INTRODUCTION

The human hand is a highly sophisticated tool of sensibility and prehension. The functional perfection of brain and hand coordination has permitted man to control his environment. It is a sensor that receives information from the environment–sharp/dull, smooth/rough, hot/soft, with such sensitivity that the blind can "read" with their fingertips. This tool can undertake an ultimate variety of prehensile tasks. The hand is also an organ of expression, be it a simple gesture, a parent's loving touch to a sleeping child's brow, or the speech for the deaf. If hand injury or disease occurs, it afflicts both the sensory input and the motor output of this marvelous tool. As a result, people with hand disorders can be uprooted from their career and lifestyle-unable to play a trade, to work a job, to care for a family, or to compete in sports [(1)].

Each digit of the hand can be viewed in manner analogous to an entire limb, given it's compliment of structures; yet no where else in the body does function follow form as closely as the hand. The precesion and stability of its small articulations, the fine balance between its extrinsic and intrinsic motors, and the complex tendon mechanisms gliding on their diaphanous beds demand stable, aligned, supporting skeleton. Charnley recognized this when he stated that "the reputation of a surgeon may stand as much in jeopardy from this injury [phalangeal fracture] as from any fracture of the femer” [(2)].

Fractures involving the tubular bones of the hand are the most frequent of all skeletal injuries. They constitute more than 10% to 20% of all traumas seen in the emergency room [(3)].

Hand fractures are considered one of the commonest sources of malpractice complaints. Despite of their evident importance, they are often regarded as trivial injuries and are neglected.[10]On average, each year in the United States, more than one third of all injuries involve the upper extremity. While the hand alone suffers from 1.5 million fractures and almost 6 million open wounds each year [(2)].

The ultimate goal of treatment of fracture metacarpals and phalanges is restoration or preservation of function. To achieve this goal the physician must choose a method to achieve and maintain reposition of the fracture, alignment and articular congruity that will offer the least soft tissue damage and accelerate the mobilization of the injured part by early achievement of fracture stability [(4)].

The choice of the method of treatment depends on a variety of clinical and radiological factors. They include fracture related factors as location, pattern, deformity, soft tissue involvement, articlar involvement and stability as well as patient related factors as age, occupation. Socioeconomic status, motivation and presence of other associated injures or medical condition. Other factors that should be considered include available equipment and surgeon's skills. Although failure to gain union with phalangeal and metacarpal fracture s is unusual, the preservation of angular or rotational deformity, tendon adhesion, or articular dysfunction continues to challenge even the most experienced surgeon [2].

Aim of the Work

The aim of this study is to evaluate and manage different types of fractures short long bones of hand and follow up of these cases.

Chapter One

ANATOMY AND BIOMECHANICS

No other area of the body has such a three-dimensional complex of tissues involving all the major systems-bones, joints, tendons, vessels, nerves and skin and subcutaneous tissue-compacted into such small volume and yet functioning as a machine of precision and power, as the hand [(5)].

The skeleton of the hand

Is formed of 3 segments ***Fig (1)***

1- The carpus (or wrist bones).

2- The metacarpus (or bones of the palm).

3- The phalanges (or bones of the fingers).

The scope of the study is for the metacarpals and phalanges

The Metacarpus

These are five cylindrical bones, which are numbered from the lateral side (ossa metacarpalia I-V); each consists of a body and two extremities. The metacarpal shafts radiate like spokes of a wheel, terminating in the bulbous articular heads, which are weakly, joined by transverse metacarpal ligaments [(6)].

