Treatment Modalities of Proximal Humeral Fracture

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Abstract

Proximal humeral fractures can form a challenge for the treating surgeons because of the generally osteoporotic nature of bone in the elderly and the relative deforming forces of the adjacent muscles, treatment is often managed by the relative displacement of the anatomic fragments. Non-displaced fractures were treated conservatively, with generally good outcomes. Displaced fractures with angulation of the articular surface >45° and displacement of the major segments >1 cm have been treated surgically. Various methods of open reduction and internal fixation can be used for treatment of these fractures· Open reduction and internal fixation have the advantages of anatomical reduction and stable fixation, but it carries the risk of joint stiffness, implant failure, high rate of infection and avascular necrosis of the humeral head.

Keywords: Proximal Humeral Fracture

Introduction

The most common mechanism of injury for a proximal humerus fracture is a fall on an outstretched arm in an elderly patient with osteoporotic bone. The fracture can be caused by a direct blow to the upper arm or occur when the humeral head strikes the glenoid or the acromion **(1,2).**

The incidence of proximal humerus fractures is growing, especially in the elderly. Proximal humeral fractures account for 4% to 5% of all fractures in adults and less than 1% of children's fractures. Around 3% of physeal fractures occur through the proximal humerus. **(3)**

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Proximal humerus fractures account for over 75% of humerus fractures in patients older than age 40, After age 50 women have a much higher incidence than men particularly after menopause, demonstrating the typical characteristic of an osteoporotic fracture. **(4)**

At a younger age, high-energy trauma is the most common cause of proximal humerus fractures. Up to 85% of all proximal humerus fractures are one-part (non-displaced or minimally displaced) fractures; 15% to 20% of all proximal humerus fractures are classified as displaced. **(5)**

Acquiring a medical history with special awareness of nutritional status, osteoporosis, and diabetes may help with treatment planning, in addition to long-term follow-up care. Patients should also be assessed for their physiological age instead of their chronological age**. (5)**

The symptoms and signs related to proximal humerus fractures can be quite variable. However, they are most often associated with the degree of fracture displacement and comminution. Pain particularly with any tries at shoulder motion is almost always present. Inspection of the shoulder usually shows swelling and ecchymosis. the ecchymosis that arises may extend distally to the arm and forearm or even to the chest and breast area. **(6)**

Non-displaced fractures were treated conservatively, with generally good outcomes. Displaced fractures with angulation of the articular surface >45° and displacement of the major segments >1 cm have been treated surgically. **(5)**

Operative fixation can give stability if there is a requirement for any vascular or nerve repair procedures. Patients who are medically unstable can be treated conservatively or treated once they are more physiologically stable. **(7)**

The fracture pattern can also give hints to the risk of vascular injury to the humeral head and future risk of avascular necrosis. The longer the medial metaphyseal extension of the head, the more likely the vascularity to the humeral head is undamaged. Also, the severity of osteoporosis can influence the success of operative fixation. **(7)**

Determining the cortical thickness of the diaphyseal bone can be a predictor of bone mineral density, which can influence the success of operative fixation. the surgeon should also estimate the radiographs for osteoarthritis or signs of significant rotator cuff disease such as an upward shift of the humeral head, as these can have an impact on outcome and treatment. **(8)**

Non-operative Treatment

Non-operative treatment is indicated for minimally displaced fractures, which corresponding to Neer do not meet the criteria of more than 1 cm of displacement and 45 degrees of angulation. Other relative indications for non-operative treatment may involve elderly or debilitated patients with multiple medical problems. However, the outcome of anatomic reduction and fixation is better than that of non-operative treatment, which may lead to nonunion or malunion. If non-operative treatment is preferred, a sling is generally applied from 1 to 2 weeks. Elbow and hand motion are promoted immediately to decrease the possibility of extremity swelling. **(9)**

As non-operative treatment is most often used for impacted fractures, passive motion is permitted at no later than 2 weeks when they have evaluated that gentle movement of the shoulder is not accompanied with pain and that the humerus moves as a one unite, X-rays are obtained as well to make sure that the fracture fragments have not displaced with motion. If movement at the fracture site is noticed clinically or radiographically, immobilization is continued for another 2 weeks, followed by a repeated assessment. **(10)**

After 4 to 6 weeks, if x-rays shown no change in fracture position and prove of early callus formation, an active motion should be beginning. Strengthening can usually start at 2 to 3 months after injury. Minimally displaced fractures treated corresponding to this method usually have a high success rate. The main complications following conservative management are symptomatic nonunion, severe loss of motion, avascular necrosis, and posttraumatic arthritis. **(11)**

Operative Treatment:

Operative management can consist of closed reduction and percutaneous fixation, operative fixation with plate and screw construct, or intramedullary fixation. The targets of operative fixation are to restore the anatomy of the proximal humerus to permit for successful union, maximize function, and early rehabilitation. **(12)**

