

# CONGENITAL ABSENT RADIUS

## THESIS

SUBMITTED IN PARTIAL FULFILLMENT

OF MASTER DEGREE OF

Orthopaedics



By

Tarek Abdel-Monem Ibrahim El-Taweel

SUPERVISED BY



Handwritten signature and date: 11-1-86

Prof. Dr.

Mohammed H. El-Ghawaby

Prof. and Chairman of  
Orthopaedic Surgery  
Faculty of Medicine

AIN SHAMS UNIVERSITY

Ass. Prof. Dr.

Hussein El-Khateeb

Ass. Prof. of Orthopaedic surgery  
Faculty of Medicine

AIN SHAMS UNIVERSITY

FACULTY OF MEDICINE  
AIN SHAMS UNIVERSITY

1986

## CONTENTS

|                                     | <u>Page</u> |
|-------------------------------------|-------------|
| - INTRODUCTION .....                | 1           |
| - ANATOMY OF THE PREAXIAL RAY ..... | 3           |
| - AETIOLOGY .....                   | 11          |
| - PATHOLOGY .....                   | 14          |
| - CLINICAL PICTURE .....            | 22          |
| - TREATMENT .....                   | 27          |
| - SUMMARY .....                     | 70          |
| - REFERENCES .....                  | 72          |
| - ARABIC SUMMARY .....              |             |



## INTRODUCTION

-----

The hand may be the most helpful and beautiful tool Allah has given us to deal with environment , to build our civilization , and to express ourselves even when the tongue does not utter a word .

Amongst the many congenital affections of the hand which affect function and appearance is congenital club hand , or congenital absent radius , a rare condition which puts the hand in a radial-volar deviation usually with an absent or hypoplastic thumb , an unsightly appearance and a disabling deformity.

Amongst the many names given to describe this deformity are radial club hand , radial hemimelia , radial meromelia , dysplasia of the radius , radial aplasia , and clinarthrosis . All denoting radial deviation of the hand resulting from a defect in the radius . Club hand is a descriptive term denoting some type of deformity of the hand , but actually it means very little . Clinarthrosis , absence of the radius , and hypoplasia or aplasia of the radius are all medical terms related to deformities of joint or of bone alone . In 1961 Franz and O'Rahilly pointed out that these deformities involve a great deal more than bone or joint and therefore suggested that everyone should use the term " radial hemimelia " which would describe the entire

deformity. But later on and because of an argument based on the fact that hemimelia means half and in many instances half is not particularly correct , and that partial is more explanatory , it has been suggested by the committee on Prosthetics Research and Development that the term " hemimelia" be changed to " meromelia " . Radial meromelia therefore can be further differentiated by describing it as longitudinal paraaxial when there are associated anomalies in the radial part of the hand or as intercallary when there is only absence of the radius .

Similarly an ulnar club hand may occur in association with an ulnar defect .

Recently , Swanson et al. ( 1983 ) see that the use of different Greek and Latin names to describe different deficiencies has only described an anomaly in an other language , and are confusing to most clinicians . They presented a new classification for congenital limb malformation and asked for its generalization universally . In their new classification they called our case " radial ray deficiency".

ANATOMY OF THE PREAXIAL RAY

### ANATOMY OF THE PREAXIAL RAY

In this chapter we will discuss the anatomy of the radius , muscles about the radius , anatomy of the radial artery and nerve , and the anatomy of the thumb .

**The Radius :** This bone carries the hand , and is stabilized against the ulna for pronation-supination , and against the humerus for flexion-extension of the forearm .

