

## An Overview of Management of Surgical Neck Humerus Fractures in Skeletally immature patients

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### Abstract

**Background:** Proximal humerus fractures are uncommon in the pediatric age group. Representing about 3% of all fractures and 4% to 7% of all physal fractures, this type of fracture is more common in males than in females in a 1:3 ratio, with peaks at ages 10 to 14 years. Fractures of the proximal part of the humerus, including fractures of the head of the humerus, the epiphysis, and the surgical neck have huge remodeling potential in young children, as a result of 80% of the longitudinal growth of the arm occurring at the physis of proximal humerus. Depending on the age of the patient, an excellent result for non-surgical treatment is expected for children under 11 years of age, as they have a higher remodeling capacity compared to older children. Several surgical approaches have been described for the treatment of displaced proximal humeral fractures, open or closed reduction using Kirschner wires, screws and flexible nails, the most commonly used method is percutaneous K-wires fixation to achieve a satisfactory result in displaced proximal humeral fractures.

**Keywords:** Surgical Neck Humerus Fractures

### Background

The mechanism of injury usually occurs because of a fall on an outstretched hand, or a direct blow to the lateral aspect of the shoulder. These fractures are frequently adolescent sports injuries. Proximal humerus fractures can occur in neonates as a result of birth trauma. These fractures are often caused by rotation or hyperextension of the extremity during passage through the birth canal. Proximal humerus fractures in otherwise healthy infants can be a red flag for nonaccidental trauma or child abuse. Although the exact mechanism in nonaccidental trauma is often unknown, one frequent fracture mechanism is a twisting injury. Fractures that occur in older children with a minimal history of trauma are a red flag to be aware of a pathologic fracture, because unicameral bone cysts are common in this area [1].

#### *Diagnosis of Surgical Neck Humerus Fractures*

Presentation includes a history of direct or indirect trauma to the shoulder, pain, and dysfunction of the affected shoulder, and many patients prefer to hold the arm internally rotated against the body[2].

Clinical examination usually shows swelling, ecchymosis, altered contour of the ipsilateral shoulder, tenderness, edema and decrease range of movement[2].

Open fractures are rare, Open wounds most commonly appear on the medial side of the upper arm adjacent to the axilla due to displacement of distal fragment .

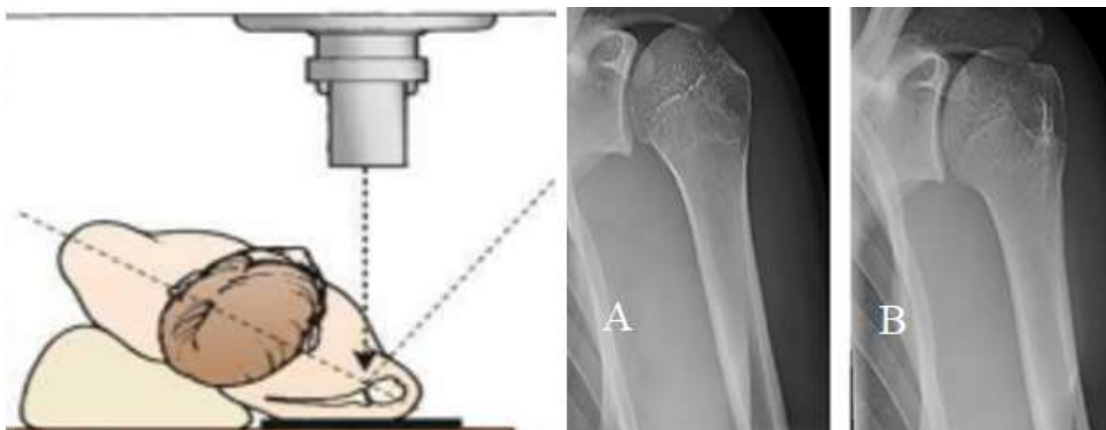
Associated neurological or vascular injury is rare also, The axillary nerve sensation should examine, as this is the nerve most affected, hypoesthesia on the lateral shoulder suggests an axillary nerve injury, Severe swelling and a pulsatile mass suggests vascular injury which are very rare.