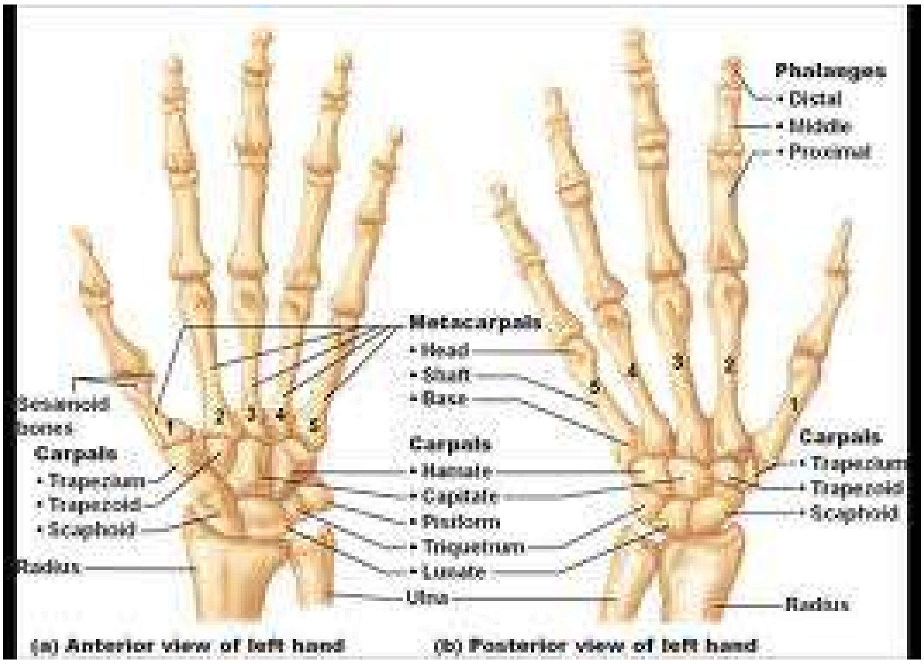

Fig. (1): Bones of Lt wrist & hand. Anterior and posterior views.

- ***Common Characteristics of the Metacarpal Bones***

The Body (shaft):

The body is prismoid in form, and curved, so as to be convex in the longitudinal direction behind, concave in front. It presents three surfaces: medial, lateral, and dorsal**.** The medial and lateral surfaces are concave, for the attachment of the Interossei separated from one another by a prominent anterior ridge. The dorsal surface presents in its distal two-thirds a smooth, triangular, flattened area, which is covered in the fresh state, by the tendons of the extensor muscles. This surface is bounded by two lines, which commence in small tubercles situated on either side of the digital extremity, and, passing upward, converge and meet some distance above the center of the bone and form a ridge, which runs along the rest of the dorsal surface to the carpal extremity. This ridge separates two sloping surfaces for the attachment of the Interossei dorsales. To the tubercles on the digital extremities are attached the collateral ligaments of the metacarpophalangeal joints [(7)].

The Base or Carpal Extremity (basis):

It is of a cuboidal form, and broader behind that in front, it articulates with the carpus, and with the adjoining metacarpal bones; its dorsal and volar surfaces are rough, for the attachment of ligaments.

The Head or Digital Extremity (capitulum):

It presents an oblong surface markedly convex from before backward, less so transversely, and flattened from side to side; it articulates with the proximal phalanx. It is broader, and extends farther upward, on the volar than on the dorsal aspect, and is longer in the antro-posterior than in the transverse diameter. On either side of the head is a tubercle for the attachment of the collateral ligament of the metacarpo-phalangeal joint. The dorsal surface, broad and flat, supports the Extensor tendons; the volar surface is grooved in the middle line for the passage of the Flexor tendons, and marked on either side by an articular eminence continuous with the terminal articular surface [(7)].

- ***<u>Characteristics of the Individual Metacarpal Bones Fig (2)</u>***

The First Metacarpal Bone (metacarpal bone of the thumb):

It is shorter and stouter than the others, diverges to a greater degree from the carpus, Its long axis passes distally and laterally, diverging from the second metacarpal about 45degrees and its volar surface is directed toward the palm. *The body* is flattened and broad on its dorsal surface, and does not present the ridge, which is found on the other metacarpal bones; its volar surface is concave from above downward. On its radial border is inserted the Opponens pollicis; its ulnar border gives origin to the lateral head of the first Interosseous dorsalis. *The base* presents a concavo-convex surface, for articulation with the greater multangular; it has no facets on its sides, but on its radial side is a tubercle for the insertion of the Abductor pollicis longus. *The head* is less convex than those of the other metacarpal bones, and is broader from side to side than from before backward. On its volar surface are two articular eminences, of which the lateral is the larger, for the two sesamoid bones in the tendons of the Flexor pollicis brevis [(8)].

The Second Metacarpal Bone (metacarpal bone of the index finger):

It is the longest, however, as the proximal and especially the middle phalanges of the middle and ring fingers are, longer the index finger is over all shorter**.** Its base is the largest, articulating mainly with the trapezoid and has major articulation with the trapezium, capitate and the third metacarpal base [(8)]**.**

The Third Metacarpal Bone (metacarpal bone of the middle finger): Its base articulates with the capitate and the two adjacent metacarpal.

The Fourth Metacarpal Bone (metacarpal bone of the ring finger): Its base articulates with the capitate and hamate as well as the adjacent metacarpals.

