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Clinical Orthopaedic Diagnosis

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Anil Kumar Pandey

5th Edition

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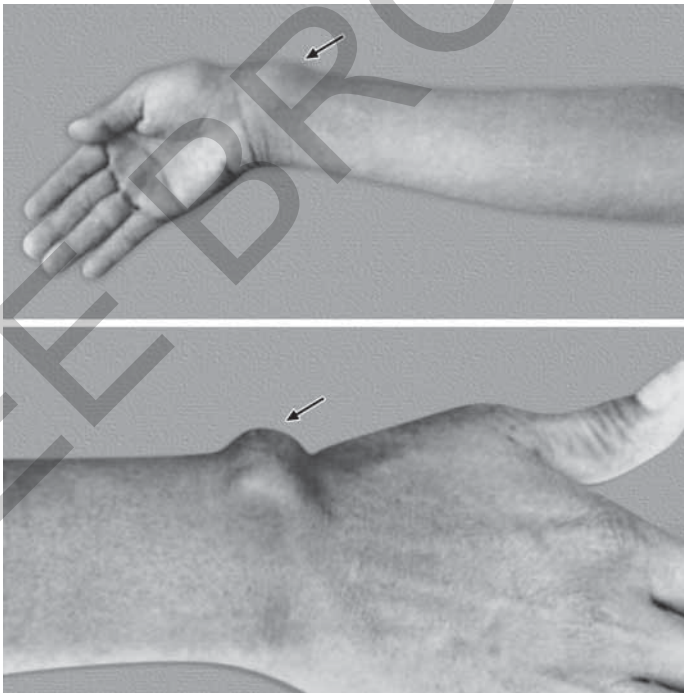
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CHAPTER 6

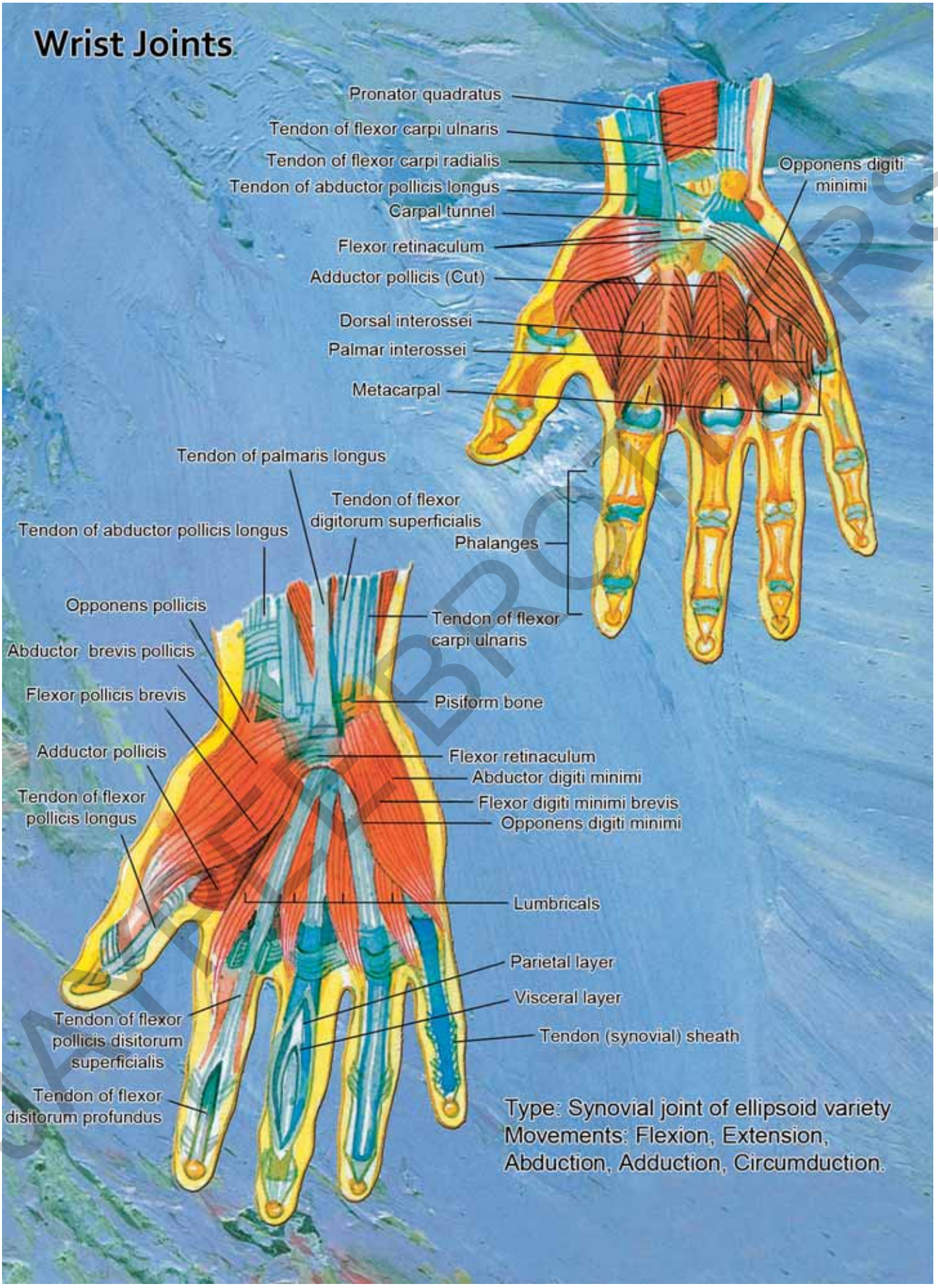
Wrist Joints



"Everyone thinks of changing the world, but no one thinks of changing himself."
—Leo Tolstoy

"Worry is like any other disease that attacks the weak and the confused."
—PP Wangchuk

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INTRODUCTION

The movements at the wrist are mainly oriented to facilitate the grip and finer movements of the hand.

For all practical purposes, in clinical assessment the local examination of the wrist, which lies in between the forearm and the hand, must include them.

ANATOMICAL CONSIDERATION

For practical considerations, the wrist should include the distal radioulnar, radiocarpal and ulnocarpal joints along with eight carpal bones and their proximal and distal articulations.

The *wrist joint proper is the articulation of the lower articular end* (concave in anteroposterior as well as lateral directions) *of the radius and the inferior surface of the triangular fibrocartilage* (extending from the medial margin of the lower end of the radius to a pit on the lateral surface of ulnar styloid process above its tip, i.e. from the rim of the sigmoid notch of radius to the ulnar styloid process) *at the proximal end.* The distal convex articulating surface consists of the curving sides of three carpal bones of the proximal row, the navicular, lunate and triquetrum (from radial to ulnar side). Since the pisiform lies on the palmar aspect of triquetrum, it is excluded from the articulation and it can be palpated as a bony prominence on the ulnar side of proximal palm, just distal to the prominent palmar crease and proximal to the base of hypothenar eminence. The intercarpal articulations *(carpals arranged in two rows in first row scaphoid, lunate, triquetrum and pisiform and in second row trapezium, trapezoid, capitate, and hamate)* participate in all movements of the wrist joint. Occasionally (about in 2%) accessory carpel bones are present – like commonly present "os centrale" amidst trapezoid, capitate and scaphoid (Gray 2008).