The articular surface's relationship to the shaft must be restored to maximize the range of motion in addition to stability. The tuberosities must also be returning to their anatomical position particularly Isolated fractures of the greater tuberosity may be achieved surgically even with less displacement to maximize the function of the arm by re-establishing the insertions of the rotator cuff. **(13)**

Closed reduction and percutaneous fixation:

With Percutaneous fixation of proximal humeral fractures less disruption of the vascular supply than conventional open approaches. **(14)**

The indications for closed reduction and percutaneous pinning involve fractures without comminution with good bone quality. Every week radiographic evaluation and shoulder immobilization for a duration of 4 to 6 weeks is necessary. **(14)**

Contraindications include the occurrence of severe osteopenia or osteoporosis. Comminution of the proximal part of the humeral shaft is too a relative contraindication. Tuberosity comminution that prevents screw or pin fixation prevents the use of this technique. **(15)**

Operative Technique

Preparation:

The patient is placed in the beach-chair position with the affected shoulder resting outside the perimeter of the operating table under general anesthesia. This setup allows easy access to an image intensifier. With the C-arm of the image intensifier located cranially, anteroposterior, and axillary views of the upper end of the humerus are easily obtained. **(15)**

Pinning Technique

a) Conventional method:

The fracture is first reduced under fluoroscopic guidance and either K-wire or screws are inserted percutaneously to stabilize the fracture. Through a stab incision at the level of the surgical neck, the humeral head is elevated with a reduction tool, re-establishing the neck-shaft angle. An anterior pin, a lateral pin, or an anterolateral pin can be used. The anterolateral pin is most employed to achieve percutaneous fixation of the shaft to the humeral head. A superolateral pin can be used as a supplement if instability is a problem, but it will slow rehabilitation because it will impinge on the acromion. **(16)**

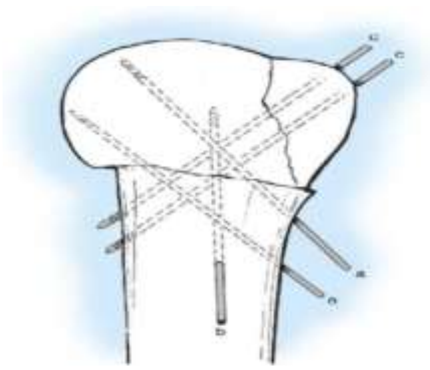

Fig (1): Placement of percutaneous pins for fracture fixation. **(17)**

For the safe starting point, lateral pins should enter the humeral cortex at a point just proximal to the deltoid insertion (about twice the distance from the top of the humeral head to the most inferior margin of the articular cartilage as the incision for the fracture reduction) to avoid injury to both the radial nerve at the spiral groove and axillary nerve which is located at an average of 5 cm distal to the acromion with the pin angulated approximately 45 degrees to the cortical surface. **(16)**

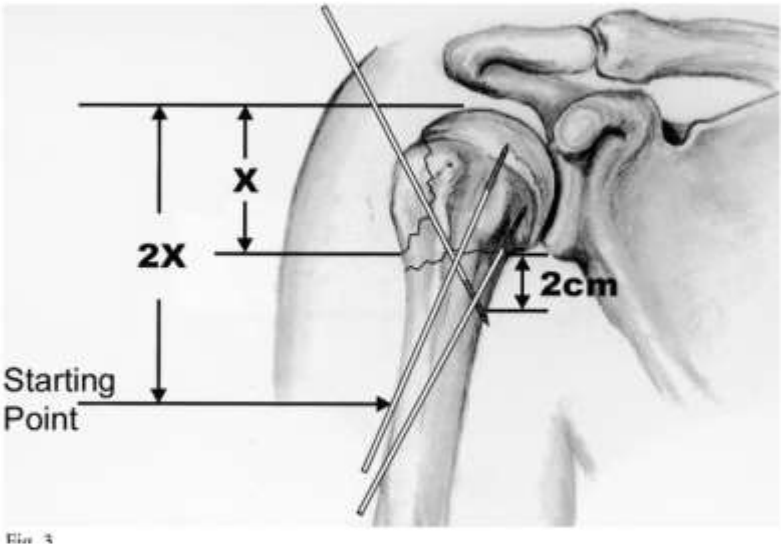

Fig (2): The safe starting point for the proximal lateral pins at the endpoint for the greater tuberosity pins. X = distance from the superior most aspect of the humeral head to the inferior most aspect of the humeral head. 2X = the starting Point for the proximal lateral pin. The endpoint for the greater tuberosity pin should be >2 cm from the inferior most margin of the humeral head. **(18)**

b) Modified method:

