

# The Handbook of Hand Emergencies

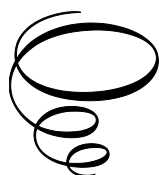


# The Handbook of Hand Emergencies

Edited by

Jose Couceiro,  
Manuel R. Sanchez-Crespo  
and Huey Yuan Tien

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## FOREWORD

“The Handbook of Hand Emergencies” is an excellent resource for the emergency room physicians, residents, fellows, or general practitioners who are confronted with a hand emergency.

When assessing the human hand, the major consideration is to return the patient to functional capacity as soon as possible with the best result that could be achieved. Time is of the essence, and in this brief review and reference book, the doctor can quickly find a citation for most, if not all, pertinent conditions.

Most of the chapters in this handbook are written by hand surgeons who completed a hand surgery fellowship at Kleinert and Kutz here in Louisville, Kentucky. There had been more than 1400 fellows representing more than 50 countries. This handbook contains the most current concepts and clinical applications. It is a handy first reference book for future fellows to use for the diagnosis and treatment of hand emergencies.

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# CHAPTER ONE

## HISTORY AND PHYSICAL EXAMINATION OF THE INJURED HAND

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### Introduction

A correct history and a thorough physical examination of the injured hand is essential in the trauma setting. The importance of arriving at a correct diagnosis and an adequate assessment of the existing lesions cannot be overstated. This chapter aims to show the basic indispensable techniques to achieve that goal.

### History

Demographics:

- Record age, gender, hand dominance, job, sports, and leisure activities.
- Register the patient's allergies and past medical history, including active medications, pay special attention to anticoagulant medications, and write down their smoking and drinking habits.

### Type of injury:

- Question the patient regarding the injury mechanism. High energy mechanisms such as car and motorbike accidents tend to create more serious injury patterns.
- In the case of burns, inquire about the type of chemical product or substance, or if the burn is electrical or fire related.
- In the case of a chemical injection, register the chemical if available, and obtain the manufacturer specifications and safety sheets if possible.
- Question the patient regarding any possible puncture wounds. In coastal areas, ask about any possible contact with marine organisms such as sea urchins. Also, be aware of fight bites, as patients tend to lie about their involvement in these kinds of incidents.
- For animal bites, record the animal, vaccination status (if known), and the area of the bite.
- For amputated parts, write down the time of the hot/cold ischemia and which part has been amputated – whether finger, transmetacarpal, hand, forearm, or arm.
- Write down any laceration or stab areas and the type of tool or weapon that produced them. An accidental injury with a kitchen knife is usually less severe than that produced by an assault with a samurai sword.
- If the patient has sustained a gunshot wound, record the area and, if possible, the type of weapon – not so much the specific type, but whether it is a low or high velocity round or a special round, such as buckshot, pellets, or expansive rounds (high-velocity rounds produce cavitory effects in the body which are not produced by low-speed rounds).

### Physical Exam

- Inspect the hand for any puncture wounds or lacerations that may be occult – even the patient may be unaware of these in some cases.

## Check the General Hand Aspect

### Color:

The hand must be pink as a general rule. Any pale areas may be ischemic, while areas that are swollen and bluish may be congestive, which is especially important in the follow up of replanted fingers and flaps.

### Finger position:

- The fingers must follow a natural cascade (see Fig. 1-1). When relaxed, the fingertips aim at the scaphoid distal tubercle. A disturbance of this cascade may indicate an injury. This is very frequent, but not always present, in flexor tendon lacerations.
- Malrotation of the fingertips can indicate a metacarpal or phalanx fracture. Grossly malrotated fractures may require a surgical correction. Check if finger rotation is correct – if possible, both in extension and in flexion, as malrotation may only be evident with finger flexion in some cases. Ask the patient to actively move their fingers, if possible.
- Check for any areas of swelling and tenderness around the hand and fingers – these may indicate a fracture or an infectious process.
- Nerve injuries can produce an atrophy of the intrinsic hand muscles or finger clawing, so be on the lookout for these (see Fig. 1-2).