The synovial reflections of the wrist and the intercarpal joints are intercommunicating. As around the ankle, the wrist also has important hand-fingers-thumb controlling tendons around it, but for a difference that on the palmar aspect, just above the wrist level, the stamp-like stout pronator quadratus muscle binds the lower ends of the radius and ulna.

The lower ends of the radius and ulna articulate as a pivot joint to form the inferior radioulnar joint. Which is anatomically a diarthrodial synovial joint consisting of two parts – The bony radioulnar articulation and soft tissue stabilizers (Hagert 2010). Here, the lower end of the radius along with the triangular fibrocartilage revolves around the head of ulna. This synovial joint has its continuity with the wrist joint, therefore, this joint is likely to be affected simultaneously in all affections of the wrist proper.

The *articular surface of the distal aspect of radius* tilts 21° in the anteroposterior plane and 5–11° in the lateral plane.

The scaphoid, trapezium, first metacarpal, and thumb phalanges function conjointly as an independent unit—like 'a jointed strut.' The joints of this strut are vulnerable to degenerative arthrosis.

The dorsal cortical surface of the radius thickens to form the Lister tubercle and osseous prominences which support the extensors of the wrist in the second dorsal compartment.

On the dorsal aspect of the wrist, just beneath the extensor retinaculum (more or less blended with the dorsal capsule of the wrist joint) the following tendons are arranged in a definite order. *There are six fibro-osseous compartments lodging the following tendons* (from dorso-lateral to dorso-medial direction) **(Fig. 6.1)**.

- First compartment—Abductor pollicis longus and extensor pollicis brevis;
- Second compartment—Extensor carpi radialis longus and extensor carpi radialis brevis;
- Third compartment—Extensor pollicis longus;
- Fourth compartment—Extensor indicis and extensor digitorum;
- Fifth compartment—Extensor digiti minimi;
- Sixth compartment—Extensor carpi ulnaris.

In the fourth compartment, deep to the tendons, the posterior interosseous nerve ends as a pseudoganglion and the anterior interosseous artery ends anastomosing with the fine local articular arteries. Each compartment has a double blind ending synovial sheath around the tendon. Proximally, the sheaths extend to a variable extent and distally they end beyond the retinacular extension.

On the palmar aspect, however, none of the tendons are directly bound to the wrist surface (as on the dorsal surface) because of: (i) intervention by pronator quadratus, (ii) concave surface of the lower end of radius, and (iii) lack of separate fibro-osseous compartments which would prevent the tendons from bowstringing during flexion.



Fig. 6.1: Showing the fibro-osseous compartments on the dorsal aspect of the wrist with their contents: 1. Abductor pollicis longus and extensor pollicis brevis; 2. Extensor carpi radialis longus and brevis, 3. Extensor pollicis longus; 4. Extensor indicis, extensor digitorum, anterior interosseous artery ending and posterior interosseous nerve ending in pseudoganglion; 5. Extensor digiti minimi; 6. Extensor carpi ulnaris.

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However, four tendons can be palpated and even seen, when the fingers are slightly flexed and muscles on flexor side are made tense. Three tendons (from ulnar to radial side)—flexor carpi ulnaris, palmaris longus and flexor carpi radialis—are apparently prominent in most of the person **(*see* Fig. 6.42)**. When the fist is clenched firmly, the tendon of flexor digitorum sublimis also gets prominent between the tendons of flexor carpi ulnaris and palmaris longus.

Of the nerves, the median nerve is in closer relation to the wrist than the ulnar. The median nerve lies in between the tendons of the flexor carpi radialis and flexor digitorum sublimis and on the posterolateral aspect of the palmaris longus tendon. This nerve is likely to suffer with any encroachment of the space in between the flexor retinaculum and the wrist joint, i.e. the carpal tunnel. Normally, *carpal tunnel contains the median nerve and nine flexor tendons*—the four sublimis, four profundus and the flexor pollicis longus tendons.

The ulnar nerve becomes superficial at the wrist level. At about 5 cm above the wrist joint proper, after sending a dorsal cutaneous twig, it passes in front of the flexor retinaculum on the lateral side of the pisiform bone and posterolateral to the musculotendinous mass of the flexor carpi ulnaris where it divides into a superficial and a deep branch. The deep branch continues under cover of the hook of the hamate into the palm **(Guyon's canal)**. Guyon's canal is triangular and lies immediately ulnar to the carpal tunnel in the wrist region. Ulnar nerve and artery traverse the canal, which may be site of ulnar nerve entrapment.

The radial nerve more or less divides into 4 or 5 dorsal digital branches at about the wrist level. Clinically, it is not of much importance, as its cutaneous supply is ultimately limited to a stamp-shaped area on the back of the first web.

The creases around the wrist run almost circumferentially. The radial artery lies quite superficial on the anterolateral aspect of the lower forearm and wrist and it is not likely to be affected in common wrist affections, except for infiltrative neoplasms, glass pan cut and suicidal injuries.

The dorsal or Lister's tubercle lies on the dorsum of the lower end of the radius just lateral and proximal to the central point of the wrist. It provides a pulley-like surface on its medial aspect for the extensor pollicis longus tendon. This tendon, by passing a circuitous route around this tubercle becomes more effective in subserving its important function of extension of the thumb. On the other hand, this tendon, lying in such a close proximity to the bony tubercle, is likely to be affected in any roughness in this area (e.g. rupture of this tendon in Colles fracture).

When the thumb is actively extended firmly, a recess, bounded by the tendons of extensor pollicis longus on the ulnar side and abductor pollicis longus and extensor pollicis brevis on the radial side, becomes obvious at the dorsolateral aspect of root of thumb—it is the *anatomical snuff box*.

Fracture separation of the lower radial epiphysis (cf. Colles fracture in adult) is a very *common injury around the wrist in children.* Due to seen or unseen damage of the growth plate, it may lead to various deformities in this region **(Fig. 6.13)**.

METHODOLOGY

History Taking

In history taking, besides the usual points as mentioned in the Chapter 1, in case of wrist and hand (rather upper limb), the hand dominance, occupation and current work status should also be noted.

In case of trauma, ask about the mode of injury and the part of the limb which first bore the impact of violence. Usually, the wrist is involved in indirect injuries, seldom by direct violence.

General and Systemic Examinations

(*See* the Chapter 1 'Introduction')

Regional Examination

It includes overall assessment of the forelimb of the affected side with its connections to the central axis, both anatomically and neurologically. It is obligatory to examine the cervical spine, supraclavicular region, shoulder girdle, supracondylar region, elbow, forearm and up to the tip of the fingers while assessing the wrist joint.

Local Examination

Prerequisites

Both wrists must be fully exposed and examined simultaneously keeping them in identical position as far as possible, while the patient sits comfortably on a stool.

