INTRODUCTION

The goal of restoring normal,pain-free elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surface,restitution of the overall geometry of the distal humerus and stable fixation of the fracture fragments to allow early and full rehabilitation [1,2].

Although these goals are now widely accepted by the orthopedic community, they may be technically difficult to achieve, especially in the presence of substantial osteoporosis or comminution [2].

Until recently, the standard technique for fixation of distal humerus fractures has been that proposed by the AO/ASIF group [2,3].Their recommended technique includes fixation of the articular fragments with screws and column stabilization with two plates at a 90° angle to one another (3,4,5).

The limiting factor of this technique unquestionably is fixation of the distal fragments to the shaft.When this method fails, it does so because of nonunion at the supracondylar level or stiffness resulting from prolonged immobilization that has been used in an attempt to avoid failure of inadequate fixation [2].

Using these fixation techniques, different authors have reported unsatisfactory results in 20-25% of the patients [1,6].

Distal humerus fractures are difficult to manage successfully because of the local anatomic constraints, the frequent presence of comminution, displacement, osteopenia and the commonly experienced postoperative sequelae such as heterotopic ossification, joint stiffness and ulnar neuropathy that affect the functional outcome [2,7].

Early stable ORIF which permits early active mobilization is the treatment protocol accepted worldwide[2,7].

AIM OF THE WORK

The Aim of the essay is to Highlight current trends in management of distal humeral fractures in adults ,Current fixation techniques and Surgical approaches.

Anatomy

The distal humerus is involved in two joints: the ulnohumeral, which allows for flexion and extension of the elbow, and the radiocapitellar, which allows forearm rotation[8].

The ulnohumeral joint is essentially a hinge joint, whose axis of rotation lies in 3° to 9° of external rotation and 4° to 8° of valgus in relation to the humeral shaft, which contributes to the carrying angle of the elbow[8].

The trochlea forms the center of the hinge and is supported by the medial and lateral columns; it has a 300° arch of cartilage, which leads to the highly constrained association with the olecranon, thus providing the bony stability of the elbow [8].

The medial column diverges from the humeral shaft at a 45° angle, and the lateral column diverges at a 20° angle. The medial column terminates as the medial epicondyle, which serves as the origin of the anterior and posterior bundles of the medial collateral ligament and the flexor/pronator mass, so that anatomic reduction of this structure is critical for elbow stability [8].

The lateral column terminates as the lateral supracondylar ridge and epicondyle, which provide the origins of the lateral collateral ligament and extensor mass (also critical for stability), and in the capitellum anteriorly[8].

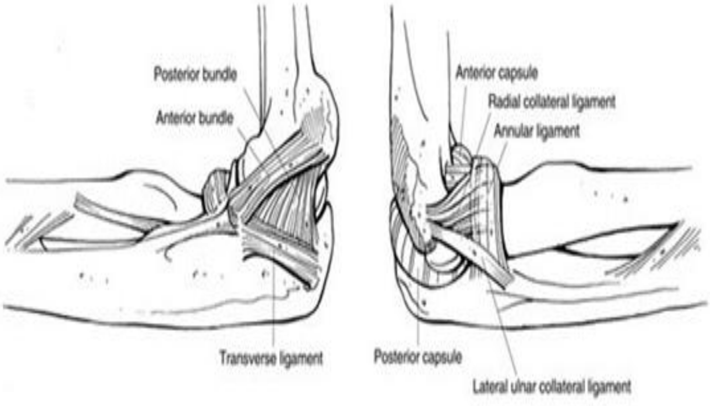


Figure (1): The elbow is held together by ligaments, muscles, tendons, and the shape of the bones themselves[8].

The olecranon and coronoid fossae accommodate their corresponding portions of the proximal ulna during extension and flexion, respectively [8].

The most pertinent neurovascular structures involved in the management of distal humerus fractures are the ulnar and radial nerves[8].

The radial nerve exits the spiral groove approximately 101 to 148 mm from the lateral epicondyle and courses anteriorly through the lateral intramuscular septum at an average of 10 cm above the elbow joint line, but never closer than 7.5 cm.The ulnar nerve travels anterior to the medial intermuscular septum in the upper arm until reaching the arcade of Struthers, about 8 cm above the medial epicondyle, where it crosses into the posterior compartment, and then continues behind the medial epicondyle through the cubital tunnel[8].

