Fractures of the Distal End of the Humerus

Essay

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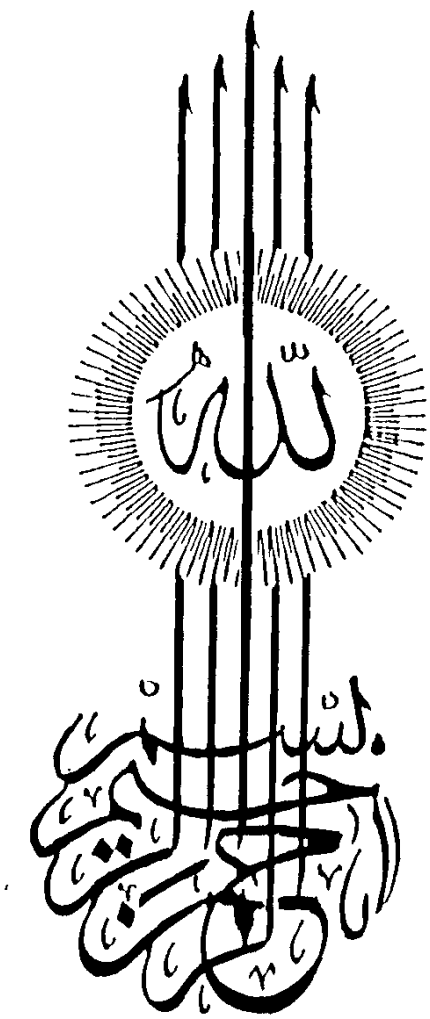