Attitude

Note any fixed attitude of the wrist and hand **(Figs. 6.2 to 6.14)**. Certain typical attitudes are significant, e.g. dinner fork deformity (or silver fork deformity) of Colles fracture; congenital manus valgus of Madelung's deformity (forward and ulnar curving of lower end of radius due to growth disturbance at the ulnar-palmar aspect of distal radial physis)—**(Otto Madelung, 1878—Figs. 6.7 and 6.8)**, arrow head deformity in diaphyseal aclasis (usually seen in X-ray **(Fig. 6.6)**, flexion and ulnar/radial deviation of the wrist and ulnar deviation of the fingers in rheumatoid arthritis; hourglass swelling on the palmar aspect both above and below the flexor retinaculum in compound palmar ganglion **(Figs. 6.15 and 6.16)**; wrist drop **(Figs. 16.19 and 16.20)** in radial nerve palsy. In established severe Volkmann's ischaemic contracture **(*see* Fig. 5.23)**, there is a striking flexion contracture of the wrist and fingers due to the shortening of the fibrotic forearm flexor muscles. The post-burn contractures **(Fig. 6.2)** vary according to contracted structure.

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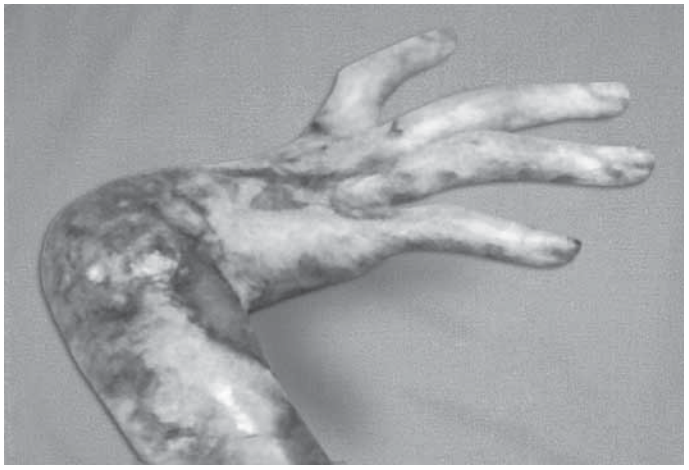


Fig. 6.2: Post-burn contracture of wrist.



Fig. 6.3: Congenital disorganised wrist and hand.



Fig. 6.4: Early post-corrective picture of the same patient **(Fig. 6.3).**

Inspection

Inspect both wrists (for comparison) in symmetrical position from the sides, dorsal and palmar aspects for asymmetry, swelling, tenderness, deformities.



Figs. 6.5A and B: Congenital club hand with absence of radial ray. Such cases (including congenital absence of radius) can be managed by radialization of ulna, shortening of ulna (which corrects the deformity) and centralization of carpus over the digital end of ulna. These all can be done in one stage and usually provide well acceptable satisfactory result–both functional and cosmetic.

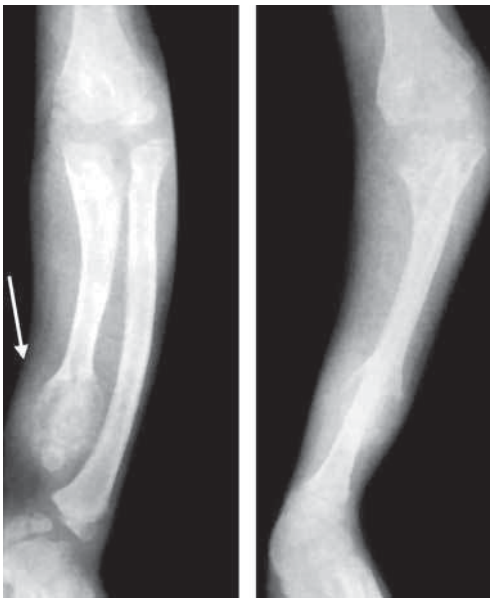
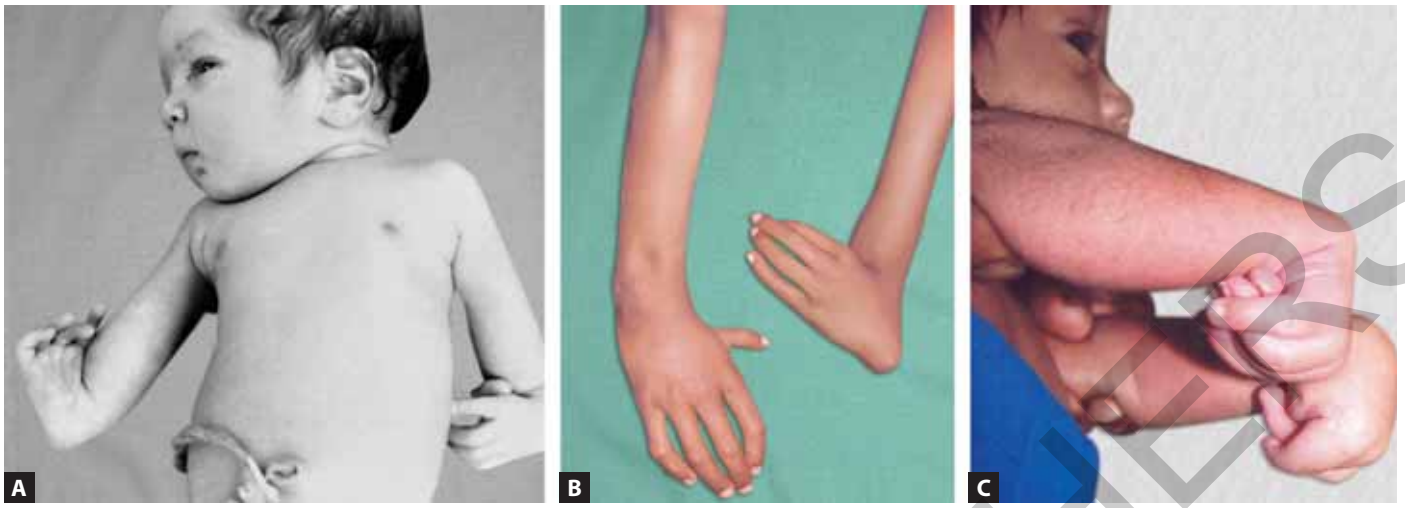


Fig. 6.6: Arrow head deformity of ulna in diaphyseal aclasis.

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Figs. 6.7A to C: (A) Bilateral congenital Madelung's deformity (congenital subluxation of wrist); (B) Congenital solid left upper limb with Madelung's wrist on the left and mild manus valgus on the right; (C) Bilateral congenital flexion contracture of wrist, fingers and thumbs in palm deformity.