The ulnar nerve enters the anterior forearm by traveling between the two heads of the flexor carpi ulnaris(8).

The median nerve and brachial artery travel anterior to the elbow joint, are rarely injured in adult distal humerus fractures, and are not commonly encountered during surgical treatment(8).

Both course anterior to the medial intermuscular septum, then between the pronator teres and the distal biceps brachii tendon, the nerve lying medial to the artery(8).

The blood supply around the elbow is primarily fed by anastomotic vessels from the brachial artery. Most vessels supplying the lateral condyle enter posteriorly and course into the ossific nucleus. They feed into the lateral portion of the trochlea (8).

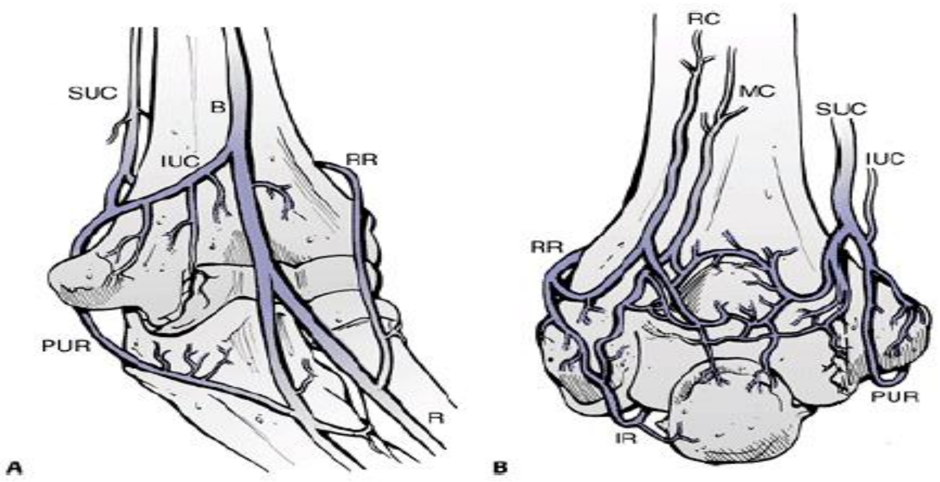


Figure (2): The blood supply of the distal humerus
A. Anterior view.
B. Posterior view. *SUC*, Superior Ulnar Collateral artery; *B*, Brachial artery; *IUC*, Inferior Ulnar Collateral artery; *RR*, Radial Recurrent artery; *PUR*, Posterior Ulnar Recurrent artery; *R*, Radial artery; *RC*, Radial Collateral artery;*MC*,Middle Collateral artery;*IR*,Interosseous Recurrent artery[8].

INITIAL MANAGEMENT

The common signs and symptoms of distal humerus fractures are pain, swelling, deformity, and, sometimes, instability of the elbow after a fall[9].

Acomplete neurovascular examination of the radial, median, ulnar, and anterior and posterior interosseous nerves should be completed both before and after any manipulation[9].

The skin should be carefully inspected so as not to overlook a subtle open fracture. Significant posterior soft-tissue injuries like road rash, degloving, fracture blisters may need to be managed with prolonged elevation, delayed surgery, or avoidance in planning the skin incision[9].

Radiology of distal humeral fracture

A- IMAGING

X-ray:

Clinically deformed fractures should be immobilised in about 30 degrees short of full extension, prior to x-ray evaluation. This is important for pain management[10].

On an elbow X-ray, the fat pad sign, also known as the sail sign suggests anoccult fracture. [10]

It is caused by displacement of the fat pad around the elbow joint. Both*anterior* and *posterior* fat pad signs exist, and both can be found on the same X-ray[10].