The Fifth Metacarpal Bone (metacarpal bone of the little finger): Its base articulates with the hamate and fourth metacarpal bone [(7)]**.**

- ***Ossification of metacarpal bones***

The metacarpal bones are each ossified from two centers: one for the body and one for the distal extremity of each of the second, third, fourth, and fifth bones; one for the body and one for the base of the first metacarpal bone. The first metacarpal bone is therefore ossified in the same manner as the phalanges, and this has led some anatomists to regard the thumb as being made up of three phalanges, and not of a metacarpal bone and two phalanges. Ossification commences in the middle of the body about the eighth or ninth week of fetal life, the centers for the second and third metacarpals being the first, and that for the first metacarpal, the last, to appear; about the third year the distal extremities of the metacarpals of the fingers, and the base of the metacarpal of the thumb, begin to ossify, they unite with the bodies about the twentieth year [9].

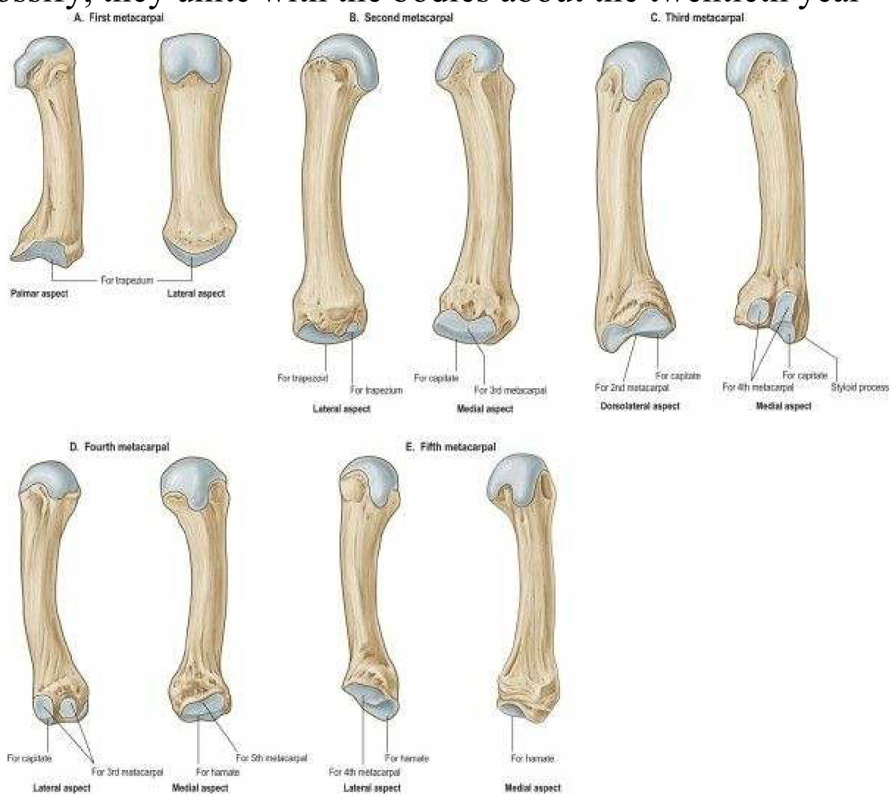

Fig. (2): Individual metacarpal bones [7].

The Phalanges of the Hand

The phalanges are fourteen in number, three for each finger, and two for the thumb. Each consists of a body and two extremities. ***The body*** tapers from above downward, is convex posteriorly, concave in front from above downward, flat from side to side; its sides are marked by rough edge which give attachment to the fibrous sheaths of the Flexor tendons. ***The proximal extremities*** of the bones of the first row present oval, concave articular surfaces, broader from side to side than from before backward. The proximal extremity of each of the bones of the second and third rows presents a double concavity separated by a median ridge. ***The distal extremities*** are smaller than the proximal, and each ends in two condyles separated by a shallow groove; the articular surface extends farther on the volar than on the dorsal surface, a condition best marked in the bones of the first row .The ungual phalanges are convex on their dorsal and flat on their volar surfaces; they are recognized by their small size and by a roughened, elevated surface of horseshoe form on the volar surface of the distal extremity of each which serves to support the sensitive pulp of the finger [7].