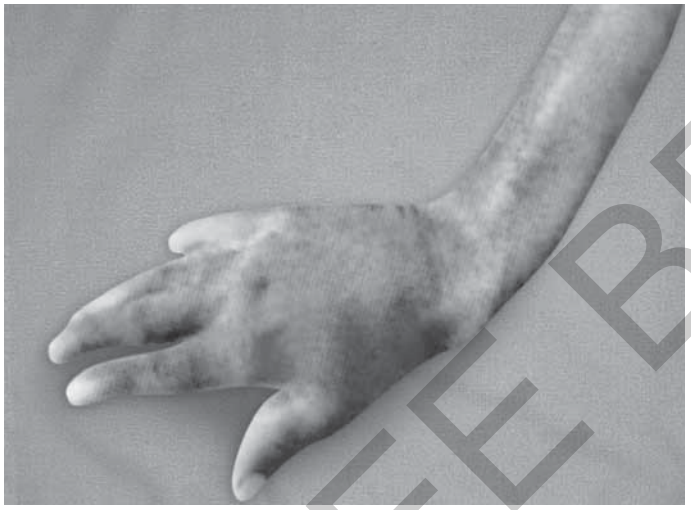


Fig. 6.8: Photograph of deformity due to osteochondroma of lower end of radius.

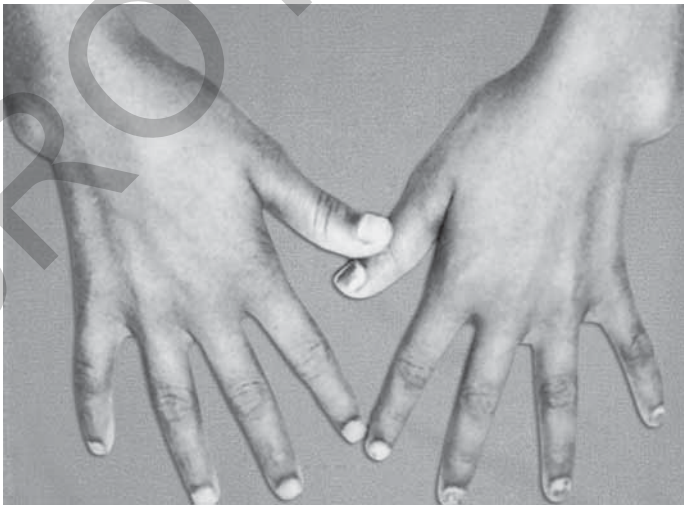


Fig. 6.10: Madelung's deformity.

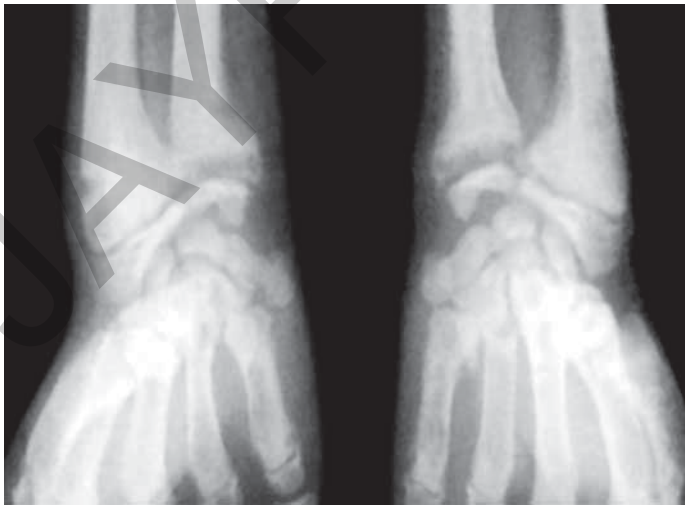


Fig. 6.9: Osteonecrosis in both wrist and hand regions.



Fig. 6.11: Bilateral club hand.

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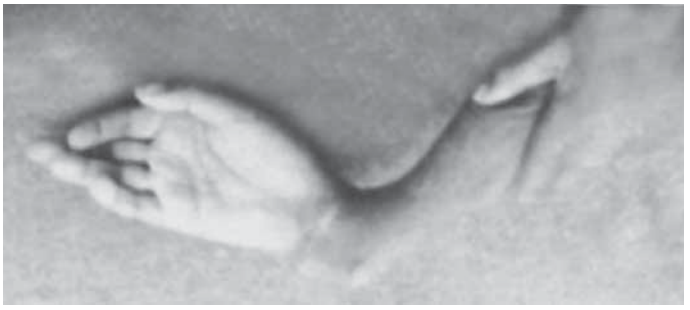


Fig. 6.12: Old epiphyseal injury of lower end of radius leading to premature closure of growth epiphysis and overgrowth of ulna.



Fig. 6.13: Old epiphyseal injury of lower end of radius—premature closure of growth epiphysis and overgrowth of ulna.

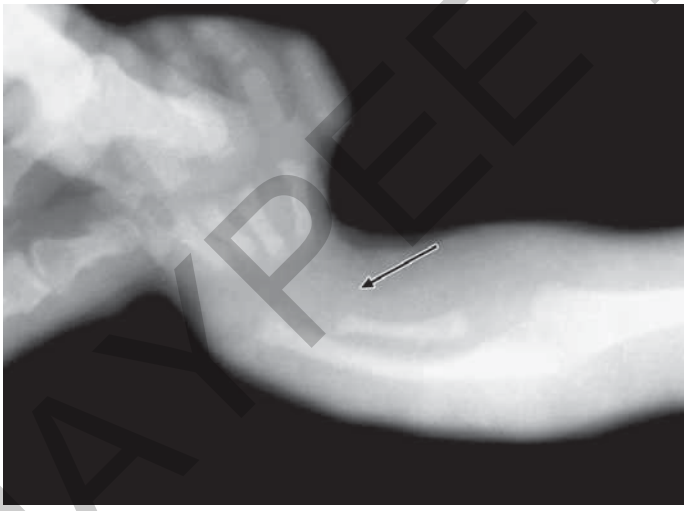


Fig. 6.14: Congenitally deficient distal radius with overgrowth of ulna and supernumerary finger.

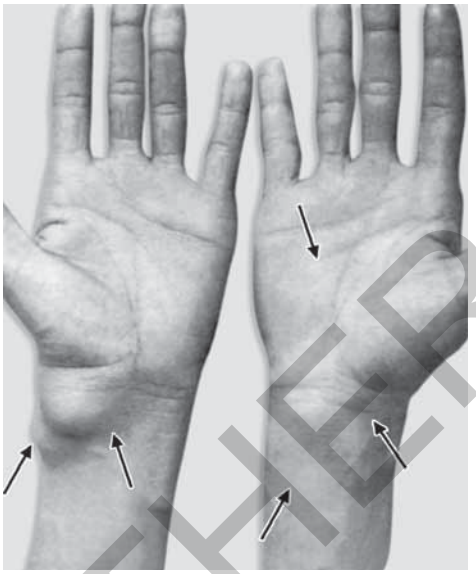


Fig. 6.15: Compound palmar ganglion on the right side and (simple) ganglion on the left side.