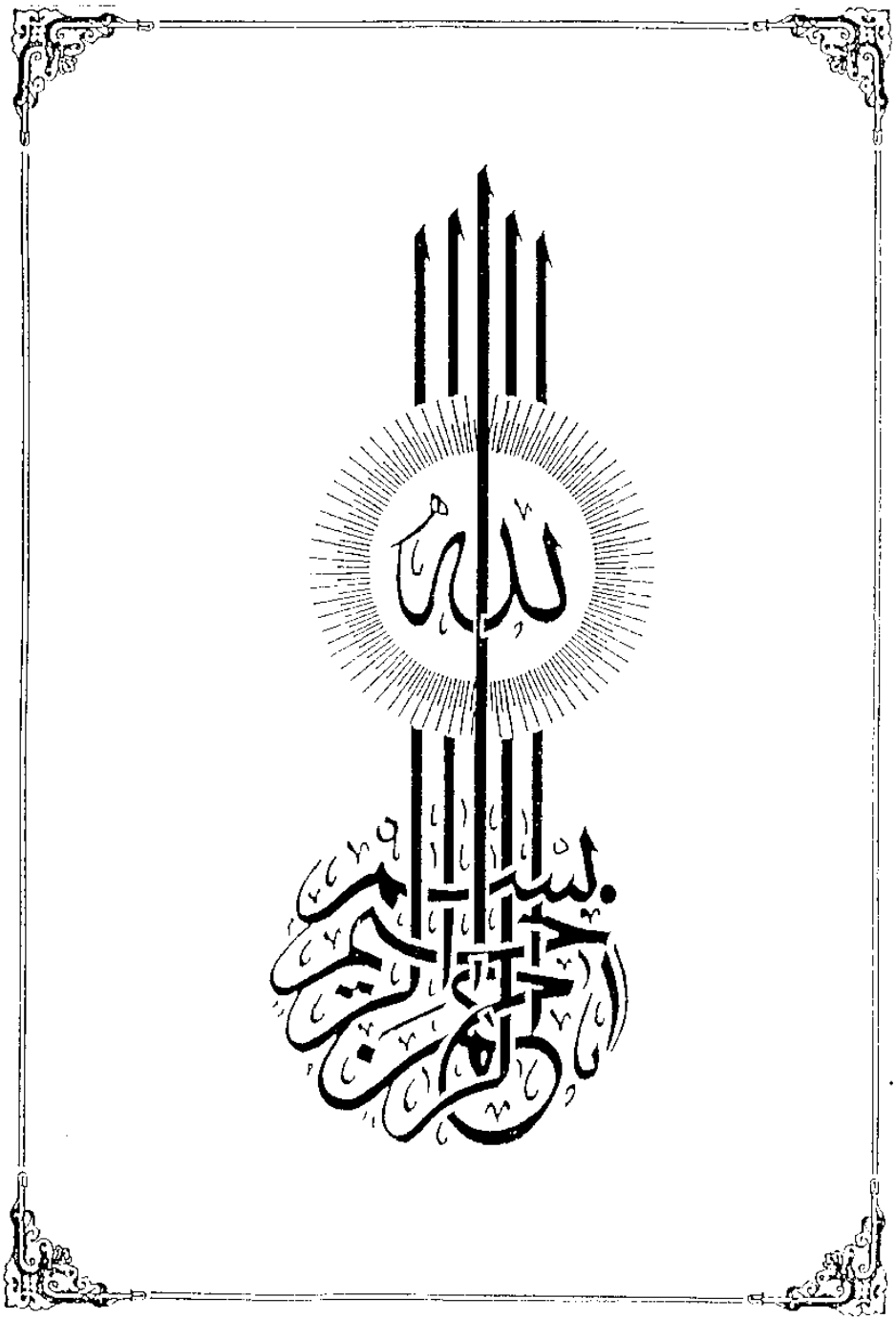

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ABBREVIATIONS

G.A.	: General anathesia.
DCP	: Dynamic compression plate.
IF	: Internal fixation.
OR	: Open reduction.
ORIF	: Open reduction and internal fixation.

INTRODUCTION

The upper limb is considered as a series of rigid links, the elbow is the intermediate joint in this chain of mechanical links which begins at the shoulder and ends at the finger tipes, elbow motion serves to adjust height and length of the limb to reach any point within the sphere of the shoulder motion, this joint is not a weight bearing joint but joint reaction forces can be great on its articular surfaces by the large muscle groups crossing it, and also by external forces transmitted through the hand and forearms, so this joint may be exposed to tensional and torsional forces which the hip and knee do not experience, these movements are usually balanced by active muscle contraction and stretching of the surrounding soft tissues as well as transmission to the bony articulation.

In this essay dealing with fractures of the distal end of the humerus which is a major contributor to formation of the elbow joint, we tried to summarize the current knowledge about this bone, its anatomical features, growth, ossification and blood supply to it.

This is followed by a biomechanical study of the joint, factors controlling its movement, forces acting and stabilizing it, then common classifications for fractures of the distal humerus is given and a detailed description of each individual fracture, incidence, mechanism of injury and management.

ANATOMY OF THE DISTAL END OF THE HUMERUS

The distal end of the humerus is flattened antro posteriorly, expanded transversely, taking the shape of an artist's palette (Kapandji, 1970).

It is separated into medial and lateral condyles, the sulcus between the lateral ridge of the trochlea and the hemispherical surface of the capitulum separates the two condyles, it is called the capitulotrochlear sulcus (Delee, 1984).

Each condyle contains an articulating and a non-articulating portion. This non-articulating portion contains the medial epicondyl the lateral epicondyle and the three fossae olecranon, coronoid and radial.

* The Medial Epicondyle:

The terminal and most prominent point of the medial supracondyla ridge, easily felt as blunt projection especially with passive flexio of the elbow (Johnston (1958) & Mahran (1974)).

Its smooth posterior surface is crossed by the ulnar nerve and the inferior ulnar collateral artery. Funny sensation is aroused when the ulnar nerve is jarred against the epicondyle. The superficial flexor muscles of the forearm and hand originate from an impression on its lower anterior surface. Distal to this a small facet gives attachment to the ulnar collaterla ligament. This ligament is the strongest one extending from the the medial epicondyle to the sublime tubercle on the medial border of the coronoid process. The posterior band connects low and back parts of the medial epicondyle and the medial border of the olecranon. A middle band connects these two bands and lies more deeply lodging the ulnar nerve (Jast(1984) and Mikhail (1977)).

The ossific center of this traction epiphisis (apophysis), appears according to most authors, around the fifth year according to [illegible], Last and Dalee in 1984, and at seven years according to Wadsworth (1982).

In preparing his atlas of elbow in children, Silberstein, 1982, stated that it ossifies at four years age and he adds that this ossific center, although uncommon, may be multicentric giving it a fragmented appearence.

* The lateral Epicondyle:

A less prominent projection occupying the lateral side of the non-articular portion of the lower end of the humerus. Its rough antero-lateral surface gives origin for the superficial extensors of the fore-arm fused distally with the attachement of the radial collateral liga-ment, which is surrounded by the origin of the anconeus muscle. The lateral (radial collateral ligament) is a flattened band attached to the humerus below the common extensor origin; it fuses with the annular ligament of the head of the humerus[Last(1984), and

The lateral epicondyle ossifies nearly at twelve years ge,[Johnston (1958), Grant (1972) and Wadsworth(1982)]; and at thirteen years age [Last, 1982].