The Head is cylindrical , covered with hyaline cartilage , and it articulates with the capitulum , the radial notch of the ulna , and the annular ligament . The Neck is enclosed by the tapered lower margin of the annular ligament . The Shaft of the radius at its upper end is characterized by the bicipital tuberosity projecting towards the ulna , the biceps tendon is inserted along its posterior lip. From the anterior margin of the tuberosity , the anterior oblique line forms a ridge that runs down to the point of greatest convexity of the shaft. It is mirrored by a similar but less prominent posterior oblique line . Between the two lines the shaft receives the insertion of the supinator , with the posterior interosseous nerve off the bone , being sandwiched between the two layers of the muscle . From the medial ridge of the bone the fibres of the interosseous membrane pass down to the ulna. The Lower End of the radius is broad and articulates with the ulna at the inferior radioulnar joint , and with the

carpus at the wrist joint. The articular surface for the wrist joint has two concave areas covered with hyaline cartilage . The medial square area for the lunate , the lateral triangular area for the scaphoid . A triangular fibrocartilage divides the inferior radioulnar joint and the wrist joint from each other . The capsule and synovial membrane are attached to the articular margins , and to the fibrocartilage. The very strong anterior ligament of the wrist joint is attached to a smooth area between the articular margin and the prominent ridge above it . Laterally the lower end is projecting into the pyramidal styloid process.

The expanded lower end of the radius takes the full thrust of the hand. This thrust is partially transmitted to the ulna via the fibers of the interosseous membrane , and subsequently from the ulna to the humerus via the elbow joint. Thrust is also transmitted from the radius to the humerus by the head against the capitulum .

Ossification : The radius appears as a cartilaginous model at the sixth intrauterine week , a centre of ossification appears in the middle of the shaft at the eighth week . At birth both ends are cartilaginous ; the lower end is the growing end . A centre appears in the lower end early in the second year and fuses at twenty. The centre for the head appears at four years , and fuses at eighteen .



Articulations and Movements of the Radius : The head shares in two joints ; the elbow and the superior radioulnar joints. The lower end articulates with the carpus at the wrist joint in which the ulna does not share. The radius and ulna articulate with each other via the superior and inferior radioulnar joints and the interosseous membrane , whose fibers are taut in pronation and lax in supination. The basic movements of pronation-supination are produced by movement of the radius around an immobile ulna. The axis around which the radius rotates obviously passes through the centre of curvature of each radioulnar joint. So , it joins the centre of the head and the base of the styloid of the ulna . So , in the supinated fore-arm it lies in the line of the shaft of the humerus , and oblique to the axis of the fore-arm which extends between the midpoint between the epicondyles of the humerus , and the midpoint between the styloids of the radius and ulna. In supination the axis of the forearm is parallel with the ulna and oblique to the shaft of the humerus , forming with it the carrying angle of the forearm which is about  $163^{\circ}$  open to the lateral side ( Steel and Robinson, 1958). The carrying angle of the elbow is compensated by the carrying angle of the hand , where in the supinated hand , its axis-third metacarpal-is parallel with the humerus . Lateral movements of the wrist joint are symmetrical about this axis , but not symmetrical about the axis of the forearm .

Musculature about the Radius : The radius receives the insertion of many muscles , and is the origin of others . Some muscles though not attached to the radius yet , worth mentioning because either of their relation to the radius or because of their importance in our subject .

The muscles inserted into the radius are ; Biceps Brachii , Supinator , Pronator Teres , Brachioradialis , and Pronator Quadratus .

The muscles originating from the radius are ; Flexor Digitorum, Superficialis and Flexor Pollicis Longus from the volar aspect. From the posterior aspect the Abductor Pollicis longus and Extensor Pollicis Brevis take origin. The Extensor Carpi Radialis Longus and Brevis are of the muscles of the preaxial border of the upper limb , This border extends from the tip of the shoulder down to the thumb ( Last 1979 ) .

#### The Radial Artery :

The smaller of the two terminal branches of the brachial trunk. It begins at the level of the head of the radius , and passes down the radial side of the forearm to the wrist , where its pulsations can be felt. Then it winds backwards around the lateral side of the carpus on the scaphoid and trapezium to reach the first interosseous space , from which it goes to the palm by passing between the two heads of the first dorsal interosseous muscle . In the palm it forms the

deep palmar arch by uniting with the deep branch of the ulnar artery.

Variations : Sometimes the origin of the radial artery is higher than usual , it branches from the axillary or upper part of the brachial artery. In the forearm it is sometimes superficial to the deep fascia. In turning round the wrist it is occasionally superficial instead of deep to the extensor tendons of the thumb .

