

Humeral Shaft Fracture with Ipsilateral Anterior Shoulder Dislocation and Posterior Elbow Dislocation

A Case Report and Review of the Literature

Amiethab Aiyer, MD, Matthew Varacallo, MD, Henry Boateng, MD, and J. Spence Reid, MD

Investigation performed at the Department of Orthopaedic Surgery, Penn State University/Hershey Medical Center, Bone and Joint Institute, Hershey, Pennsylvania

Fractures of the humeral shaft are rarely complicated by ipsilateral shoulder or elbow dislocation. While the majority of isolated humeral shaft fractures can be treated nonoperatively, polytrauma, neuromuscular disease, and pathologic fractures are often indications for operative intervention^{1,2}. Injuries resulting in concomitant joint dislocation



Fig. 1-A



Fig. 1-B

Anteroposterior (AP) (**Fig. 1-A**) and lateral (**Fig. 1-B**) radiographs of the right humerus and elbow demonstrating a comminuted oblique midshaft fracture with lateral apex angulation and posterior displacement of the distal fragment. Also evident are the anterior glenohumeral dislocation (**Fig. 1-A**) and the posterior elbow dislocation (**Fig. 1-B**).

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Fig. 2-A

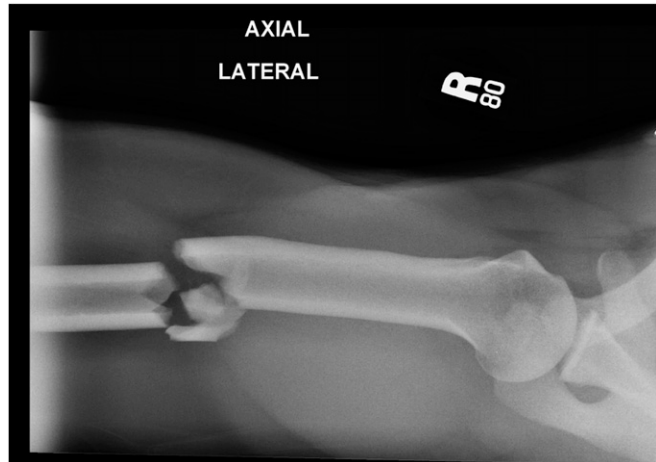


Fig. 2-B

Cross-table lateral (**Fig. 2-A**) and axial lateral (**Fig. 2-B**) radiographs after reduction of the glenohumeral and elbow joints. Splint material was applied to the elbow after the reduction maneuver had been completed.

may be associated with functionally adverse outcomes³. Since first reported in the literature in 1940, there have been twenty-three reports in eighteen papers of humeral shaft fractures associated with anterior shoulder dislocation⁴. There have been even fewer reports of humeral shaft fractures with ipsilateral posterior shoulder dislocation^{5,6} or ipsilateral elbow dislocation⁷.

We present a case of an extremely rare injury involving a humeral shaft fracture with ipsilateral shoulder and elbow dislocation. To our knowledge, the simultaneous dislocation of both joints in association with an ipsilateral humeral shaft fracture has been reported only once in the literature⁷.

The patient was informed that data concerning the case would be submitted for publication, and he provided consent.

Case Report

A twenty-six-year-old black man arrived at our level-I trauma center. He had been struck by a forklift while trying to save a two-year-old child from being hit by the machine. He sustained a left frontal intraparenchymal subarachnoid hemorrhage with associated facial and orbital fractures. Radiographs obtained in the trauma bay and physical examination revealed a fracture of the midshaft of the right humerus with an ipsilateral anterior glenohumeral dislocation and a posterior elbow dislocation (Figs. 1-A and 1-B).