The lateral supracondyle ridge is sharp and gives origin to the brachioradialis and extensor carpi radialis longus respectively before it terminates into the lateral epicondyle.

Medialy the supracondylar ridge gives origin to the 'Pronator' teres muscle at its lower part before it terminates into the medial epicondyle [Mahran, 1974].

When an epicondyle is avulsed from the shaft, the capsule and the col leteral ligament are torn, exposing the interior of the joint into

which the fragment may become displaced (Kapandji, 1970).

* The Olecranon Fossa:

The deepest and largest one lies posteriorly above the trochlea lodging the tip of the olecranon which is masked during elbow extension. Any internal fixation device or fractured fragments in this fossa may impeds full extension of the elbow (Delee, 1984).

* The Coronoid Fossa:

Anteriorly placed small hollow above the trochlea receiving the ulnar coronoid process during elbow flexion

*The Radial Fossa:

Slight depression above the capitulum on the lateral aspect of the coronoid fossa. It receives the head of the radius during full flexion of the elbow.

Sometimes the thin plate of bone in between olecranon and coronoid fossae, is absent and there is a foramen 'supratrochlear foramen' (Grant (1972) and Last (1984).

* The Capitulum:

Rounded convex projection on the lateral aspect of the humeral condyle covering anteriorly and inferiorly only not extending posteriorly Mahran (1974). This posterior surface is not covered by cartilage and does not share in articulation while the anterior and inferior surfaces articulate with the radial head which lies in contact with its inferior surface in full extension but moves on to is anterior surface when the joint is flexed (Last, 1984). It is bounded by a bony ridge separating it from the non-articular part of this bone.

* The Trochlea:

Pully shaped structure which covers the anterior, inferior and posterior surfaces of the lower medial end of the ulna (Johnstone (1958) and Mahran

(1974)).

The ulna articulates with the inferior and posterior surfaces of the trochlea in extension, but during flexion the ulna leaves the posterior trochlear surface uncovered and lodges the anterior and inferior trochlear surfaces.

The trochlea is separated from the capitulum by a faint groove and its medial margin projects downward beyond the rest of the bone. This downward projection of the medial edge of the trochlea is the principal factor in determining the carrying angle, owing to this angulation the ulnar boarder of the supinated and extended forearm can not be brought into contact with the lateral surface of the thigh when the arm is by the side (Johnston 1958).

* The Capsule of The Elbow Joint:

It extends above the level of the radial and coronoid fossae anteriorly and medially it is attached to the medial flange of the trochlea. Laterally it is attached to the lateral border of the capitulum in-between it and the lateral epicondyle. Posteriorly it passes across the olecranon fossa or in its margin.

Distally the capsule is attached to the edge of the articular notch of the ulna and to the annular ligament of the superior radio-ulnar joint.

The three fossae are lined by synovial membrane which covers also the flattened medial surface of the trochlea.

The synovial membrane is reflected over the deep surface of the capsule and lines the deep surface of the lower part of the annular ligament, projecting into the point between the radius and ulna from behind partially dividing the joint into humeroradial and humero- ulnar parts(Mahran (1974)

* Fat Pads:

There are three fat pads imprisoned between the synovial membrane and

the fibrous capsules two anteriorly on the radial and coronoid fossae and the longest one lies posteriorly over the olecranon fossa and pressd into it by triceps muscle during elbow flexion.

The radial and coronoid fat pads are pressed by the bradrialis into their fossae during elbow extension.

* Arterial Blood Supply to the Distal Humerus and Elbow Region:

There is a close vascular network about the elbow joint. It derives its supply mainly from the brachial artery which enters the arm at the lower border of the teres major muscle and runs medially till a point at the level of the radial neck where it divides into radial and ulnar arteries.

Two vena comitants accompany the artery throughout its course in the upper arm.

The most important branches of the brachial artery are the profunda brachii and the superior and inferior ulnar collateral arteries, all of which form collateral anastomoses around the elbow.

In front of the medial epicondyle anterior branche of inferior ulnar colleteral artery anastomoses with anterior ulnar recunent artery (branche of ulnar artery).

Behind the medial epicondyle, the superior ulnar collateral artery anastomoses with posterior ulnar recunent artey (branche from ulnar artery).