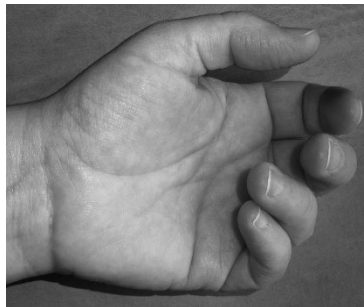


Fig. 1-1. In the normal resting cascade of the hand, the fingertips aim at the distal tubercle



Fig. 1-2. The patient shows an atrophy of the intrinsic muscles of the hand following an injury to the ulnar nerve

## Nerve Function

Assess median, ulnar, and radial nerve motor function:

- If possible, ask the patient to flex their fingers to evaluate the motor function of the median nerve. Pay special attention to the thumb and index finger – the flexor digitorum profundus is generally innervated by the median nerve in those digits.
- Tell the patient to extend their fingers and wrist to check the motor function of the radial nerve. Be careful to check this at the metacarpophalangeal joints of the fingers. The proximal interphalangeal joints can be extended by the intrinsic muscle function (ulnar nerve), and are therefore not indicative of an intact radial nerve.
- Tell the patient to spread their fingers apart and hold them in that position against resistance. This is useful to evaluate the patient's intrinsic muscles and their power, and subsequently the motor function of the ulnar nerve (see Fig. 1-3).



Fig. 1-3. The motor function of the ulnar nerve can be evaluated by testing the intrinsic muscles, as shown in the picture

Muscle strength can be graded using the medical research council scale:

- 0 – No contraction
- 1 – Flicker of contraction
- 2 – Active movement with gravity eliminated
- 3 – Active movement against gravity but not against resistance
- 4 – Active movement against gravity and resistance
- 5 – Normal strength

Specific signs:

- Wartenberg's sign – an involuntary abduction of the small finger, frequently seen in ulnar nerve palsies.
- Froment's sign – a weakness of the adductor pollicis. The patient usually compensates for this by flexing their thumb interphalangeal joint when grabbing objects. This sign is also frequently encountered in ulnar nerve palsies.
- Ulnar clawing – an extension deficit of the proximal interphalangeal joints of the ring and small fingers, and a hyperextension of the metacarpophalangeal joints of the same fingers. Low ulnar nerve injuries can produce this deformity, which is caused by an imbalance between the intrinsic and extrinsic hand muscles, and is typically absent in high ulnar nerve lesions as this imbalance no longer exists.

If possible, conduct a two-tip discrimination test at the fingertips (see Fig. 1-4). Touch one of the patient's uninjured fingers and ask if they can feel

the difference between one or two touches of the fingertip. Once the patient understands the test there are two ways of conducting it:

- (1) Dynamic – sweep the two tips from one side of the fingertip to the other in one motion, then ask the patient if they can tell whether one tip or two were in contact with the finger. This modality is especially useful for the assessment of peripheral neuropathies.
- (2) Static – place the two tips in line with the axis of the finger and lightly touch the radial or ulnar border of the fingertip, then ask whether the patient can tell whether they were touched with one or two tips. This modality is especially useful for examining peripheral nerve injuries, such as collateral nerve lacerations.

The test result is considered normal if the patient can discriminate two tips 6 mm apart or less. Should a two-tip discriminator not be available this test can be conducted with a bent paper clip.

Areas of innervation vary slightly from patient to patient. However, the sensitivity of the following areas belongs quite constantly to a particular nerve:

Median nerve – tip of the index finger

Ulnar nerve – tip of the small finger

Radial nerve – dorsum of the first web space

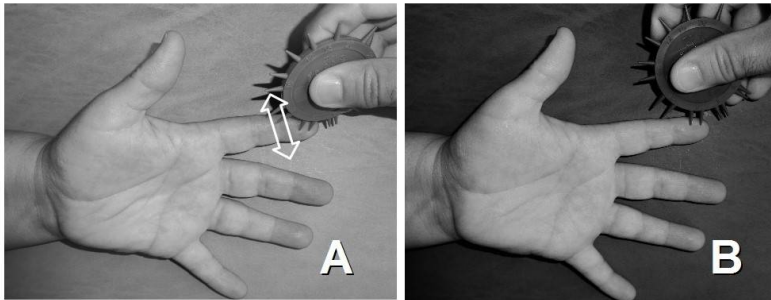


Fig. 1-4. Two tips discrimination can be tested at the fingertips either in a dynamic (A) or static (B) fashion

### Vascular Status

- If active bleeding is present, try to determine the approximate site of bleeding – a collateral artery, a proper digital artery, the radial artery, or the ulnar artery. These arteries have different sizes and their potential for bleeding is also different.
- Is the finger or the hand ischemic? To answer this question, the first step is to check the coloration and temperature of the affected area, and whether it is a finger, several fingers, or the whole hand. Normal fingers should be pink and warm to the touch (see Fig. 1-5).



