Percutaneous fixation of displaced proximal humeral fractures

Theses for the partial fulfillment of the MD certificate in orthopedic surgery

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List of Abbreviations

CHL	……………………………………Coracohumeral Ligament
SGL	…………………………………Superior Glenohumeral Ligament
GT	………………………………………………Greater Tubrosity
LT	……………………………………………..…Lesser Tubrosity
GHL	……………………………………………Glenohumeral Ligment
IGHL	…………………………………Inferior Glenohumeral Ligment
CAL	……………………………………Coraco – Acromial Ligment
AHCA	……………………………Anterior Humeral Circumflex Artery
PHCA	……………………………Posterior Humeral Circumflex Artery
AN	…………………………………Axillary Neurovascular Structure
AL	…………………………………………………Anterolateral
CT	……………………………………………Computed Tomography
AVN	………………………………………………Avascular Necrosis
AP	……………………………………………………Anteroposterior
ADL	…………………………………….Active Daily Living Activity
ESSES	……………European Society for Shoulder and Elbow Surgery
PHILOS	………………………Pre-shaped Angular Stable Locking Plates
DASH	…………………Disabilities of the Arm, Shoulder and hand score
ASES	………..American should and Elbow Surgeons Shoulder score

Aim of the Work

The aim of this work is to evaluate the clinical outcome of percutaneous fixation of displaced proximal humeral fractures and to discuss the topic as regard anatomy, biomechanics, clinical, radiological diagnosis, indication, contraindication, scoring, technique, follow up and results of the percutaneous fixation of displaced proximal humeral fractures using threaded pins to eliminate the need for open reduction and internal fixation or hemi arthroplasty in proximal humeral fractures , and report follow – up results using this technique.

Chapter 1
Literature Review

1.1. Introduction:

Proximal humerus fractures (fig. 1) are relatively common, accounting for 5% to 9% of all fractures [١]

These fractures can pose a challenge for the treating orthopaedist because of the generally osteoporotic nature of bone in the elderly and the relative deforming forces of the surrounding muscles. Fractures are classified according to the Neer criteria, and treatment is often guided by the relative displacement of the anatomic fragments. Non displaced fractures have historically been treated conservatively, with generally good outcomes [٢].

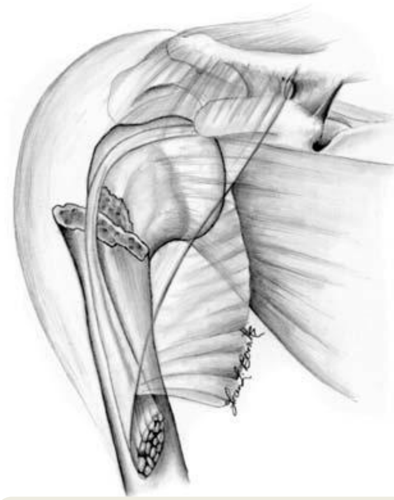

Figure (1): diagram showing proximal humeral fractures[1]

Displaced fractures with angulation of the articular surface >45° and displacement of the major segments >1 cm have been treated surgically, as have fractures with substantial valgus impaction, all with mixed results [٣].

Surgical techniques have included percutaneous fixation, standard plate-and-screw fixation, intramedullary fixation with rods or pins, the use of tension bands with and without plates or rods, standard plate modification into blade plate constructs, and hemiarthroplasty [٤] .

Many of these alternative open techniques were developed because of the high failure rates noted initially with standard plating. The inherent difficulties with internal fixation have led several authors to recommend hemiarthroplasty for the treatment of most three- and four-part humerus fractures [5].

Proximal humerus fractures are increasingly common in societies with maturing populations. These fractures are not simple to treat. A variety of options exists; however, outcomes are less than ideal in many patients [6].

Most proximal humerus fractures are either non displaced or minimally displaced and can be treated non surgically. Nonsurgical options focus on early functional exercises with the goal of achieving a functionally acceptable range of motion (ROM). For the 15% to 20% of displaced proximal humerus fractures that may benefit from surgery, no single approach is considered to be the standard of care [6].

Surgeons should be familiar with the different treatment options available, including recent advances in the management of complex periarticular fractures and in locking plate technology, which are particularly relevant to the care of these fractures. [7]

Locking plate technology and the use of osteobiologics may become increasingly important in the management of displaced proximal humerus fractures, facilitating humeral head preservation in appropriately selected patients [8].

1.2. Epidemiology:

Proximal humerus fracture is the second most common fracture of the upper extremity, following distal forearm fracture. In people older than age 65 years, fracture of the proximal humerus is the third most common fracture, after hip fracture and Colles' fracture. [6]

Proximal humerus fracture is associated with significant morbidity, leading to functional impairment lasting at least 3 months. Displaced proximal humerus fractures generally result in long-term functional disability. This type of injury usually is sustained after a moderate-energy fall in an individual with low bone density [6].

Fractures of the proximal humerus comprise about 5% of all fractures. The incidence increases rapidly with age and occurs twice as often in women as in men. Most occur as a result of a fall from a standing height. Fractures in younger patients are more often the result of higher energy trauma. Kannus et al. projected a 300% increase in these fractures over the next 30 years.