While the patient was in the trauma bay, we first turned our attention to the closed joint reductions. We employed general anesthesia to relax the patient adequately. In order to take tension off of the median, ulnar, and radial nerves distally, and to give us a stable and adequate segment for reducing the shoulder, we elected to reduce the elbow first. During the reduction, countertraction was gently applied distal to the fracture site and proximal to the right elbow. A postreduction radiograph was checked to ensure successful relocation. We then turned our attention to the shoulder. Again, general anesthesia was used to obtain adequate muscular relaxation; gentle traction was employed through the proximal half of the

arm while maintaining countertraction in the axillary and chest wall regions. We were mindful of the brachial plexus during application of the countertraction force. Finally, internal rotation through the proximal segment of the humerus resulted in successful closed reduction. Again, a postreduction radiograph was checked to verify relocation, and the right humerus and elbow were immobilized in a combined posterior slab coaptation splint with the elbow in the neutral position (Figs. 2-A and 2-B). The patient was admitted to the surgical intensive care unit, where he was closely monitored by the neurosurgical team. Given the presence of the head injury, the uncomplicated nature of the elbow dislocation, and no osseous involvement of the glenohumeral joint, we wanted to maximize rehabilitation.

Forty-eight hours later, the patient was taken to the operating room for open reduction and internal fixation of the right humeral fracture. Definitive fixation allowed for preservation of joint motion both proximal and distal to the fracture site. A standard anterolateral approach was used to expose the fracture site. We developed the proximal interval between the deltoid and pectoralis major muscles, and then distally between the biceps and brachioradialis muscles. Once we exposed the comminuted fracture site, a 4.5-mm broad limited contact dynamic compression plate (LC-DCP; Synthes) was used for internal fixation. Prior to the conclusion of the operation, no appreciable laxity was detected at the right elbow with application of varus and valgus forces.

In the immediate postoperative period, the patient was transitioned out of the surgical intensive care unit; he was kept non-weight-bearing and wore a sling for comfort. Sensation and motor function remained grossly intact, with no evidence of radial nerve palsy. Range-of-motion exercises for both the shoulder and the elbow were started immediately in order to limit the development of stiffness and to develop dynamic stabilization of both joints. Once discharged to home, he was instructed to continue wearing the upper-extremity sling while outside of the house, and he was encouraged to remove the arm from the sling several times per day to complete range-of-motion exercises.



Fig. 3-A



Fig. 3-B

Anteroposterior (**Fig. 3-A**) and lateral (**Fig. 3-B**) radiographs of the right humerus at the two-month follow-up demonstrating anatomic alignment and callus formation around the fracture site.

At the two-week postoperative visit, the patient could achieve 45° of both forward flexion and abduction of the right shoulder. Right elbow flexion was achieved from 40° to 95°, and varus-valgus stability remained intact. At the two-month follow-up, he was able to achieve full range of motion at both joints and continued to demonstrate excellent stability at the right elbow. Radiographs taken at that time showed early fracture-healing (Figs. 3-A and 3-B). He returned to the clinic eight months after surgery, demonstrating an equivalent examination from the previous office visit. No radiographs were taken at this time. At the one-year follow-up appointment, he demonstrated full strength in the right arm with pain-free full range of motion and excellent stability at both the right elbow and the right shoulder. No radiographs were obtained at this office visit.

Discussion

This case report describes an extremely rare injury consisting of a right humeral shaft fracture with ipsilateral anterior shoulder and posterior elbow dislocations. To our knowledge, the literature contains only one other report of a similar injury⁷. While most humeral shaft fractures can be managed conservatively, operative treatment should be undertaken in the setting of open fractures, pathologic fractures, polytrauma, associated neurovascular compromise, or inadequate reduction by closed methods^{1,2}. Given the rare nature of these types of combined injuries and the lack of long-term outcome data⁸, there are differing opinions as to the appropriate treatment stratification⁴.

Inan et al. advocated rigid surgical fixation of the humerus prior to closed joint reduction in order to reduce the risk of radial nerve injury⁷. However, because their patient had a fracture that was open and contaminated upon arrival, closed reduction was achieved first, followed by definitive fracture

fixation forty-eight hours later. Radial nerve palsy was not appreciated until after definitive fixation.

We have demonstrated a successful treatment algorithm for this rare injury, advocating closed joint reduction prior to surgical fixation. First, adequate general anesthesia and muscle relaxation was critical to being able to reduce the elbow and subsequently the shoulder; this effectively took tension off of the radial nerve and the brachial plexus, respectively. There is evidence that delayed shoulder joint reduction in the setting of anterior dislocation poses a risk to injuring the brachial plexus³.

Considering that our patient sustained a simple elbow dislocation and a shoulder dislocation without an associated fracture, surgical intervention made sense for two major reasons: the presence of an associated head injury and to allow early range of motion of the elbow and shoulder¹.