In front of the lateral epicondyle, the anterior descending branche of the profunda brachii anastomoses with the radial recunent artey (branche from the radial artery).

Behind the lateral epicondyle, posterior descending branche of profunda brachii anastomeses with interosseous recurrent artery(from posterior interosseous artery).

The nutrient artery of the humerus usually arises about the middle of the upper arm from the brachial artery, entering the nutrient canal near the insertion of the coracobrachialis and is directed downwards. Most of the intrasseus blood supply of the distal humerus comes from the anastomotic vessels that course posteriorly (Wilkins, 1984). The vessels supplying the lateral condylar epiphysis enter on the posterior aspect just lateral to the origin of the capsule, and proximal to the anticular cartilage near the origin of the anconeus muscle, 'the only non-articular and extra-capsular part'. These vessels penetrate the non-ossified cartilage and traverse it to the developing ossific nucleus. These vessels communicate with one another within the ossific nucleus but do not communicate with vessels in either the metaphysis or non-ossified chondroepiphisis. Thus practically they are end arteries. Morrissy(1984), and Haraldssan(1959), said that it was believed that these vessels came from the anastomosis between the colleteral branch of the profunda brachii artery and the recurrent interossens artery, but now it has been demonstrated that these vessels arise medially from the inferior ulnar colleteral artery crossing the posterior surface of the olecranon fossa to enter the capitulum.

The blood supply to the ossific nucleus of the medial portion of the trochlea is from two sources: the lateral vessel is on the posterior surface of the distal humeral metaphysis, penetrates the periphery of the epiphyseal plate and terminates in the trochlear nucleus, injury to this end vessel can markdly affect the nourishment to the developing lateral ossific nucleus of the trochlea. The medial vessel penetrates the non- articulating portion of the medial crista of the trochlea. Finally, when growth is complete, metaphyseal and epiphyseal vessels

anastomose freely (Morrissy(1984), and Wilkins(1984)).

* Ossification of the Distal Humeral Epiphysis:

Summurising what has been previously mentioned with each ossific nucleus, the capitulum ossify at the second year of life then the medical epicondyle at the fifth year, trochlear at the twelveth year and lateral epicondyle at thirteen years. The conjoined epiphsis formed nearly at 14-15 years, and fuses to the shaft at 16-18 years.

The medial epicondle fuses at nearly the same time(Last (1984), Dele (1984), Mahran(1974), Grant (1972), Silberstein(1981), Wadswath(1982)).

* Supracondylar Process:

Sometimes a hook shaped process projects anteromedially about 5 cms above the medial epicondyle from the humeral shaft, a fibrons band connects this occasionally present process to the area just above the medial epicondyle and it may gives partial origin to pronator teres muscle. This fibrous band is called the 'Ligament of Struthers'. The median nerve, sometimes accompanied by the brachial artery, proceeds through the foramen formed by the ligament and supracondylar process. Fig 2.

This process when present, becomes vulnerable to injury as it may break giving marked pain around the elbow, sometimes it may lead to median nerve compression aided by the ligament of struthers, which called 'supracondylar process syndrome (Wadsworth 1982).

* Movements:

Only simple extension and flexion movements are possible in this synevial joint of the hinge variety.

but during pronation and supination of the forearm there is some rocking movement (abduction and adduction) of the ulna on the trochlea (Last, 1984).

Both olecranon and coronoid fossae increase the range of movement at the elbow joint by delaying impaction of the two ulnar process on the humeral shaft (Kapandji 1970).

The articular portion of the condyle of the humerus is curved forward, so that its anterior and posterior surfaces lie in front of the corresponding surfaces of the shaft making an angle of approximately 45 degrees (Wilkins, 1984).

In the same way, the trochlear notch of the ulna projects anteriorly and superiorly at an angle of 45 degrees to the ulnar shaft and so, lies anterior to the axis of the ulna.

The anterior projection of these articular surfaces and their inclination at 45 degrees promote flexion in the following two ways:

1. Contact of the coronoid process with the humerus occurs only when the two bones are almost parallel, i.e. theoritically flexed to 180 degree
2. Even during full flexion the two bones are separated by space which lodges the muscles.

In the absence of these two mechanical factors flexion would be limited to 90 degree by the impact of the coronoid process on the humerus (Kapandji, 1970).

* Nerve Supply of the Elbow:

According to Hilton's Law, the musculocutaneous, radial, ulnar and median nerves supply this joint.