Recent reports suggest that the incidence of displaced proximal humeral fractures may be greater than reported in earlier literature. Tamai et al.; 2009 reported that 64% were displaced [9]

1.3. Shoulder anatomy:

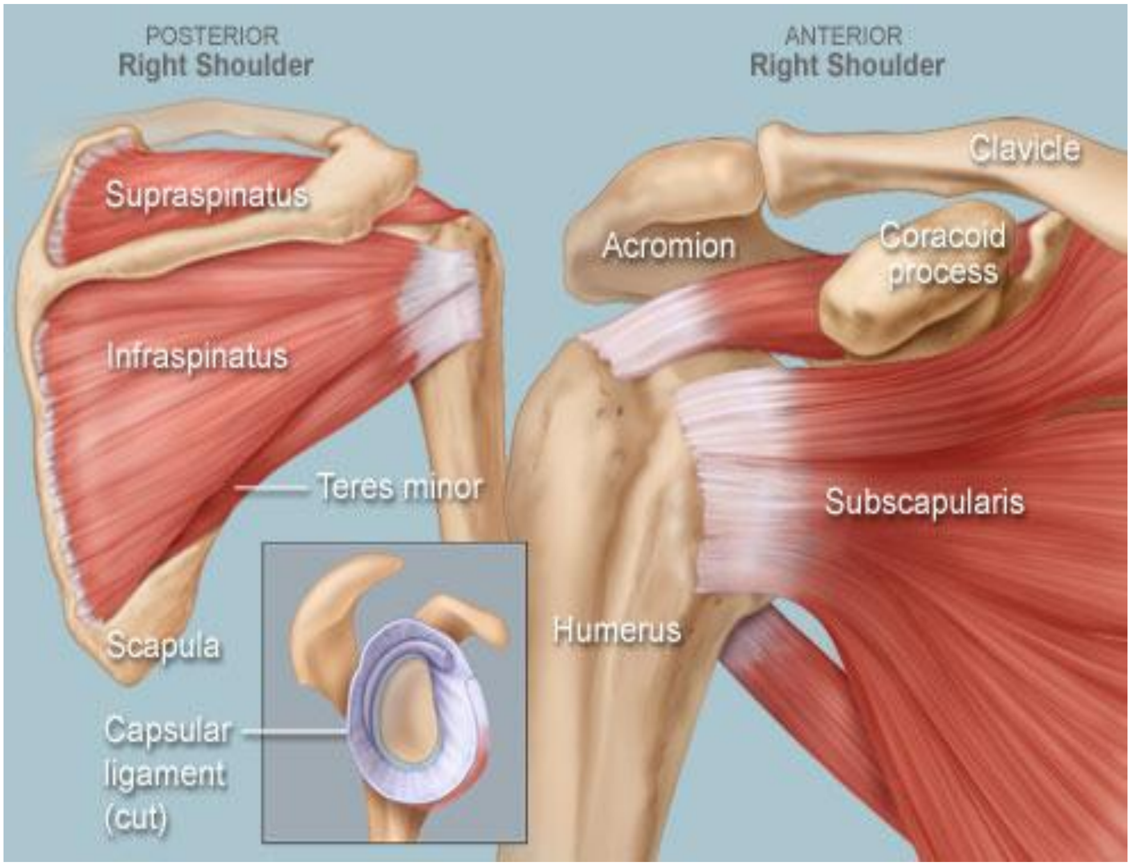

Figure (2): Shoulder anatomy

The glenohumeral joint is the most mobile joint in the body (fig.2), resulting from a series of complex interactions among bone, muscle, and soft tissue forces. An appreciation for this anatomy enables the surgeon to effectively restore function in the setting of fracture.

In neutral rotation, the greater tuberosity forms the lateral border of the proximal humerus. The lesser tuberosity, which sits directly anterior in this position, becomes profiled medially when the humerus is internally rotated this creates a rounded silhouette “light bulb sign” on radiograph (fig.3).