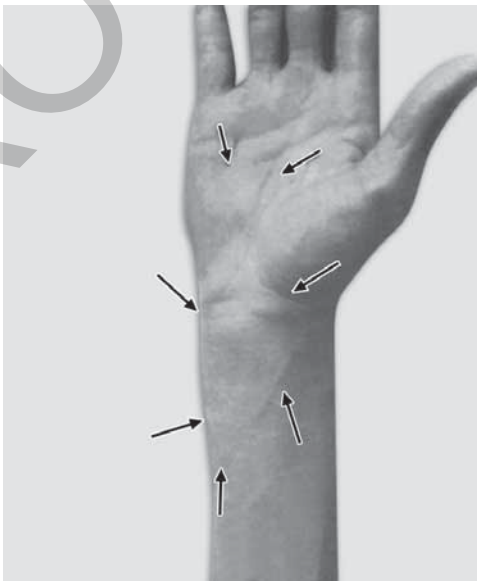


Fig. 6.16: Compound palmar ganglion more marked in oblique position of the wrist.

On the dorsal aspect: Note the normal bony and soft tissue points in systematic order, while the fingers are opened up and the patient attempts to make a fist. Look at the contour of the region, any swelling, skin condition, venous prominence, ulnar styloid prominence, creases around the joint, any swelling in relation to any tendon or the wrist joint [e.g. ganglion **(Figs. 6.15, 6.26A and B)**] and back of the forearm, any sinus, and skin contractures.

On the radial side: Ask the patient to extend the thumb and inspect the *snuffbox* (bounded by abductor pollicis longus and extensor pollicis brevis on the radial side, and extensor pollicis longus on the ulnar side) for any fullness. Note any abnormal prominence on this side of the lower radius—a typical site for de Quervain's disease **(Fig. 6.19)** and giant cell tumour **(Fig. 6.20)**.

On the palmar aspect: Look for the skin creases in relation to thenar and hypothenar eminences and at the wrist level, and note any abnormal finding—e.g. swelling, sinus, atrophy,

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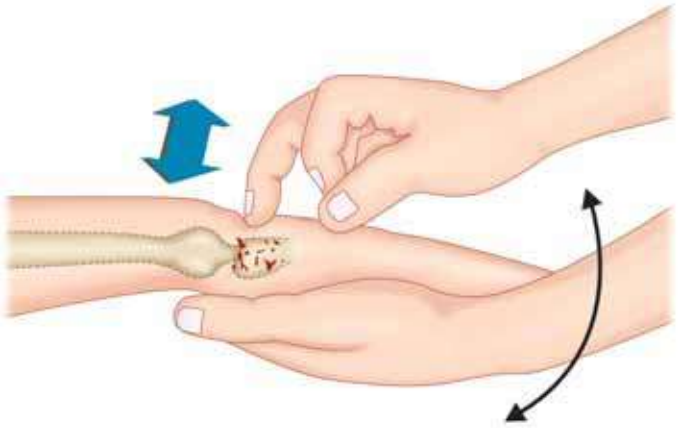


Fig. 6.17: Localisation of wrist joint line.



Fig. 6.18: Septic arthritis wrist with collection of pus projecting below the ulnar styloid process.

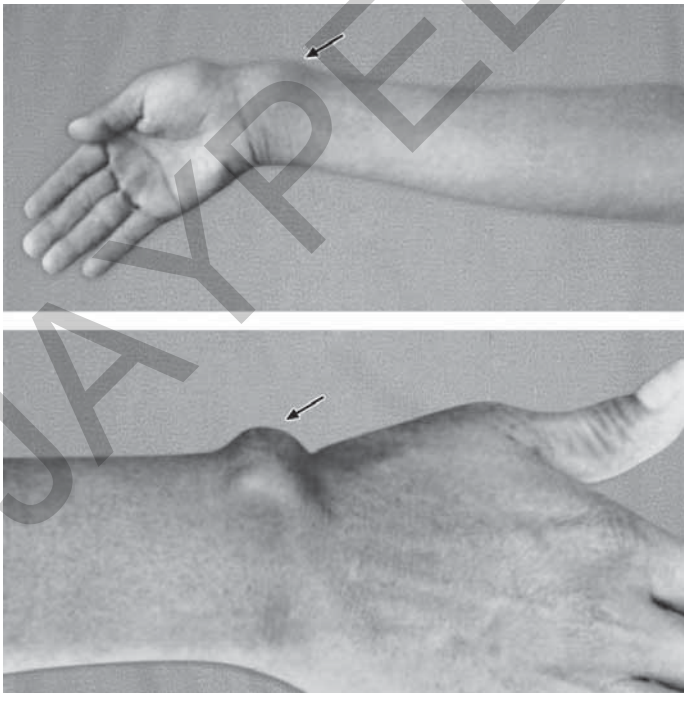


Fig. 6.19: Photographs of de Quervain's disease.

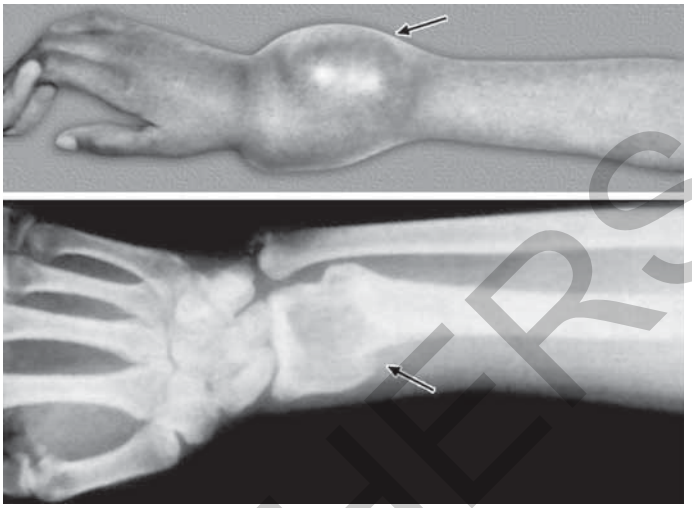


Fig. 6.20: Giant cell tumour from lower end of radius with pathological fracture.

hypertrophy, discolouration (in cervical rib syndrome), fullness in the lower forearm [compound palmar ganglion **(Figs. 6.15 and 6.16)** or Parona's space affections].

On the ulnar side: Look for the hypothenar eminence and muscular bulge of the lower forearm above the wrist. Most of the affections of the wrist, specially injuries, are associated with swelling of the hand components.

Palpation

Superficial palpation: Note the temperature, condition of the skin, any hyper- or hypoanaesthesia, any bony projection, or any other abnormal feature. Note the radial pulse with any variation, if present.

Deep palpation: Certain normal relations must be confirmed before searching for any abnormal findings. Localise the tips of the ulnar and radial styloid processes. Note their levels and compare with the other side. Normally, the tip of radial styloid process lies about 1 cm distal to that of ulnar styloid process.

