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Comprehensive Management of Proximal Humerus Fractures in Adults: A Practical Clinical Review and Decision-Making Framework

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Abstract

Background: Proximal humerus fractures accounts for 5-6% of all adult fractures, treatment of which still remains controversial. The present review highlights the clinical review and propose a decision making framework for the treatment of proximal humerus fractures.

Methods: This narrative review focuses on key principles that directly influence day-to-day clinical decision-making. The review has been subdivided into sections covering anatomy and biomechanics, Clinical evaluation and imaging, various classification systems, decision-making and complications.

Conclusion: The management of proximal humerus fractures should always be individualized, integrating fracture-specific factors such as pattern, displacement, and vascular compromise with patient-related considerations including age, bone quality, and functional expectations. A thorough understanding of anatomy, biomechanics, and available treatment modalities is essential for optimal outcomes. Advances in fixation techniques and the increasing role of shoulder arthroplasty—especially reverse shoulder arthroplasty—have significantly improved functional results, particularly in the elderly population. Careful patient selection and adherence to sound surgical principles remain the cornerstone of successful management.

Keywords: Proximal Humerus fracture, Clinical decision making, Neer classification

Introduction

Proximal humerus fractures account for approximately 5-6% of all adult fractures with females being affected twice than males [1]. These fractures demonstrate a characteristic bimodal distribution: in elderly individuals, they typically occur following low-energy mechanisms such as simple falls from standing height, whereas in younger patients, they are more often the result of high-energy trauma, including road traffic accidents or sports-related injuries [2, 3].

The management of these fractures is crucial to achieve adequate shoulder function. Inadequate treatment of these fractures can lead to variety of complications such as malunion, non-union, avascular necrosis and even arthritis [4].

Over the years, the management of proximal humerus fractures has undergone considerable evolution. Traditionally, undisplaced fractures, patients with two part valgus impacted fractures and medically unfit patients can be successfully managed conservatively with brief immobilization followed by early passive range of motion exercises [3, 4].

A variety of surgical options have been proposed for treating proximal humerus fractures which involves proximal humerus locking plate system, intramedullary nailing, elastic nail, hemiarthroplasty and even reverse total shoulder arthroplasty [3-6].

The present review highlights the clinical review and propose a decision making framework for the treatment of proximal humerus fractures.

Materials and Methods

This review is further divided in various sections

- Anatomy and biomechanics
- Clinical evaluation and imaging
- Classification systems
- Treatment strategies and decision-making
- Complications

1. Anatomy and Biomechanics

The proximal humerus is composed of four key parts as described by Neer [7]

- Anatomical neck- Represents the epiphyseal plate
- Surgical Neck- Separates the humeral head and shaft
- Greater Tuberosity- Incorporates three rotator cuff muscles insertion (Supraspinatus, Infraspinatus and Teres Minor)
- Lesser Tuberosity- Incorporates the insertion of Subscapularis

The Bicipital groove separates the greater and lesser tuberosities.The long head of biceps passes through this groove.

Apart from the bony structures, the deforming forces play a pivotal role in proximal humerus fractures. The pectoralis major displaces the

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humeral head anteriorly and medially. The subscapularis causes internal rotation of the proximal fragment while the supraspinatus, infraspinatus and teres minor causes upward and posterior displacemet of the proximal fragment in proximal humerus fractures8. The posterior circumflex humeral artery (PCHA) provides majority of the blood suppy to proximal humerus. The anterior circumflex hueral artery (ACHA) on the other hand is divided into two main branches- the anterolateral ascending branch and the arcuate artery supplying the greater tuberosity [9].

2. Clinical Evaluation

History

• Mechanism of injury (e.g., Low energy trauma in >65 years while direct trauma/high energy trauma like motor vehicular accident in young adults)

• Associated risk factors (osteoporosis, steroid use)

Examination

• Pain, ecchymosis, abnormal mobility

• Restricted shoulder movement

• Neurovascular assessment (especially axillary nerve function)

Imaging

• X-rays: True AP (Grashey) view, Axillary lateral views

• CT scan: useful in complex fractures especially to assess the intra-articular involvement

