Fractured Humerus

Fractures of the humerus are common and may result from injury. However, they are also associated with pathological fractures and osteoporosis, particularly in the elderly.

The anatomy of the humerus

The humeral head articulates with the glenoid fossa of the scapula. The anatomical neck separates the greater and lesser tuberosities from the humeral head. The long head of biceps runs between the tuberosities in the bicipital groove, and the surgical neck is just below the greater and lesser tuberosities. The radial nerve runs posteriorly around the middle third of the humeral shaft in the spiral groove. The medial and lateral epicondyles are at the lower end of the humerus, and the joint surface consists of the capitulum (articulates with the head of the radius) and the trochlea (articulates with the ulna).

Mechanism of injury

Fractures of the humerus usually result from falls or direct trauma. In children the possibility of non-accidental injury should be borne in mind when taking the history and examining the child, especially in very young children. In the elderly, pathological fracture should be considered.

The humerus is a relatively common site of pathological fracture. 8% of humeral shaft fractures in a Swedish study were pathological.\[1\]

Suspect pathological fracture if any of the following features are present:
- Bone pain preceding fracture.
- Limb swelling predating fracture, or marked post-fracture swelling.
- Cystic abnormality of the humerus on X-ray.
- History of malignancy, particularly metastatic.
- Paget’s disease of bone.

Classification of humeral fractures

Classification of humeral fractures is difficult. One method is to classify them as:
Proximal humeral fractures

Epidemiology

- 4-5% of all fractures.

Mechanism of injury

- Usually after a fall on to an outstretched hand from standing height.
- Can also occur during seizures or electric shock when fracture may be associated with a posterior shoulder dislocation.
- Can also result from a direct blow.

Age group affected

- Middle age/elderly are most commonly affected. It is common in women. Many patients are osteoporotic.
- In younger people, the same injury mechanism can cause fracture with co-existing shoulder dislocation. In younger age groups, trauma is likely to be of higher energy and the resulting injury more serious. Humeral epiphysis separation can occur in adolescents.

Presentation

- History of trauma.
- Pain, loss of shoulder/arm function, swelling and bruising.

Assessment

- Determine the injury mechanism. Establish whether osteoporosis is likely.
- Assess for associated injuries to the arm/shoulder/chest wall/lungs.
- Perform a neurological examination, particularly examining the axillary nerve by testing for sensation in the regimental badge area over the deltoid muscle and assessing upper limb muscle power. Assess for brachial plexus injury through distal neurological examination.
- Check peripheral pulses.
- If there are neurological or vascular deficits, orthopaedic referral is required.

Investigations

- X-rays - include AP, trans-scapular (or Y) and axillary views.
- CT scan may be needed in difficult cases.

Classification

- Neer classification: based on the four usual cleavage lines that occur due to the anatomy of the proximal head of the humerus (the articular segment or head, the lesser tuberosity, the greater tuberosity and the surgical neck/shaft). Two-part, three-part and four-part fractures can occur. The fractures are then classified by their degree of displacement and angulation.
- Considered to be displaced if there is more than 10 mm movement or angulation >45°.
- Surgical neck fractures are the most common type of proximal humeral fracture.
Management
- General principles: the fracture should be immobilised as soon as possible and potent analgesia given. Keep the patient comfortable and minimise any need for movement. Open fractures, those associated with a shoulder dislocation or combined with fracture in the forearm are a surgical emergency and an immediate orthopaedic opinion is necessary.
- Most fractures are extra-articular and minimally displaced.
- Up to 85% of proximal humeral fractures can be treated non-operatively.\textsuperscript{[3]} This involves the use of a sling or a shoulder immobiliser. A physiotherapy referral should be made.
- If displaced, surgery may be needed but which surgical technique is used is controversial.\textsuperscript{[4]}
- Surgery involves either closed reduction with percutaneous fixation, open reduction and internal fixation, or proximal humeral head replacement.
- A recent meta-analysis concluded that plate fixation was associated with a higher rate of avascular necrosis than conservative management.\textsuperscript{[5]}
- Fracture dislocations and fractures of the anatomical neck should be referred for orthopaedic review.\textsuperscript{[2]}

Complications
- Neurovascular injury: about a third of proximal humeral fractures produce neurovascular injury. Axillary nerve damage is most common. Suprascapular, radial and musculocutaneous nerves can also be affected. Axillary artery injury may (rarely) occur (look for expanding mass over the proximal shoulder girdle). The brachial artery is also rarely injured.
- Avascular necrosis of the humeral head: this is more common in complex fractures with multiple fragments where interruption to the blood supply is more likely and in fractures of the surgical neck. It causes pain and stiffness in the shoulder. Shoulder arthroplasty may eventually be needed or may be the initial treatment of choice in the fracture management. The development of intramedullary nails and minimally invasive locking plates provides greater ability to fix more complex fractures with less risk to the blood supply.
- Malunion.
- Associated glenohumeral dislocation.
- Associated rotator cuff injury.