Fig. 1-5. This patient's ring finger is pale owing to the lack of blood flow

- Feel the radial and ulnar artery pulses, if possible.
- Check the capillary refill at the fingertips by gently pressing on the fingertip and producing blanching. If the capillary refill is correct, the fingertip should be pink within two seconds, or less. Be aware that the capillary refill is not fully trustworthy for evaluating ischemia, as a fingertip may be pink and remain relatively ischemic owing to the preservation of a variable blood inflow through the dorsal arterial branches.
- It is possible to evaluate fingertip bleeding with an insulin needle by using the needle to puncture the fingertip lightly and waiting for the subsequent bleeding. Do not squeeze the finger – the bleeding should appear in less than two seconds.
- Remember to remove any rings from the fingers before the onset of

significant edema, as they render this task almost impossible.

## Tendon Integrity

- Flexor tendon injuries that completely disrupt the tendon may produce an inability to flex the finger and a disruption of the normal digital cascade (see Fig. 1-6).

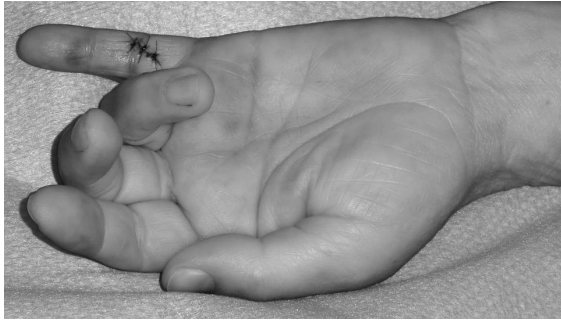


Fig. 1-6. A disruption of the normal digital cascade produced by a complete flexor tendon laceration

- Partial flexor tendon injuries may not be so conspicuous as the finger may flex normally and the cascade may remain undisrupted. If undiagnosed, partial tendon injuries may cause a posttraumatic triggering or a complete laceration (see Fig. 1-7).

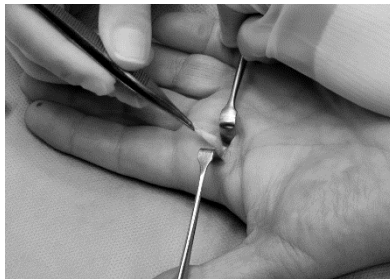


Fig. 1-7. In this intraoperative picture the reader can see a partial laceration of the flexor digitorum superficialis that was producing pain and triggering

- Partial flexor tendon injuries commonly produce pain when the finger is flexed against resistance.
- To examine the flexor digitorum superficialis, with your hand, block all of the metacarpophalangeal joints of the digits in extension and allow the proximal interphalangeal joint of the affected digit to move. An active flexion indicates the absence of a complete laceration of the flexor tendons.
- In order to specifically examine the flexor digitorum profundus, with your hand, block the proximal interphalangeal joints of all the fingers, except for the affected one. If the distal interphalangeal joint flexes this indicates the absence of a complete laceration of the profundus tendon.
- Extensor tendons are very close to the dorsal skin of the hand. Any lacerations affecting the area can easily produce an injury to the extensor tendons.
- Extensor tendon lacerations may not always produce an inability to extend the finger. Extensor tendons are linked in variable ways by tendinous connections known as the junctura tendinum. A partial extensor tendon laceration may not produce an immediate functional deficit as the tendon may keep functioning due to the junctura.
- A very distal extensor tendon laceration can produce a mallet finger deformity if the tendon is lacerated at its insertion on the distal phalanx (see Fig. 1-8).

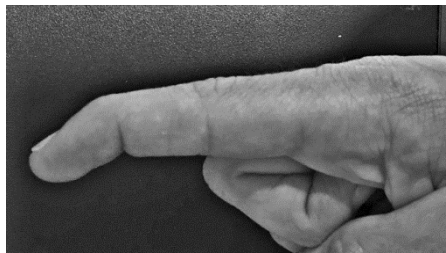


Fig. 1-8. A typical mallet finger deformity

- A rupture of the extensor pollicis longus may also produce an inability to extend the thumb interphalangeal joint, which is difficult to differentiate from the typical mallet on the basis of a physical exam. A possible way of doing this is by palpating the third extensor sheath at the wrist. If it is painful, suspect an extensor pollicis longus rupture.

- Lacerations or ruptures of the extensor tendon central slip can cause a Boutonniere deformity, a flexion deformity of the proximal interphalangeal joint, and hyperextension of the distal interphalangeal joint. This is caused by the attenuation of the triangular ligament and volar migration of the lateral bands.

