sup> Ligament reconstruction has also been described.

### Sagittal band injuries of the MCPJ

**Introduction:** the sagittal band forms an important component of the dorsal hood, which stabilizes the extensor digitorum communis (EDC) tendon on the dorsum of the MCPJ. Sagittal bands are oriented perpendicular to the EDC tendon and attached to palmar plate and transverse metacarpal ligament. The two components of sagittal band, radial and ulnar prevent subluxation of the EDC tendon over the MCPJ.

Injury to the ulnar sagittal band does not necessarily cause the subluxation of the extensor tendon. This contributes to the geometry of the MCPJ and hence radial dislocation is rare. The injury to radial part affecting more than 50% of the band is known to cause ulnar subluxation of the extensor tendon over the MCPJ. Sagittal band injuries are uncommon in non-rheumatoid patients. In non-rheumatoid patients it is commonly seen in boxers.

Rayan and Murray<sup>27</sup> has described classification on clinical examination.

- Type I: Contusion without tear
- Type II: Associated extensor tendon subluxation
- Type III: With Extensor tendon dislocation

Ultrasonography has been found to be helpful in dynamic evaluation of extensor tendon following sagittal band injury.

**Mechanism:** These injuries are seen with axial loading of flexed digits in flexed and ulnarly deviated wrist.

**Clinical examination:** Clinically patients present with swelling and difficulty in initiation of finger extension at the MCPJ from flexed position. Crepitation and pseudo-triggering are also described as presenting symptoms.

**Treatment:** Non-operative treatment with splinting for acute injuries has been recommended. Operative treatment is recommended following failure of non-operative management and this ranges from direct repair of sagittal band to realignment of extensor tendon with reconstructive techniques using a strip of EDC tendon.

### Conclusion

Ligament injuries of hand are very common in a trauma and orthopaedic practice. Most of these injuries are diagnosed clinically. Clinicians must have the awareness and diagnostic skills to identify these injuries. A timely accurate diagnosis is key to achieving the best possible outcome from these injuries. ◆

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