Branches of the radial artery : The Radial Recurrent Artery arises immediately below the elbow and anastomoses with the radial collateral branch of the arteria profunda brachii .

The Muscular branches are distributed to the muscles on the radial side of the forearm. The Palmar Carpal branch which anastomoses with its ulnar fellow to form the palmar Carpal arch. The Superficial palmar branch which anastomoses with the terminal part of the ulnar artery completing the superficial palmar arch. The Dorsal Carpal branch shares in the formation of the dorsal carpal arch . The dorsal and palmar carpal arches are both close to bone , and supply the lower epiphyseal parts of the radius and ulna. The First Dorsal Metacarpal Artery , The Arteria Princeps Pollicis , and the Arteria Radialis Indicis are the last three branches which the radial artery gives ( Peter and Roger 1960 ) .

The Radial Nerve :

Arises from the posterior cord of the brachial plexus C5,6,7,8, (T1). It is the largest branch of the plexus . Descends behind the third part of the axillary artery , spirals down around the humerus in the spiral groove to reach the front of the lateral epicondyle to the lateral side of the biceps tendon , where it divides into terminal rami ; superficial and deep.

The branches of the radial nerve are muscular , cutaneous, articular , and superficial and deep terminal branches . The muscular branches supply the triceps , anconeus , brachioradialis , extensor carpi radialis longus , and the lateral part of brachialis .

Its cutaneous branches are the posterior cutaneous and lower lateral cutaneous nerves of the arm ; and the posterior cutaneous nerve of the forearm. Its articular branches are distributed to the elbow joint. The Superficial Terminal branch descends in the forearm lying close to the radial artery in the middle third of the forearm. The Deep Terminal branch ( Posterior Interosseous nerve ) winds to the back of the forearm round the lateral side of the radius . Then it descends between the superficial and deep muscles of the back of the forearm , accompanied by the posterior interosseous artery . It supplies most of the muscles of

the back of the forearm , also gives articular branches to the inferior radioulnar , wrist , and the intercarpal joints. The nerve is sensory to the interosseous membrane and periosteum of radius and ulna ( Peter and Roger 1980 ) .

### The Thumb

Being able to be opposed to the other four fingers to grip objects , the thumb is functionally as important as all other digits combined ( Last 1979 ) . The thumb has two phalanges and a short thick metacarpal which articulates with the trapezium , the articular surfaces are reciprocally saddle shaped , enclosed in a thick but loose capsule , and permit independent movement of the whole thumb .

The long muscles acting on the thumb are the extensor pollicis longus et brevis , the abductor pollicis longus and the flexor pollicis .

The short muscles acting on the thumb are the adductor pollicis , and occasionally the first palmar interosseous muscle , and the muscles of the thenar eminence ; which are the abductor pollicis brevis , the flexor pollicis brevis and opponens pollicis .

In the resting position the thumb nail lies in a plain vertical to that where the other four finger nails lie .

So , flexion of the thumb occurs across the palm in a plain parallel to it . When all joints of the thumb are flexed , flexion is accompanied with medial rotation . Abduction-adduction occurs in a plain vertical to that of flexion , i.e. vertical to the palm ( Peter and Roger 1980 ).

Opposition of the thumb is a complex motion made by coordination of 1-abduction of the thumb from the palmar surface of the index finger 2- flexion of the metacarpophalangeal joint of the thumb 3- internal rotation of the thumb 4-radial deviation of the proximal phalanx of the thumb on its metacarpal , and finally 5-motion of the thumb towards the finger. This is the result of co-ordinate function of all the long and short muscles that act on the thumb . But the abductor pollicis brevis is the most important muscle that takes part in this complex movement , it rotates internally and abducts the thumb away from the index metacarpal , internally rotates and abducts the proximal phalanx on its metacarpal , and assists the extensor pollicis longus in extending the interphalangeal joint of the thumb ( Lee Wilford 1980 ).

A B T I C L E S