### **Assessment of Bone and Ligament Injuries**

- Fractures frequently produce swelling and hematoma – the area is usually tender on palpation. Be careful when palpating potential fracture sites as this may cause a significant amount of pain to the patient.
- Fractures of the fifth metacarpal are very common following fights and are most common in young men. Check for malrotation or scissoring of the affected digit as this may require surgical correction. If possible, ask the patient to flex their finger to make sure that rotation remains normal through the whole range of motion.
- Different fractures and dislocations cause different deformities of the fingers and wrist.
- Dorsal proximal interphalangeal joint dislocations cause a very characteristic deformity as the middle phalanx dislocates dorsally, overriding the proximal phalanx. Distal radius fractures also induce different deformities, and typical Colles fractures produce a dorsal deformity and shortening.
- Dorsal interphalangeal joint dislocations may be unstable in the anteroposterior plane, and the joint stability in the lateral plane should be examined for additional injuries, if possible (Fig. 1-9). Refrain from doing this in other dislocation types such as lateral dislocations, which are potentially unstable in this lateral plane.
- When examining the stability of the thumb metacarpophalangeal joint it is advisable to do so under local anesthesia after testing the thumb's neurovascular status (see Fig. 1-10).



Fig. 1-9. Proximal interphalangeal joint instability may be checked in the lateral plane, as shown in the picture. The examiner stabilizes the joint with his thumb and index finger and produces a stress in the lateral plane

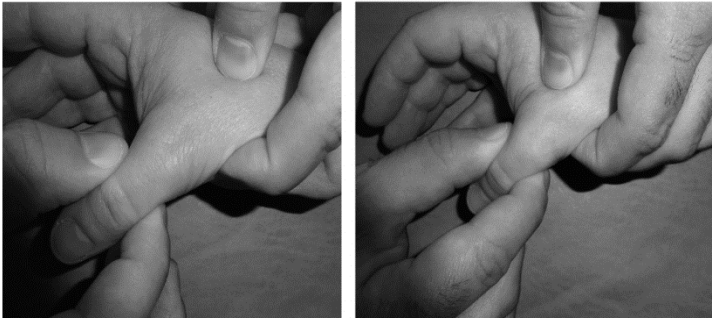


Fig. 1-10. The ulnar collateral ligament of the thumb metacarpophalangeal joint must be examined both in extension to test the accessory collateral ligament, and in 30° of flexion to test the proper (more dorsal) collateral ligament. It is advisable to compare the exam with the contralateral side

- In distal radius fracture cases, examine the distal radio-ulnar joint stability. If the patient is undergoing surgery this may be better done in the operating room (see Fig. 1-11).

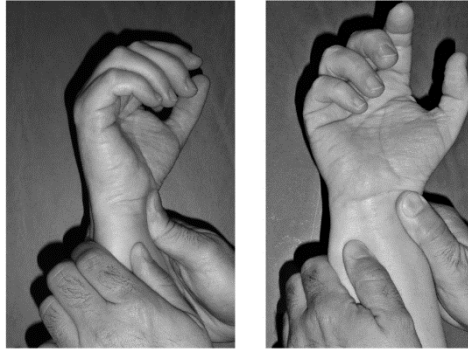


Fig. 1-11. To test the distal radioulnar joint stability, the examiner stabilizes the distal radius with one hand and the ulna with the other. The examiner applies force in the anteroposterior plane, balloting the ulna back and forth in pronation, supination, and neutral positions. The joint stability is compared to that of the contralateral side

- Tenderness on palpation at the anatomical snuffbox is suggestive of a scaphoid fracture, although this sign on its own is not very specific. The combination of tenderness on palpation at the anatomical snuffbox, pain on palpation at the distal scaphoid tubercle, and pain with longitudinal thumb compression provides a much more accurate diagnosis (see Fig. 1-12).



Fig. 1-12. The three tests for a suspected scaphoid fracture, from left to right: pain on palpation at the anatomical snuffbox, pain on palpation at the distal scaphoid tuberosity (distal flexion crease), and pain with longitudinal thumb compression

## Infection

Purulent drainage is a clear sign of infection, but this is not always present. Infections of the hand commonly display swelling and redness, and the

affected areas are hot to the touch. Use the dorsum of your hand to test the temperature.