Current literature highlights the lack of conformity of treatment for these combined injuries and the difficulty in achieving closed reduction of the shoulder prior to fracture fixation^{4,9-11}. Successful reduction requires a long enough proximal fragment of the humerus in order to manipulate the shoulder⁴, as well as the ability to achieve adequate muscle relaxation. In addition, soft-tissue and/or osseous interposition (nerve, muscle, cortical comminution, periosteum) can block reduction. Care also must be taken to avoid damage to the radial nerve. Some authors have advocated the use of Steinmann pins¹⁰ or external fixators⁹ to aid in the reduction. We propose that closed reduction of the dislocated joint(s) with or without these adjuncts should be attempted and precede surgical fixation in all cases of these combined injuries.

Management of our patient highlights the importance of obtaining complete radiographs to appropriately delineate injuries that may affect joints both proximal and distal to the fracture site⁷. Radiographically, an anterior shoulder dislocation is a much easier diagnosis compared with its posterior

counterpart. However, an anterior shoulder dislocation in the setting of an ipsilateral humeral shaft fracture has been missed in the past when radiographic imaging taken at the time of presentation included only the fracture site¹².

There have been several proposed theories for the mechanism of injury in humeral shaft fractures with ipsilateral joint dislocations. In regard to shoulder dislocations with humeral shaft fractures, Kontakis et al. claimed that dislocation always occurs first and the ensuing forces on the humerus lead to the shaft fracture pattern¹³. Sankaran-Kutty and Sadat-Ali proposed an alternate mechanism in which the force is transmitted through the long axis of the humerus and into the shoulder⁹. Anterior dislocation occurs as the arm extends and abducts, causing the greater tuberosity to impinge on the acromion, levering the humeral head out of the glenoid^{4,9}. The type of fracture depends on the orientation of the humerus. In the neutral position, the humeral neck or the glenoid have the highest chance of fracturing. When the shoulder is flexed, posterior dislocation is likely to occur⁴. In our case, as in the report by Inan et al.⁷, the patient could not recall the exact sequence of events in the trauma. It is reasonable to conclude that the force exerted through the humerus came at a time when the shoulder was abducted and externally rotated, and the elbow was most likely in an extended position with a valgus stress applied.

In conclusion, we report an extremely rare case of a humeral shaft fracture with ipsilateral anterior shoulder dislocation and posterior elbow dislocation. This rare injury emphasizes the importance of evaluating an injured limb in its entirety upon initial presentation. One must first make sure adequate and complete radiographic investigation of all injuries has occurred. The shoulder and elbow should always be visualized in anteroposterior and appropriate lateral radiographs (axillary view for the shoulder). As a general rule of thumb, the joint proximal and distal to the fracture site should be viewed in full when evaluating any fracture.

This case also highlights the importance of a systematic step-by-step approach in reducing joint dislocations in the setting of an ipsilateral fracture. Fracture location and risk of neurapraxia are two key elements in deciding which joint to reduce first. As applied to our case, reducing tension on the radial nerve at the elbow while simultaneously achieving a more stabilized segment for shoulder reduction led us to conclude that reducing the elbow first was the most appropriate course of action. It is also important to perform an appropriate and complete assessment with documentation of the status of the radial nerve prior to any reduction maneuvers, and care should be taken so that there is no damage to the radial nerve during the reduction. In general, closed joint reduction attempts prior to surgical fixation are advocated, and success hinges on the ability to achieve adequate muscle relaxation in the patient. This concept must be communicated with other physicians and care providers while in the trauma bay. Furthermore, factors such as the nature of the fracture (open versus closed, degree of comminution), the amount of soft-tissue swelling and soft-tissue interposition (which may block closed reduction), and the length of the proximal humeral fragment should be considered. Finally, in our patient, surgical fixation of the humerus was important because long-term outcome was largely dependent on achieving full range of motion and stability at both the elbow and the shoulder; this may not have been possible with nonoperative management of the humeral shaft fracture. ■

Amiethab Aiyer, MD
Matthew Varacallo, MD
Henry Boateng, MD
J. Spence Reid, MD
Department of Orthopaedic Surgery,
Penn State University/Hershey Medical Center,
Bone and Joint Institute,
30 Hope Drive, Hershey PA, 17033

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