Method of palpating the styloid processes **(Fig. 6.21)** with the patient's forearm pronated and the wrist in as much neutral a position as possible, support the palm in one hand. Put the thumb and index fingertips of the opposite hand on the two sides of the wrist from the dorsal aspect. In case of the right hand of the patient your right index fingertip should be in the snuffbox and the thumb tip should be distal to the head of the ulna. Gently squeeze within and at the same time shift your fingertips proximally. The pointed bony projections will be felt (the tips of the radial and ulnar styloid processes). Reverse the position of your thumb and index finger for the patient's left hand.

Method to localise the joint line on the dorsum of the wrist **(Fig. 6.17)** Support the patient's wrist on your one hand and put the tip of the index or middle finger of the opposite hand

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Fig. 6.21: Palpating the tips of radial and ulnar styloid processes.

in about the centre of the inter-styloid line. You will feel a gap. Confirm by gently dorsiflexing and palmar-flexing the wrist as far as practicable, the gap will slightly close and open up accordingly. Extend the fingertips along the inter-styloid line while gently moving the wrist joint, and you will assess the wrist joint line. Now, palpate for the presence of any abnormal finding, specially those which you have seen on inspection.

Bony components: Note for any bony irregularities at the lower end and posterolateral surface of the radius and the lower end of the ulna. Any abnormal swelling or bony prominence in front of the wrist should be palpated for its temperature, tenderness, size, shape, texture, consistency, relation to deeper structures and mobility.

Assessment of Instability of Distal Radioulnar Joint

Several patients present with the symptoms of instability of distal radioulnar joint even symptoms after distal radial fractures have healed. They complain of pain and abnormal motion on the ulnar side of the wrist and sometimes feeling of wrist "out of joint" in certain position, which may need manual reduction. Crepitus or clicking may be felt on rotating the forearm. *Ballottement of distal radioulnar* joint should be performed as follows:

Support the front of wrist region on one hand, and with your another thumb press over the ulnar head pushing it anteriorly and release the pressure—the ulnar head will recoil back. Note the anteroposterior excursion range of ulnar head and compare it with the normal side. The range will be more of the affected side and patient may complain of pain.

COMMON SWELLINGS AROUND THE WRIST JOINT

Traumatic

Initially diffuse, soft to hard swelling, later localise as a bony swelling.

Non-traumatic

- Diffuse swelling (soft to cystic):
  - Tuberculosis **(Figs. 6.22 and 6.23)**
  - Rheumatoid arthritis (Refer **Figs. 7.36 to 7.38**)
  - Septic arthritis **(*see* Fig. 6.18)**.
- Localised swellings (either communicating with wrist joint or in relation to any tendon sheath).
  - Ganglion—round, tense, tender cystic swelling containing clear gelatinous fluid usually on dorsal, radial-palmar and ulnar-palmar aspects of the wrist **(Figs. 6.26A to C)**
  - de Quervain's disease—a firm tender swelling about 1.5 cm proximal to the radial styloid process **(Fig. 6.19)**
  - Giant cell tumour—expanded soft to bony hard swelling from lower outer aspect of the radius **(Fig. 6.20)**
  - Compound palmar ganglion—diffuse bulge above and below the flexor retinaculum **(*see* Figs. 6.15 and 6.16)**.

Egg-Shell Crackling

The lower end of the radius is a common site for giant cell tumour. One of its cardinal clinical sign is egg-shell crackling, which is tested by the method of palpation. However, palpation to demonstrate egg-shell crackling should be avoided, since it may break the thinned out cortex through which the tumour tissue can leak out in the surroundings.

Step Sign

In case of injury, note for the step sign **(Figs. 6.27A to C)**. Pass down your index finger on the outer aspect of the forearm over the rounded radial shaft. In case of outer shift of the lower fractured fragment, your finger will suddenly step over the hard underlying structure. This 'stepping' can be felt in similar circumstances on the dorsal aspect too. This 'step sign' is of special importance in ascertaining the shift in *Colles* (posterior stepping up) and *Smith's* or *reverse Colles fractures* (posterior stepping down).

Palpation of the Snuffbox

Snuffbox lies just distal to the radial styloid process. Its radial border is formed by the abductor pollicis longus and extensor pollicis brevis tendons and ulnar border by the extensor pollicis longus tendon. The floor of snuffbox is the scaphoid bone.

Palpate carefully the snuffbox, specially in case of fall on outstretched hand. Ask the patient to extend and abduct the thumb as far as possible (thumb up position). Supporting the wrist from the ulnar side in one hand, press deeply at the floor of the snuffbox, in between the prominent tendons, and note for tenderness which usually occurs in scaphoid

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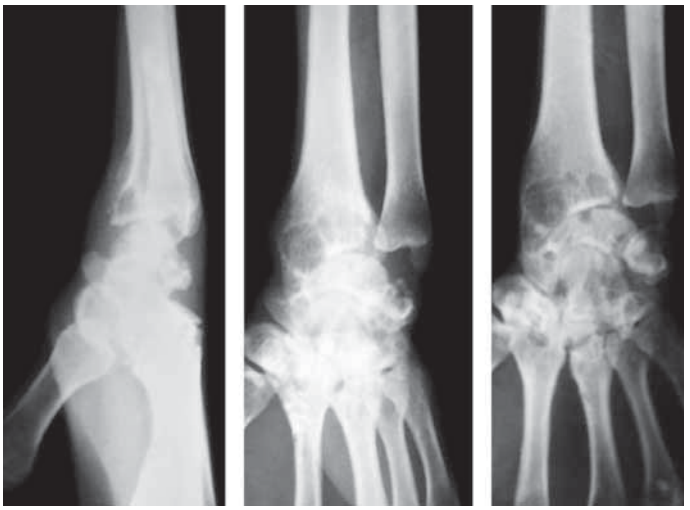


Fig. 6.22: Tuberculosis of the wrist joint with main osseous foci in lower end of radius, styloid process and scaphoid.

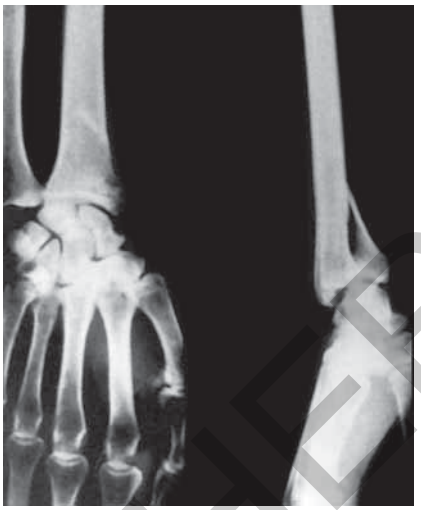


Fig. 6.24: Barton's fracture.