In suspected infected tenosynovitis look for the four Kanavel signs:

- diffuse swelling of the finger
- flexed posture in a resting position
- severe pain on passive extension
- tenderness from palpation along the flexor sheath

The following three aspects are extremely serious hand emergencies. BE VERY CAUTIOUS:

- (1) high-pressure injections (frequently missed)
- (2) devascularization or amputations (check the capillary refill as described above – do not rely solely on coloration)
- (3) a mangled hand (refer to the mangled hand chapter)

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## CHAPTER TWO

### PHYSICAL EXAM OF THE TRAUMATIC WRIST

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#### **Introduction**

The wrist is a mechanical wonder when intact. However, injuries may result in significant morbidity and be easily missed. Evaluation begins with a careful building of the history and a thorough physical examination to understand the anatomical location and mechanism of the injury, avoid missing occult fractures, and rule out the possibility of any coexisting injury. In this chapter, we address the key points in the evaluation of the traumatic wrist in the emergency room. Additionally, imaging and other exams that may clarify and support the diagnosis of the injury to the wrist will be presented.

#### **Evaluation of the traumatic wrist**

This can be broken down into four areas: (1) inspection, (2) palpation, (3) range of motion, and (4) special tests.

#### **(1) Inspection**

The patient should sit with both elbows resting on a table. To avoid causing anxiety, and to develop a baseline for the patient, both upper extremities should be inspected for comparison. Inspection should include evaluation

of the skin, color, signs of edema or bleeding, deformity, and abnormal posture. In the emergency setting, common wrist problems relate to fractures, dislocations, tendon or nerve injuries, or inflammatory conditions not related to trauma.

Soft-tissue erythema and swelling associated with pain with no history of a traumatic event may be infective or related to an acute arthritic condition such as gout, osteoarthritis, rheumatoid arthritis, or tendonitis like de Quervain's or intersection syndrome. Ideally, patients with these conditions should be seen in an outpatient clinic, but in some cases are seen in the ER.

Lacerations may damage deep underlying structures such as tendons, nerves, and arteries. Bruising and swelling following a fall on an outstretched hand or blunt trauma may indicate an underlying fracture. Distal radius fractures may present a characteristic "dinner fork deformity" of the wrist (see Fig. 2-1), while metacarpal fractures are commonly accompanied by dorsal hand swelling and range of motion limitation. Fractures of the carpal bones do not normally produce significant bruising or swelling, and hence can easily be overlooked.



Fig. 2-1. Dinner fork deformity seen in a Colles fracture

## **(2) Palpation**

Palpation of the wrist is one of the best ways of getting a diagnosis of an acute wrist problem. Pain may indicate several underlying pathologies,

including fractures, ligament injuries, tendonitis, infection, or inflammation. The examination is refined in combination with history and imaging. If an underlying fracture is suspected, it is prudent to request a radiograph before palpation as the examination may be very painful. Bony crepitus is indicative of a fracture. Subcutaneous crepitus in the presence of infection suggests a possible necrotizing infection and is a surgical emergency.

There are some important landmarks in the wrist that aid examination, summarized in Fig 2-2. The physical exam of the wrist can be divided into radial, dorsal, ulnar, and palmar examinations. Knowledge of the structures in these zones of the wrist greatly simplifies diagnosis.

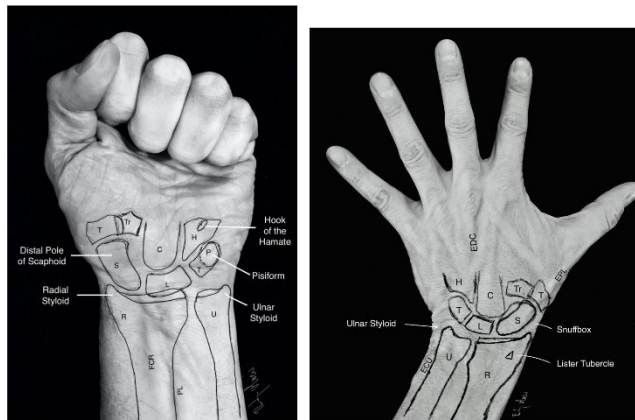


Fig. 2-2. Soft Tissue and bony landmarks of the wrist

### Radial wrist examination

- Scaphoid – can be palpated in the anatomical snuffbox, dorsal proximal pole just distal to the Listers Tubercle, and at the scaphoid tuberosity located at the palmar aspect of the wrist radial to the FCR (see Fig 2-2). Tenderness at the snuffbox area will suggest a scaphoid fracture. If X-rays are negative the patient should be evaluated two weeks after the emergency-room visit to rule out an occult nondisplaced scaphoid fracture, which may require a CT scan or MRI.
- Radial styloid – palpation of the bony prominence on the radial side of the wrist. After a traumatic event without evident deformity of the wrist, positive tenderness in this area can represent a nondisplaced distal radius fracture.