• MRI: evaluates soft tissue and rotator cuff integrity

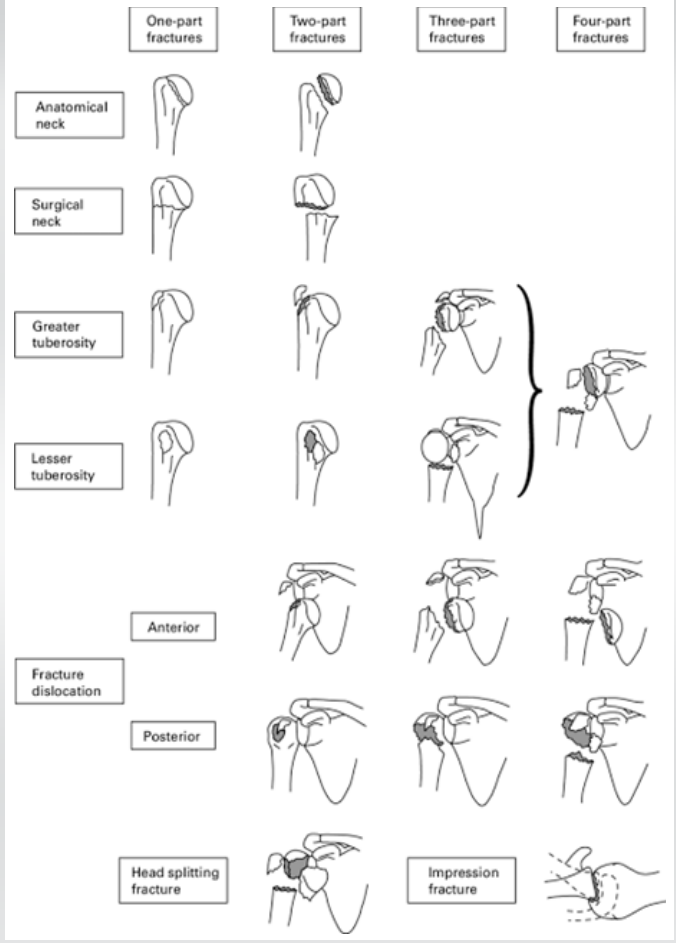

Figure 1: NEER'S Classification

Figure 2: Modified Neer's classification

3. Classification Systems

a) Neer Classification

Based on displacement criteria (>1 cm or >45° angulation)

• One-part: non-displaced

• Two-part: one segment displaced

• Three-part: two segments displaced

• Four-part: all segments displaced

b) Modified Neer Classification

The Neer classification system had an addition of valgus impacted 4 part fracture in which the head of the humerus is rotated in valgus position between both the tuberosities [10] (Fig. 2).

c) AO/OTA Classification [11] (Fig. 3)

• Type A: extra-articular

• Type B: bifocal

• Type C: articular involvement

d) Hertel Classification

Hertel in 2004 classified proximal humerus fractures based on the disruption of medial hinge and involvement of medial calcar (<8mm) which he considered as the main indicators of fragment viability and head vascularity [12]. (Fig. 4)

4. Treatment and Decision-Making

Conservative Management

The decision to go for conservative management depends on two main factors [13, 14].

a) Fracture characteristics- Isolated greater or lesser tuberosity or surgical neck fractures with valgus impaction

b) Patient factors- Elderly low demand patients, patients with medical co-morbidities

Protocol for conservative management

- The position of immobilization can be an arm sling or 300 external rotation (especially in patients with greater tuberosity fracture where there is postero-superior displacement of the fracture). A small bump/pillow beneath the axilla also helps to counteract the medial pull of distal fragment by pectoralis major.

- The duration of immobilization can be between 1 and 3 weeks which further depends upon the fracture characteristics. More than 1 month of immobilization has been shown to increase shoulder stiffness [15, 16].

Figure 3: AO/OTA Classification

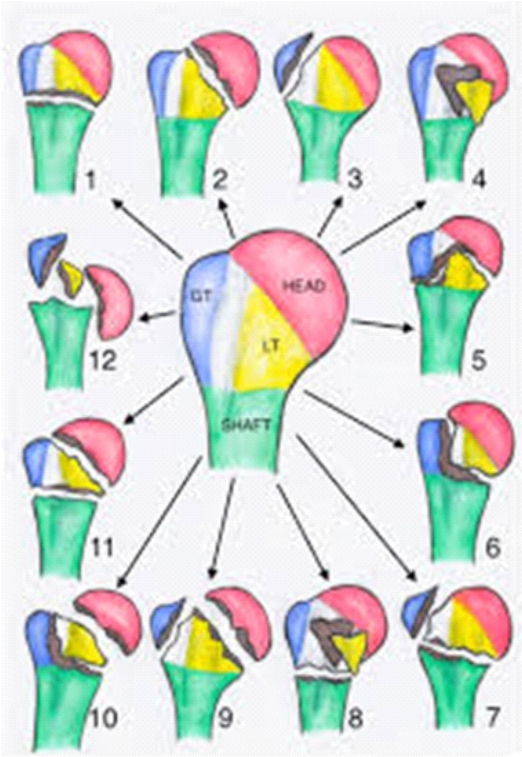

Figure 4: Hertel Classification

Surgical Treatment

A variety of surgical options have been proposed for treating proximal humerus fractures which comprises of

a) Closed reduction and percutaneous pinning

b) Open reduction and internal fixation using proximal humerus plate or intramedullary nail

c) Arthroplasty- Hemi or Reverse total shoulder arthroplasty

a) Closed reduction and percutaneous pinning [17, 18]

Indications-

- 2 and 3 part fractures
- Valgus impacted/ minimally varus impacted surgical neck fractures
- Isolated greater tuberosity fractures with <5 mm displacement

Contraindications

- Displaced varus fractures
- Irreducible fracture dislocations
- Fractures involving comminution of calcar region