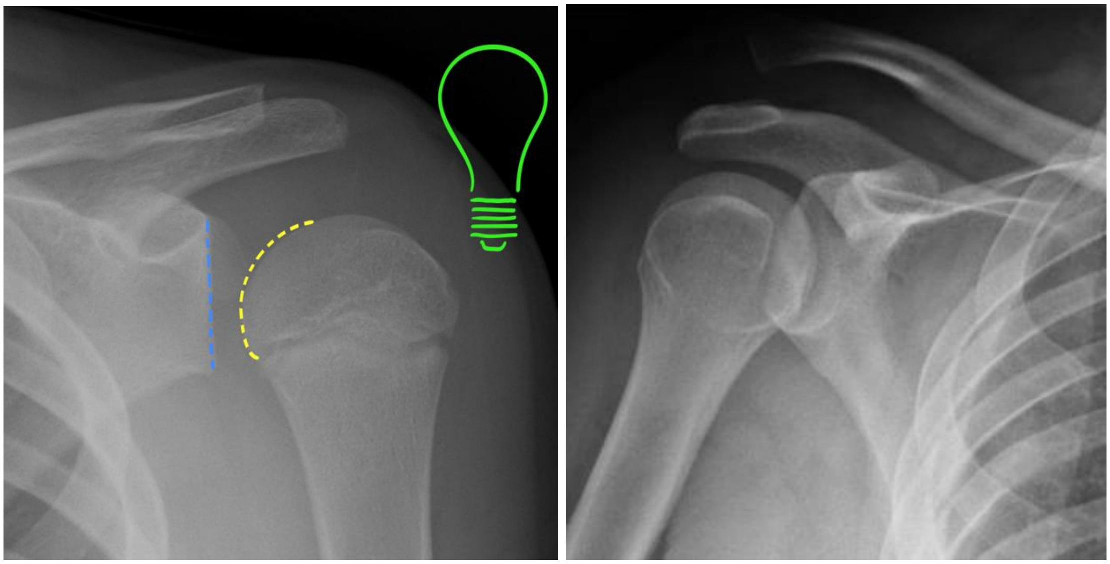

Figure (3): light bulb sign

The long head of the biceps passes between the two tuberosities in the intertubercular groove, approximately 1 cm lateral to the midline of the humerus, and its relationship is an important landmark during fracture reduction [10]

Figure (4): This drawing demonstrates the deforming forces on the proximal humerus in the setting of fracture. The supraspinatus (A) exerts a force posteromedially. The infraspinatus and teres minor (B) pull posteromedially and externally rotate. The subscapularis (C) exerts an anteromedially directed force on the lesser tuberosity. The pectoralis major (D) internally rotates and adducts, while the deltoid (E) pulls superiorly on the metadiaphysis of the humerus.[10]

The supraspinatus muscle, innervated by the suprascapular nerve, attaches to the superior facet of the greater tuberosity with a force vector that pulls predominantly in a medial direction. The infraspinatus muscle, also innervated by the suprascapular nerve, inserts on the middle facet of the greater tuberosity. The teres minor muscle, innervated by the axillary nerve, attaches to the inferior facet. Together, these three externally rotate and yield a posteromedially directed deforming force (fig.4). Therefore, if the greater tuberosity is fractured, it is displaced posteromedially. If it remains intact, and there is a surgical neck fracture, the resulting deformity is typically varus and external rotation. Anteriorly, the subscapularis, innervated by the upper and lower subscapular nerves, attaches to the lesser tuberosity, resulting in anteromedial displacement of this osseous fragment if fractured. The pectoralis major tendon insertion is an important landmark (fig.5), especially during hemiarthroplasty. Murachovsky et al. showed that the average distance from the pectoralis major tendon insertion to the tangent to the humeral head was 5.6 cm [11]**.**

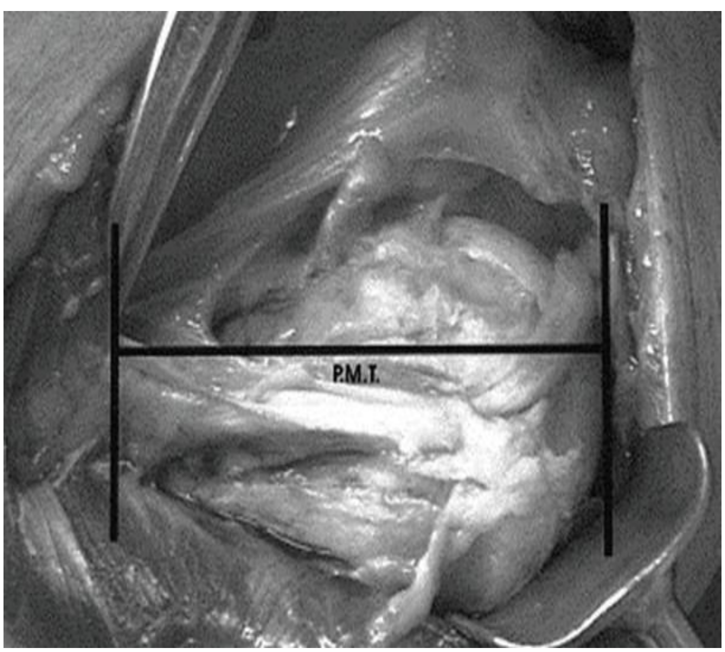

Figure (5): The average distance from the pectoralis major tendon (PMT) insertion to the tangent to the humeral head is 5.6 cm [10]

1.3.1. BONES:

A. Scapula:

- Body is formed by intramembranous ossification
- Glenoid has 2 ossific centers................... Failure of inferior center formation 1^{ry} glenoid dysplasia
- Glenoid has thicker cartilage to the periphery & thin in center -making it congruent
- It has a smaller surface than head........ Mobility.

B. Acromion:

- Acromion has 2 ossific centers................ Failure of fusion (osacromiale).
- Humans & chimpanzees are the only animals with an acromion
- Acromion provides a platform for a powerful deltoid but impedes repeated overhead activities

C. Proximal Humerus:

- Epiphysis has 3 ossific centers .... head, greater & lesser tuberosities.
- The center of head rotation.................... medial & posterior to shaft