Prognosis
- This depends on fracture type, mechanism of injury and the patient's age and underlying health. In general, an elderly person with a proximal humeral fracture never regains full range of movement, whether treated conservatively or surgically. The aim is rehabilitation to a functional range of movement.
- Generally recovery takes at least one year but union is expected at 6-8 weeks.

Prevention
- Adequate treatment of those at risk of osteoporosis.

Hill-Sachs lesion\textsuperscript{[6]}
This is a type of proximal humeral fracture:
- It is defined as a posterolateral humeral head compression fracture and can occur following anterior shoulder dislocation.
- It occurs in 35-40\% of anterior dislocations and up to 80\% of recurrent dislocations.
- X-ray views should include an AP view of the shoulder in internal rotation and a special view known as the Stryker notch view.
- The reverse Hill-Sachs lesion is a compression fracture of the anteromedial humeral head as a result of posterior shoulder dislocation.

Humerus shaft fractures

Epidemiology
- 3\% of all fractures.
- 3\% of fractures in children aged <16 years.\textsuperscript{[7]}

Mechanism of injury
- A Swedish study in 2006 found most are caused by a simple fall.\textsuperscript{[1]}
- May be linked to non-accidental injury in children aged <3 years.\textsuperscript{[7]}
- Usually direct trauma or torsion injury to an upper limb. Occasionally, a fall on to an outstretched abducted arm. Blunt injury/bending forces usually cause transverse fractures. Torsional force tends to result in spiral fracture.

Age group affected
- The Swedish study found that most fractures occurred in elderly patients.\textsuperscript{[1]}

Presentation
- History of trauma.
- Arm pain, swelling and deformity.
Assessment
- Neurovascular examination should be performed. Particular attention should be paid to radial nerve assessment.

Investigations
- AP and lateral X-rays of the humerus.
- Include views of the shoulder and the elbow.

Classification
There is no recognised universally accepted classification. Can be described using:

- Location - proximal, middle, distal. Distal third humeral fractures are also known as Holstein-Lewis fractures.
- Type of fracture line - transverse, oblique, spiral, comminuted, segmental.
- Open or closed.

Management
- The same general principles as listed above should be applied.
- Most can be treated non-operatively in a hanging arm cast or coaptation splint (a splint from the axilla to the nape of the neck with a stirrup around the elbow) followed by a functional arm brace (this has an anterior and posterior plastic shell held together by adjustable Velcro® straps) after 1-3 weeks. A physiotherapy referral should be made.
- Mildly displaced/overlapping humeral shaft fractures may be treated by closed reduction and long arm splint from shoulder to wrist. After any humeral closed reduction, neurovascular assessment and X-rays should be repeated.
- Surgical fixation may be needed if the fracture is segmental or if there is vascular compromise. This involves open reduction and the use of plates and screws or intramedullary fixation/nailing. Radial nerve injury, which may only be temporary, is a risk in any operative procedure.

Complications
- Radial nerve injury: occurs in 11.8% of fractures.\(^8\) It is most common in distal third fractures.\(^9\) It is more common in transverse or spiral fracture.\(^8\) Spontaneous recovery occurs in 70.7% treated conservatively.\(^8\) Initial expectant treatment may avoid unnecessary operations.\(^8\)
- Brachial artery injury.
- Non-union.

Prognosis
- They usually heal within four months.
Further reading & references

- Fractures of the humerus; Wheeless’ Textbook of Orthopaedics
- Image of proximal humerus fracture; Wheeless’ Textbook of Orthopaedics
- Image of transverse humeral shaft fracture; Wheeless’ Textbook of Orthopaedics

6. Hill Sachs Lesion; Wheeless’ Textbook of Orthopaedics

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