**Radiologically**

**X-ray:**

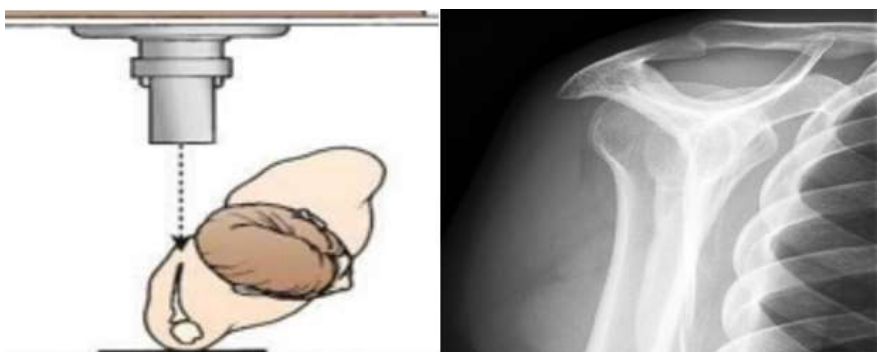
Plain radiographs will confirm the diagnosis. Recommended for evaluation are anteroposterior (AP) lateral scapular Y view), and axillary views of the proximal humerus[3].

AP scapular view (**Figure 1**) uses to assess medial and lateral translation of the fracture end, obtained by placing the unaffected shoulder is angled approximately 40 degrees toward the beam to allow the affected side to lie flat against the X-ray plate because the scapula is tilted 30-40 degrees anterior from the coronal plane[3].



**Figure 1:** AP views with arm in (A)internal and (B)external rotation [3].

lateral Y view uses to assess anterior and posterior translation of the fracture ends, obtained by placing the anterior aspect of the affected shoulder against the X-ray plate. The unaffected shoulder rotates toward the beam about 40 degrees[3].



**Figure 2:** lateral Y view [3].

Axillary view uses to assess the position of the greater tuberosity, the glenoid articular surface, and the relationship of the humeral head to the glenoid, obtained by placing the cassette on the superior aspect of the shoulder. The arm abducted away from the body. The X-ray beam directed cephalad from a position inferior to the shoulder with the beam aimed at the axilla of the patient[3].

Velpau view is an alternative for the patient that cannot tolerate abducting the arm for the axillary lateral view, Obtained by placing the cassette on a flat surface. The patient then leans back over the cassette about 30 degrees as the X-ray beam directed from superior to inferior at the cassette[3].

**Computed tomography and Magnetic resonance imaging:**

CT scan and MRI are rarely indicated but could be considered on a case-by-case basis, particularly if there is difficulty in obtaining adequate X-rays or in the case of pathologic fracture[4].

**Ultrasound:**

Ultrasound may be effective in determining whether or not an infant has a fracture. [4].

**Treatment options of Surgical Neck Humerus Fractures**

**Non-operative treatment:**

Traditionally, non-operative management of proximal humeral fractures in all children and adolescents has led to good and excellent outcomes due to its tremendous remodeling potential[5]. However, the more displaced the fractures and the older the children are, the poorer the results will be due to decrease remodeling capacity[6]. The indication for non-operative management depending on acceptable alignment according to patient age, degree of angulation, and displacement, Beaty has provided some general guidelines **Table 1**[7].

<b>Table 1: Guidelines for “acceptable” alignment of proximal humerus fractures in children and adolescents [7].</b>		
<b>Patient Age by years</b>	<b>Degrees of angulation</b>	<b>Displacement percentage</b>
<b>&lt;5y</b>	<b>70<sup>0</sup></b>	<b>100%</b>
<b>5-12y</b>	<b>40-70<sup>0</sup></b>	<b>50-100%</b>
<b>&gt;12y</b>	<b>&lt;40<sup>0</sup></b>	<b>&lt;50%</b>

Proximal humeral fractures with acceptable alignment can be treated with a sling and swath, a collar attached to a cuff about the wrist, a shoulder immobilizing splint or a coaptation splint combined with a collar and cuff [7].