After the arm and shoulder are draped freely, the only longitudinal traction force is applied to the upper extremity with the shoulder in adduction to enable fracture reduction. Confirmation of realignment is undertaken with adjustment of the C-arm of the image intensifier instead of rotation of the humerus. K- wires are then used as joysticks for adjustment of the reduction. We typically use 4 2.5-mm non-threaded-tipped Kirschner wires (also known as pins). We describe the first wire as the reduction pin, the second as the anti-rotation pin, and the third and fourth as the stabilization pins. **(19)**

Reduction Pin

Reduction of head-shaft fragments is performed with K-wires inserted from the anterior, posterior, or lateral side according to the direction of the displaced head. These reduction wires are also placed in different positions depending on the fracture angulations in the sagittal plane. The first 2.5-mm non-threaded K-wire is placed through the proximal fragment and passed into the shaft of the humerus.

By placing the K-wire along the wall, a two-point bending effect occurs at the fracture site. This effect enables the operator to reduce the humeral head with no great difficulty and to maintain the anatomic position. **(19)**

Anti-rotation Pin

A counterbalance to the reduction obtained by the first pin is provided by a second pin parallel to the first one. If the reduction pin is placed anterolaterally, then the anti-rotation pin is placed poster-laterally and vice versa. Both reduction and antirotating pins are advanced to the level of the midshaft. **(19)**

Stabilizing Pins

two-tipped threaded pins are used to stabilize the fracture site. These pins are inserted into the greater tuberosity drilled into the far medial cortex obliquely passing the fracture line.

There are three types of wires the first is reduction pin, the second is antirotating pin and the third is stabilizing pin. **(19)**

Fig (3): Reduction of head-shaft fragments was performed with Kirschner pins inserted from the anterior, posterior, or lateral side according to the direction of the displaced head. **(19)**

Fig (4): The first stabilizing pin was inserted into the greater tuberosity and passed the fracture line obliquely and reached the far medial cortex and the pin is then

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drilled through the medial cortex. **(19)**

Fig (5): Anti-rotation of the first pin was provided by a second pin parallel to the first one. Both reduction and antirotating pins were pushed forward till to the level of the midshaft. **(19)**

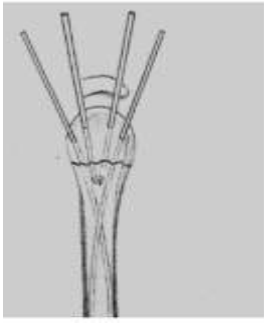

Fig (6): A second stabilizing pin is used to further stabilize the fracture as the first one **(19)**

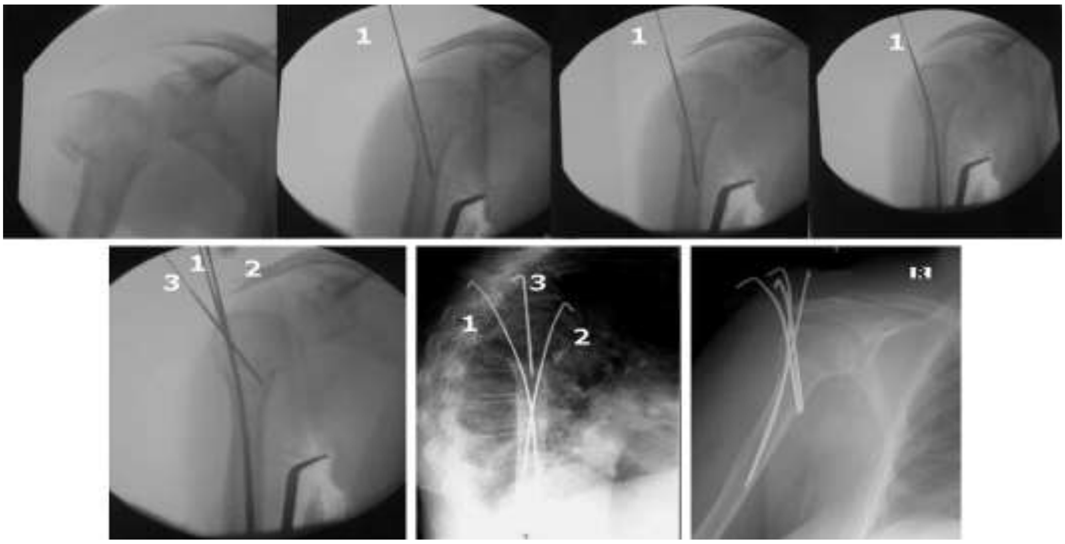

Fig (7): Intraoperative C-arm images of a patient that show the reduction of the fragments by using reduction and antirotating pins and an anteroposterior/lateral x-ray of the same patient at 4 weeks after the operation. **(1)** Reduction pin; **(2)** antirotating pin; **(3)** stabilizing pin **(19)**

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