- Dorsal rim of the distal radius/Lister's Tubercle – tenderness in this area can represent a fracture or radio-scaphoid arthritis commonly seen in patients with scapholunate advance collapse.
- Scaphotrapezotrapezoidal joint (STT) – the STT joint can be palpated between the bases of the first and second metacarpals at the dorsum of the hand and the volar aspect just distal to the pole of the scaphoid (see Fig 2-2). Pain here may be suggestive of a distal pole of the scaphoid or trapezium fracture (see Fig 2-5). It can also indicate an exacerbation of a previously existing osteoarthritis following a fall on an outstretched hand.
- First carpometacarpal joint – located at the base of the thumb, this is evaluated by stabilizing the trapezium and performing radial and ulnar displacement of the first metacarpal (see Fig 2-3). Tenderness may indicate a fracture of the first metacarpal base or the trapezium, or an exacerbation of CMC arthritis.



Fig. 2-3. First CMC grinding test. Trapezium stabilized with thumb and middle fingers and palmar/dorsal, and rotation of the thumb performed

- First dorsal compartment – containing the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons. Tenderness here may indicate de Quervain's tenosynovitis in the absence of trauma or fracture. This diagnosis can be reassured using Finkelstein's test (see Fig 2-4).



Fig. 2-4 Finkelstein's Maneuver



Fig. 2-5. Trapezium Fracture with subluxation of first metacarpal

- Superficial radial nerve – paraesthesia in the radial sensory island suggests injury to this nerve or compression at the level of the Brachioradialis and second extensor compartment (Wartenberg's Syndrome).

### **Dorsal Evaluation of the Wrist**

- Second dorsal compartment – contains the extensor carpi radialis longus and brevis (ECRL & ECRB). Tenderness 4–5 cm proximal to the radiocarpal joint associated with crepitus suggests the diagnosis of intersection syndrome. The level of pain and tenderness is where the first dorsal compartment intersects with the second extensor compartment. Resisted wrist and thumb extension elicits pain, and a subtle “squeak” can be noticed in these patients.
- Third dorsal compartment – containing the extensor pollicis longus (EPL) tendon. To confirm the integrity of the EPL tendon, ask the patient to lay their hand flat on the table and raise their thumb. If the patient is unable to perform this action it indicates an EPL rupture. Seen in patients with traumatic lacerations or previous distal radius fractures with or without fixation.
- Fourth and Fifth Extensor Compartment – evaluation of the extensors is done by flexing and extending the fingers. An extension deficit of the metacarpophalangeal joints can be observed with lacerations of these tendons.
- Dorsal rim of the distal radius and Lister’s Tubercle – tenderness in this area may indicate a nondisplaced fracture in patients without an obvious deformity. Patients with perilunate dislocations will present with tenderness and swelling at the dorsal area of the wrist and pain with a minimal attempt of wrist motion. X-rays will reveal abnormal Gilula arcs (see figs. 2-6 and 2-7). Impingement of the scaphoid on the radius with wrist extension is commonly seen with radioscaphoid osteoarthritis.



Fig. 2-6. Normal Alignment of Gilula's Arcs

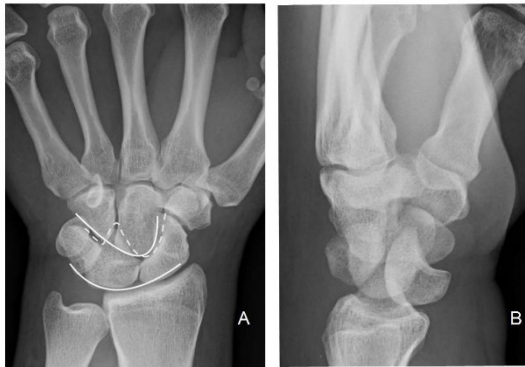


Fig. 2-7. A perilunate dislocation – note the disruption of Gilula's arc in the PA View (A) and the misalignment of the lunate with the capitate in the lateral view (B)

- Scapholunate (SL) interval—located 1 cm distal to Lister's Tubercle. Tenderness may suggest the presence of ganglion cysts or scapholunate ligament (SLL) injuries. The SL interval should be palpated with the wrist in the neutral position and during wrist flexion. Occult ganglions sometimes become evident when the wrist is flexed.
- Capitate – palpation may reveal tenderness indicative of fractures, or arthritis of the lunocapitate joint.