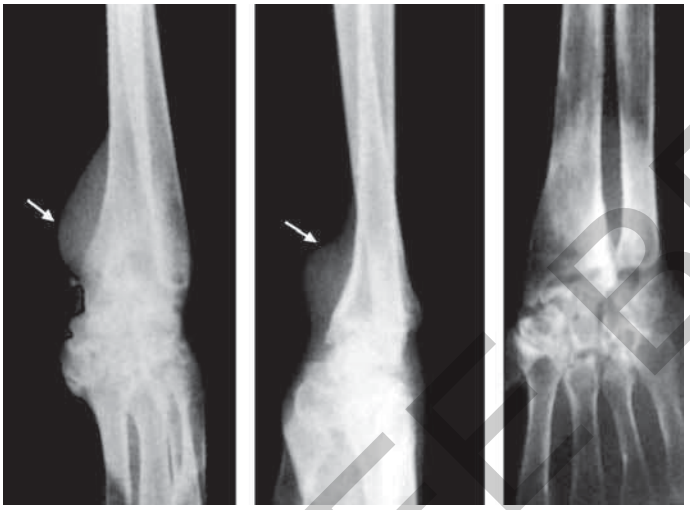


Fig. 6.23: Tuberculosis of the wrist joint with cold abscess presenting anteriorly.

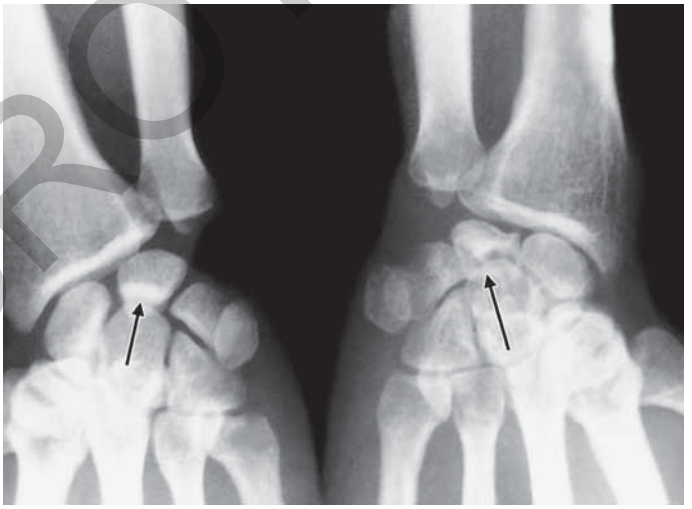
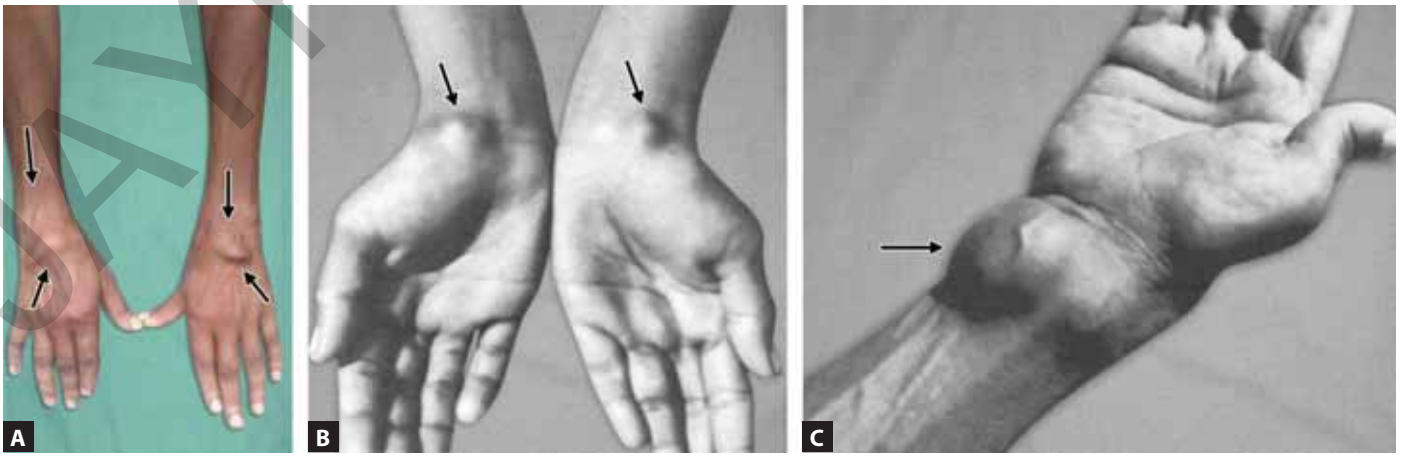
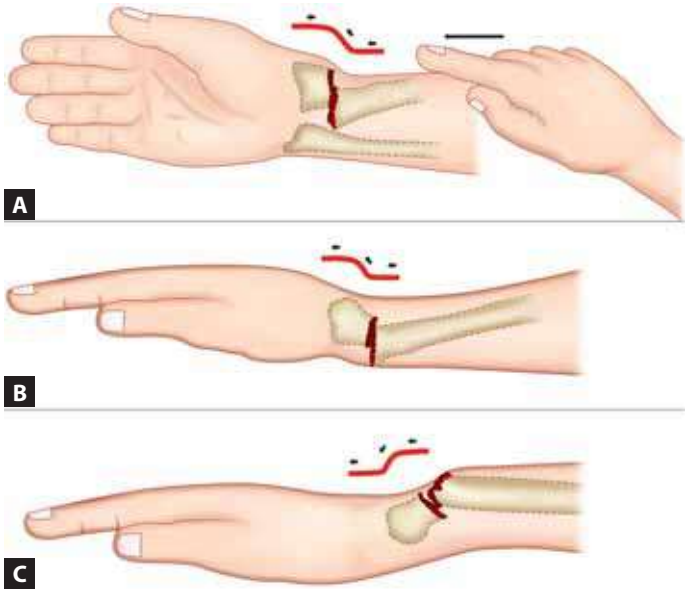


Fig. 6.25: Kienbock's disease.



Figs. 6.26A to C: (A and B) Ganglion on dorsal and ventral aspects of both wrists; (C) Ganglion on ventral aspect of lower forearm.

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Figs. 6.27A to C: (A) Lateral step up; (B) Posterior step up—Colles fracture; (C) Posterior step down—Smith's fracture.

fracture (in case of trauma) or osteoarthritis of the wrist or intercarpal joints.

Crepitus

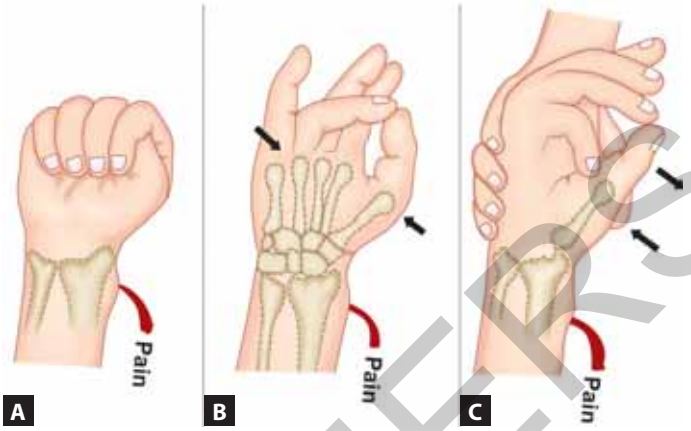
In a suspected case of fracture of the lower end of radius or ulna, note, if per chance crepitus is felt. Do not try to demonstrate it, even though it is diagnostic of fracture, since the manoeuvre for demonstrating crepitus is likely to break the fringes of fractured ends and thus can delay the healing of fracture.