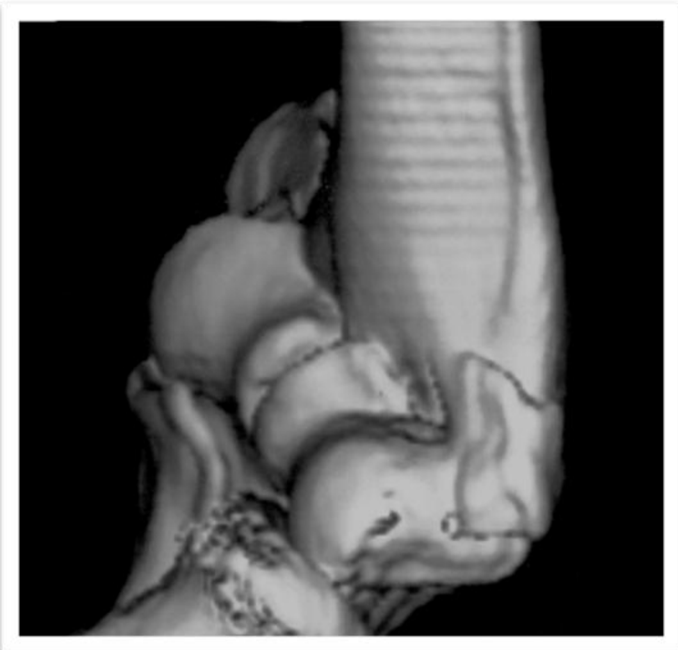
The fat pad sign is invaluable in assessing for the presence of an intra-articular fracture of the elbow. An anterior fat pad is often normal. However a posterior fat pad seen on a lateral x-ray of the elbow is always abnormal. The patient will be unable to flex their elbow and requires orthopaedic input(10).

Fig. (3) AP and lateral radiographs of the elbow and humerusshowing fat bad sign(10).

Computed Tomography:

CT scans with twodimensional views can be helpful as long as they are formatted in the correct plane. Three-dimensional reconstructions can compensate for oblique scans and often allow for subtraction of the radius and ulna. It improves the intraobserver and interobserver reliability of several classification systems(8). This technique can further illustrate fracture level, area and degree of comminution, articular incongruity, and column involvement[8].

Often obtained for surgical planning especially helpful when shear fractures of the capitellum and trochlea are suspected [8].



Fig(4) Computed tomography with 3-D reconstructions[8].

Classification

1- AO/OTA classification

2- Jupiter classification

3- Milch classification

The AO/OTA classification scheme for distal humerus fractures is currently used worldwide[(8);]similar to that for other periarticular fractures: type A fracture is extraarticular metaphyseal, transcondylar, and apophyseal; type B fracture is partial articular; and type C is complete articular. More specific subtypes are associated with each.

AO/OTA Classification of Distal Humerus Fractures	
Type A	Extraarticular (supracondylar fracture) 80% are extension type
Type B	Intraarticular-Single column (partial articular-isolated condylar, coronal shear, epicondyle)
Type C	Intraarticular-Both columns fractured and no portion of the joint contiguous with the shaft (complete articular)
Each type further divided by degree and location of fracture comminution	