Important considerations

- This technique involves indirect reduction of the head to restore the Gothic arch using blunt instruments such as Cobb elevator.
- The reduction also involves using 2 K wires of 2.5-3mm diameter in retrograde fashion from the anterolateral aspect.
- The reduction of the greater tuberosity in 3 part fractures can be achieved using indirect reduction techniques and using 3mm K wire/schanz pin and fixation with 4mm cannulated cancellous screws.

b) Open reduction and internal fixation using proximal humerus plate or intramedullary nail [19-21]

Indications

- 2, 3 and 4 part displaced fractures
- Head split fractures

Contraindications

- Severely comminuted fractures
- Osteoporotic fractures head split in elderly patients

Important considerations

- Fixation with locking compression plates have proved to be the gold standard. The newer implants provide adequate fixation in osteoporotic fractures with better tuberosity management.
- Nailing can provide comparable results like plating in 2 and few 3 part proximal humerus fractures.
- In 4-part fractures the evidence regarding superiority of one implant over another is still debatable. The intra medullary nail can have a theoretical advantage of shorter surgical time, minimally invasive nature and lesser soft tissue disruption. However, the final decision on the type of implant to be used should be tailored to patient factors such as age, fracture configuration, bone quality and functional expectations.

d) Arthroplasty- Hemi or Reverse total shoulder arthroplasty [3, 4]

Indications

- Severe comminuted and head split fragment not amenable for reconstruction
- Elderly high demand patients

Contraindications

- Young patients with good bone quality

Important considerations

- Hemiarthroplasty has limited role because of the problems associated with tuberosity healing which further compromises the functional outcome.
- Reverse total shoulder arthroplasty has emerged to be a viable option with good to excellent results especially in patients with poor bone quality.
- There has been significant improvement in functional outcomes especially external rotation due to adequate tuberosity healing (Fig. 5)

Complications [23, 24]

Early complications

- Neurovascular injury (especially axillary nerve)
- Infection- superficial or deep surgical site infections
- Pin/screw migration

Mid-term complications

- Stiffness
- Malunion/delayed union
- Impingement
- Screw cut-out

Late complications

- Avascular necrosis
- Pot-traumatic arthritis
- Hardware failure
- Compromised functional outcome

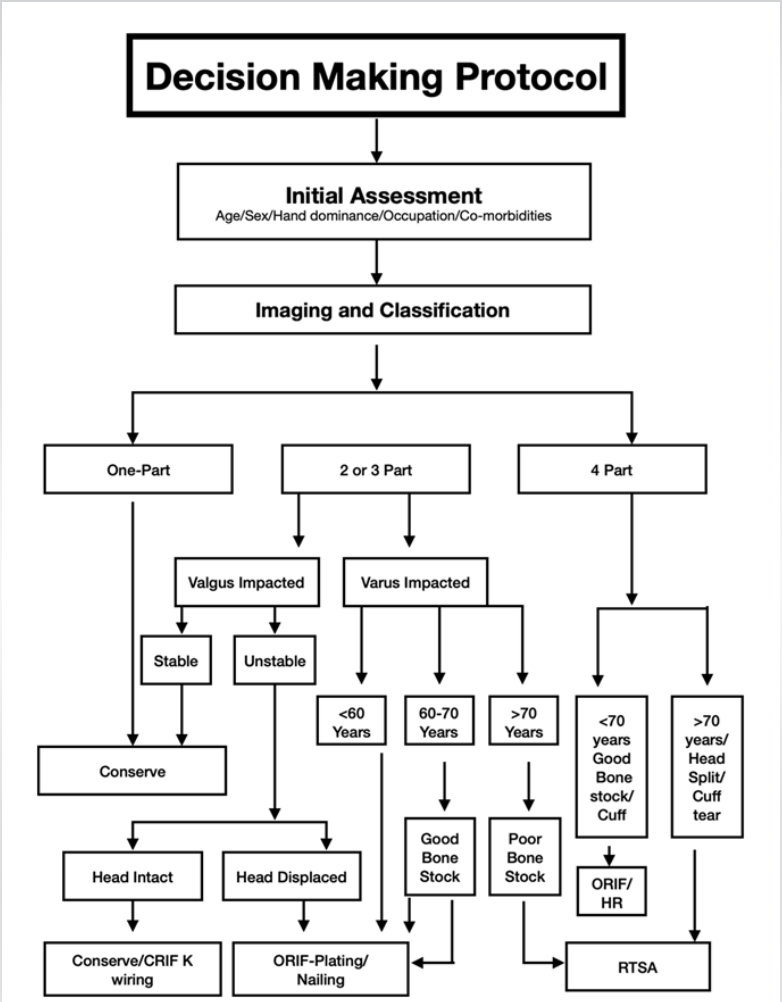

Figure 5: Decision Making Protocol

Conclusion

The treatment of proximal humerus fracture is often challenging. While the isolated 1 part undisplaced fractures and valgus impacted fractures can be successfully treated conservatively, displaced 2/3/4 part fractures, head split fracturs and fracture dislocations warrants surgery. The decision of choosing on modality over other can be difficult. The present review helps in decision making of these fractures.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of Interest: None, **Source of Support:** None

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