- ***Ossification of phalanges***

The phalanges are each ossified from two centers: one for the body, and one for the proximal extremity. Ossification begins in the body, about the eighth week of fetal life. Ossification of the proximal extremity commences in the bones of the first row between the third and fourth years, and a year later in those of the second and third rows. The two centers become united in each row between the eighteenth and twentieth years. In the ungual phalanges the centers for the bodies appear at the distal extremities of the phalanges, instead of at the middle of the bodies, as in the other phalanges. Moreover, of all the bones of the hand, the ungual phalanges are the first to ossify [(10)].

Fig. (3): Radiograph of a hand at 6½ years (male), dorsopalmar projection.

Fig. (4): Radiograph of a hand at 11 years (female), dorsopalmar projection. Note the maturing shapes of all the ossifications previously seen in Figs 3, with the addition of the pisiform.

Muscles of the hand

1- Extrinsic long flexors and extensors

2- Intrensic muscles of the hand

1- Extrinsic long flexors and extensors

A- Long flexor tendon apparatus

Flexor tendon sheaths

The fibrous sheaths of the flexor tendons are specialized parts of the palmar fascial continuum. Each finger has an osseoaponeurotic tunnel which extends from midpalm to the distal phalanx. The thumb has a tunnel for flexor pollicis longus which extends from the metacarpal to the distal phalanx. The proximal border is to some extent a matter of definition, because the transverse fibres of the palmar aponeurosis may be considered to be a part of the pulley system. The sheath consists of arcuate fibres which arch anteriorly over bone, tendons (where the sheath is required to be stiff), and the centres of joints (where a bucket-handle of arcuate fibres is a mechanically favourable arrangement). In contrast, where the sheath is required to fold to permit joint flexion, it consists of cruciate fibres. These fibrous sheaths are lined by a thin synovial membrane which provides a sealed lubrication system containing synovial fluid. The synovial membrane extends from the distal phalanx to midpalm in the case of the index, middle and ring fingers, and further proximally in the case of the little finger (Fig. 5). The sheaths around the thumb and little finger are continuous with the flexor sheaths in front of the wrist. The parietal synovial membrane is reflected onto the surface of the flexor tendon, forming a visceral synovium.

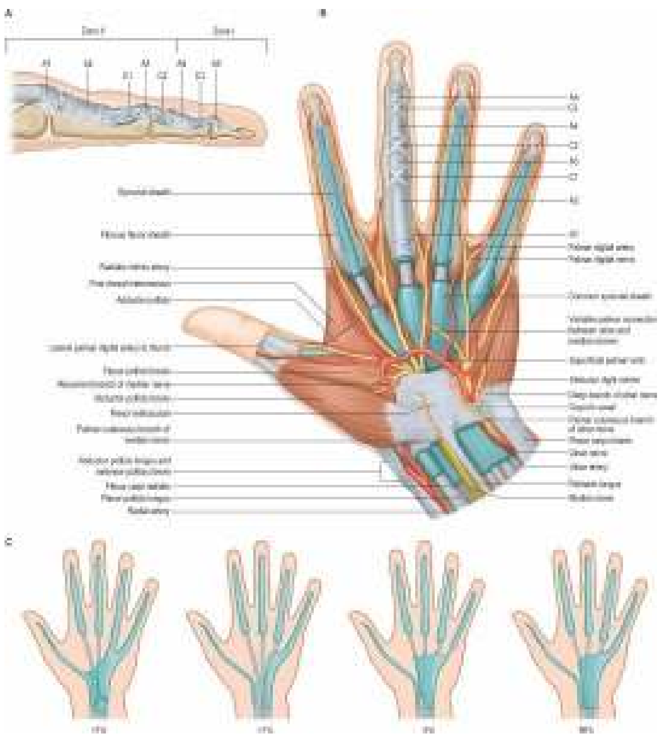

Fig. (5): Synovial sheaths of the tendons and flexor tendon sheaths on the flexor aspect of the left wrist and hand. Where they are exposed, the synovial sheaths are shown in blue. **A**, Lateral view of the anular and cruciate pulleys of the flexor tendon sheath. **B**, Palmar aspect showing the synovial sheaths and details of the anular and cruciate pulleys in the middle finger. Note the extension of the digital arteries and nerves to the end of the middle finger have been omitted to allow clarity in showing the pulley system. **C**, Variation in the arrangement to the synovial sheaths to the digits.

A standard nomenclature for the anular and cruciform pulleys that make up the sheath has been adopted by the American Society for Surgery of the Hand: the letters A and C respectively are used [(11)].

The usual pattern is as follows (Fig. 5). The A1 pulley is situated anterior to the palmar cartilaginous plate of the