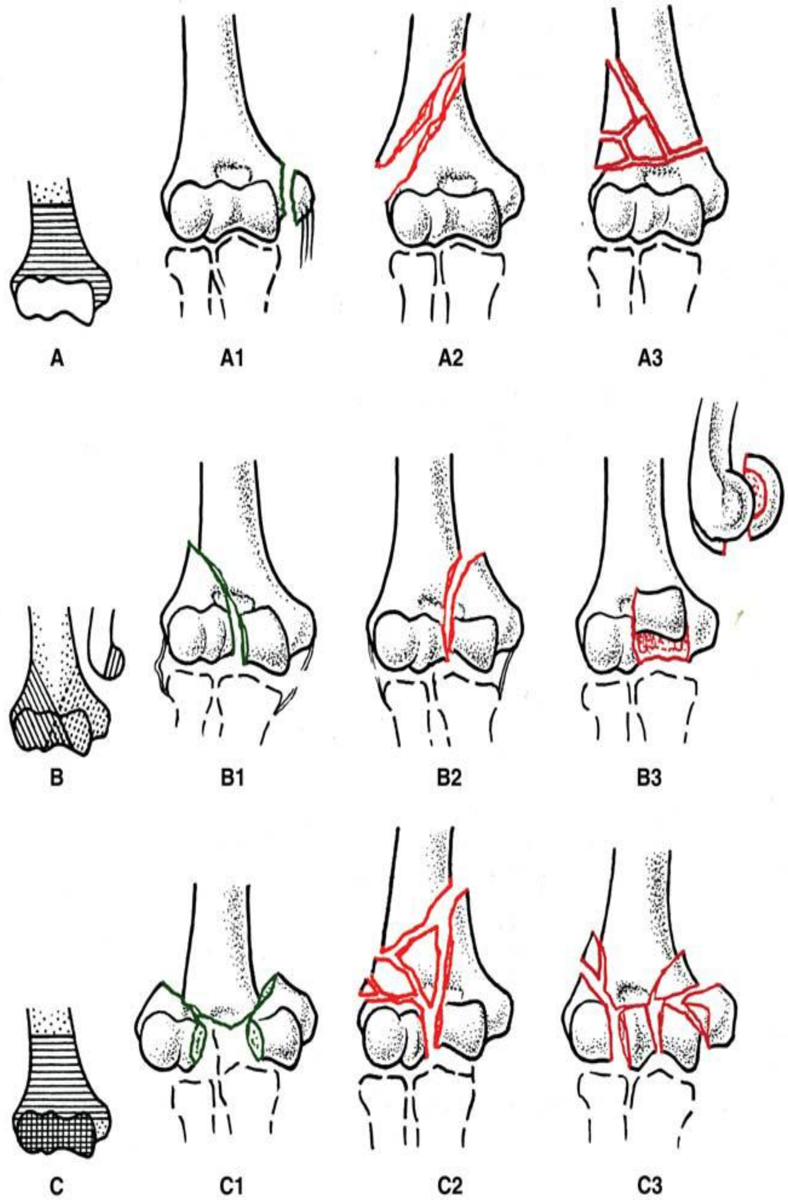


Figure (5): Illustrated AO/OTA classification of distal humerus fractures: type **A**, extraarticular; type **B**, partial articular; and type **C**, complete articular(13).

Jupiter and Mehne classification scheme, is based on intraoperative observations of fracture patterns, which can help dictate the surgical approach [11].

Jupiter Classification of Two-Column Distal Humerus Fractures	
High-T	Transverse fx proximal to or at upper olecranon fossa
Low-T	Transverse fx just proximal to trochlea (common)
Y	Oblique fx line through both columns with distal vertical fx line
H	Trochlea is a free fragment (risk of AVN)
Medial lambda	Proximal fx line exists medially
Lateral lambda	Proximal fx line exists laterally
Multiplane T	T type with additional fracture in coronal plane

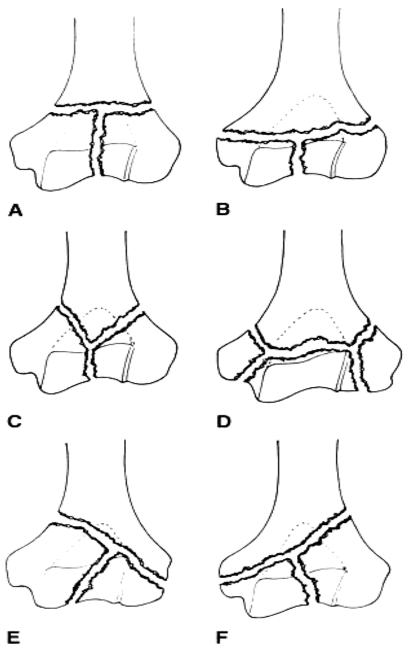


Figure (6): *Jupiter and Mehne* classification of distal humerus fractures based on intraoperative findings.

A, High T.

B, Low T.

C, Y.

D, H.

E, Medial lambda.

F, Lateral lambda[12].

The high T fracture involves a horizontal transcolumnar fracture as well as a vertical fracture extending to the articular surface. In a low T fracture, the transverse component crosses through the olecranon fossa. The Y fracture has oblique fractures through each column, with a vertical component extending to the joint. In an H fracture, the trochlea is detached from the medial and lateral columns. The lambda fracture can be either medial or lateral, based on which column is intact; both have a free trochlear fragment[13,14].

Table (3): Milch Classification of Single Column Condyle Fractures

Milch Type I	Lateral trochlear ridge intact
Milch Type II	Fracture through lateral trochlear ridge

TREATMENT

- Nonsurgical treatment
- Surgical Technique

Treatment Principles:

1. Anatomic articular reduction
2. Stable internal fixation of the articular surface
3. Restoration of articular axial alignment
4. Stable internal fixation of the articular segment to the metaphysis and diaphysis.
5. Early range of motion of the elbow(15).

A- 1st Aid treatment:

A well-padded, well-molded splint with the elbow in slight flexion and neutral rotation provides stability and pain relief until definitive treatment is possible(15).