**Operative treatment:**

Operative treatment can be divided according to the method of reduction (closed vs. open) and method of fixation .Although various methods of fixation have been described, Percutaneous Pinning (PP) and Retrograde Elastic Stable Intramedullary Nailing (ESIN) are the most commonly used[8].

In general, operative treatment indicated in [9]:

- Unacceptable alignment especially in children older than 11 years with neer and Horwitz grade III and IV injuries.
- Unable to obtain acceptable reduction due to soft tissue interposition:
  - 1- Long head of biceps tendon (most common).
  - 2- Joint capsule.
  - 3- Periosteum.
  - 4- Deltoid muscle.
- Unstable fractures after close reduction and open fractures of any age
- Fracture associated with vascular injury.

### ***Elastic Stable Intramedullary Nailing (ESIN)***

Elastic intramedullary nailing this procedure requires retrograde nailing is a good option for surgical neck humerus fractures. However, it has been associated with longer operative times and more blood loss than percutaneous pinning. It also requires additional surgery for hardware removal[10].

### ***Percutaneous Pinning***

Percutaneous penning is the most usual fixation in children, the technique is simple and rapid to perform and provides a rigid construct to maintain reduction and reduce the risk of a second general anesthetic; however, as with all surgeries, this technique associated with some risks, but it is acceptable compared to the complications resulting from leaving the fracture unreduced[11] .

### ***Surgical neck humerus fractures complications***

Acute complications are rare, the most frequent complications in pediatric population are claimed to be angulation and shortening.

- ***Neurologic injuries***

Nerve injuries are rare and occur mainly in severely displaced fractures associated with a medially displaced shaft, The axillary nerve is the most commonly affected. Most of these injuries are neurapraxias that resolve within 4 to 6 months. It can often be diagnosed early after an injury, with loss of strength and sensation of the nerve distribution.

The Axillary and Radial nerves are also at risk during percutaneous pinning[12].

- ***Vascular injury***

Vascular complications are rare; it associated with severely displaced fractures, but can have profound consequences. the axillary artery is the most common injured vessel[13].

- ***Pin loosening & migration***

Pin migration is a frequent problem around the shoulder and can have disastrous consequences. The pins may back out or proximal migration into the joint also is possible. Close follow-up is mandatory. Patients must be counseled on the importance of postoperative compliance and symptoms of concern. Immediate postoperative radiographs should be taken to document pins position, and pins should be removed if there is any change on subsequent films or evidence of loosening[14].

- ***Pin tract infections***

Although any implanted hardware may become infected, pins left protruding from the skin are at particularly high risk. Superficial infections generally are treated with local wound care, pin removal, and oral antibiotics. Deeper infections are less common but can lead to significant complications including osteomyelitis of the humerus[15].

- ***Stiffness***

Stiffness of elbow and shoulder joints is not common complications of pediatric proximal humeral fractures and can be treated by range of motion exercises[16].

- ***Malunion***

Malunion can occur if the fracture is significantly displaced or position is lost after reduction or a failed operative treatment. Children with humerus varus have a significant decrease in the humeral

neck-shaft angle and shortening of the upper extremity. The deformity results in slight limitation of ROM and often does not require surgical intervention. Corrective osteotomy indicated when severe limitation in abduction and flexion[16].

- ***Hypertrophic scarring***

Hypertrophic scarring can occur after surgical reduction of proximal humeral fractures. When the scarring is present in the anterior shoulder region after an anterior deltopectoral incision, the cosmetic deformity may be significant and psychologically damaging, especially for girls[17].

- ***Limb length discrepancy***

Shortening of the humerus occurs more frequently in pediatric treated with surgical intervention than in those treated non operatively. This is likely due to the degree of damage to the physis at the time of injury and not iatrogenically induced due the surgical reduction. Despite this inequality; however, these children rarely develop any functional deficits to warrant surgical intervention[17].

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