Scaphoid shift test (Watson et al. 1988) is useful in evaluating the stability of scaphoid in an injured wrist. It involves radial deviation of the wrist with examiner's thumb opposing the normal palmar rotation of the distal scaphoid leading to the dorsal shift of scaphoid. The test is graded according to the degree of subluxation of the scaphoid and the pain felt on the dorsum of the wrist during the test.

Test for de Quervain's Disease (Chronic Stenosing Tenosynovitis)

Any suspicious swelling existing at the lower outer end of forearm, may be due to de Quervain's disease. Chronic inflammation involves all layers of tendon sheaths of abductor pollicis longus and extensor pollicis brevis. Palpate for the local tenderness. Ascertain the relation of pain with strained movements of the thumb. Test as in **Figures 6.28A to C.**

- Ask the patient to make a firm fist, keeping the thumb in palm. The patient will complain of pain just above the radial styloid process **(Fig. 6.28A)**
- In demonstrating Finkelstein's test, the patient makes a fist keeping thumb in palm. While stabilising the patient's forearm, the hand is pressed into ulnar deviation. There should be pain or extreme discomfort over the radial styloid process or anatomical snuff box or even towards the thumb and/or elbow, if the test is positive, i.e. there is *tenosynovitis of abductor pollicis longus and extensor pollicis brevis tendons.* However, even without de Quervain's disease, variable pain can be felt in that region in this manoeuvre
- While the patient keeps his thumb in opposed position towards the ring fingertip, press over the heads of 1st and 4th metacarpal with a springing action—the patient complains of pain on the outer surface of the radial styloid **(Fig. 6.28B)**.
- In the same position, ask the patient to extend and abduct the thumb against resistance. The patient will feel pain at the same site **(Fig. 6.28C).**



Figs. 6.28A to C: Tests for de Quervain's disease. (A) Closing firm fist triggers pain; (B) Springing over 1st and 4th metacarpal head triggers pain; (C) Active abduction and extension of thumb against resistance triggers the pain.

MOVEMENTS (TABLE 6.1)

Movements of the Forearm

The movements of the forearm joints result in pronation and supination of the hand. In pronation, the radius, carrying the hand with it crosses obliquely the front of ulna, so that radial upper end remains lateral, and medial end goes medial to ulna. In supination, the movement is reversed so that radius lies lateral to and parallel with the ulna. These movements occur at the **radioulnar joints:** (1) *Proximal synovial uniaxial pivot radioulnar joint* where the radial head rotates in fibro-osseous ring formed by radial notch of ulna and the annular ligament, (2) *Middle radioulnar union,* in which shafts of radius and ulna are connected by oblique cord and the interosseous membrane of the forearm; (3) *Distal synovial uniaxial pivot radioulnar joint* where there is articulation between the convex ulnar head and the concave ulnar notch on the lower medial aspect of radius.

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TABLE 6.1: Normal movements at wrist.

Movement	*Range of movement*	*Prime movers*	*Nerve supply*	*Assisted by*	*Limiting factors*
Palmar flexion	0° to 70°–90°	• Flexor carpi radialis • Palmaris longus • Flexor carpi ulnaris	• Median nerve C6 • Ulnar nerve C8 T1	Flexor digitorum profundus, flexor digitorum superficialis	Tension of dorsal radiocarpal ligaments
Dorsiflexion	0° to 70°–90°	• Extensor carpi radialis longus • Extensor carpi radialis brevis • Extensor carpi ulnaris	Radial nerve C-6 C7	Extensor digitorum, extensor indicis, extensor pollicis longus, extensor digiti minimi, extensor pollicis brevis	• Tension of volar radiocarpal ligaments • Contact of dorsal surface of distal row of carpals to the posteriorly projected lower end of radius
Ulnar deviation	0° to 25°–35°	• Flexor carpi ulnaris • Extensor carpi ulnaris	• Ulnar nerve C8 T1 • Radial nerve C6 C7		• Tension of lateral collateral ligament of wrist joint • Contact of ulnar styloid process to the hamate
Radial deviation	0° to 15°–25°	• Flexor carpi radialis • Extensor carpi radialis longus • Extensor carpi radialis brevis	Median nerve C6 Radial nerve C6 C7	Abductor pollicis longus, extensor pollicis brevis	• Tension of ulnar collateral ligament of wrist • Contact of tip of radial styloid process to the scaphoid

For pronation—Pronator quadratus (supplied by anterior interosseous branch of median nerve, C8, TI) aided by pronator teres (supplied by median nerves, C6–C7) is responsible for rapid movement and movements against resistance.

Supination—In extended elbow for slow and unresisted supination movement, supinator may be sufficient but in flexed elbow, fast movements and movement against resistance biceps brachii (supplied by musculocutaneous nerve, C5–C6) assists the supinator (supplied by posterior interosseous nerve, C5–C6).

In *relaxed posture (anatomical rest) of the hand*, usually, the wrist is slightly extended and fingers and thumb variably flexed—the index finger is less flexed than others. In inflammation or injury of the hand, almost similar posture of hand is assumed to avoid painful tension on the involved structures, however, there may be some variation according to the tissue affected.

Palmar Flexion and Dorsiflexion (Fig. 6.29)

Method of Demonstration

The patient sits with both mid-pronated forearms supported on the table on their ulnar sides and kept parallel about 10–12" apart. The thumb and fingers are fully extended, while the forearms are firmly fixed on the table. The patient is then asked to bring his fully extended fingers towards each other in the midline as far as practicable. The outer angle subtended between the axis of the forearm and that of the hand is the angle of maximum palmar flexion. Bringing back to the zero position, the patient is asked to move the hand with fully extended fingers away from each other as far as practicable. The inner angle between the axis of the forearm and that of the hand is the angle of maximum dorsiflexion.

A quick method of comparison of dorsiflexion and palmar flexion is as follows:

Oppose the fully stretched up hands (finger-to-finger contact) and lift the elbows as far as possible. The angle sustained between the axis of the forearm and that of hand is the angle of maximum dorsiflexion. Next, the backs of the stretched hands are opposed while the elbows are depressed as far as possible, together. The angle subtended between the axis of the forearm and that of the hand will be the angle of maximum palmar flexion. However, in these manoeuvres, movement is not only at the radiocarpal joint but also includes the intercarpal and carpometacarpal joints.

Radial and Ulnar Deviation (Fig. 6.30)

The patient sits with both forearms and hands kept parallel and fully pronated about 30 cm apart on the table, the fingers and thumbs being kept fully extended. From this zero position, ask the patient to approximate the tips of extended middle fingers towards the midline as far as practicable. The outer angle between the axis of the forearm and that of the extended hand will be the angle of maximum radial deviation.

Ask the patient to move the extended fingers away from the midline as far as practicable. The inner angle between the axis of the forearm and that of the extended hand will be the angle of maximum ulnar deviation.

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