Open Glenohumeral Dislocation: Skeletonization of the Proximal Humerus Without Associated Fracture

SAMUEL S. MARONEY, DO; D. SCOTT DEVINNEY, DO

Shoulder dislocations are common injuries. In the realm of high-energy trauma, enough force can be dissipated to violate the entire soft tissue envelope surrounding the shoulder girdle, generating an open injury. This article presents a case of a young man involved in a motorcycle accident in which he sustained an open glenohumeral dislocation with complete skeletonization of the proximal humerus. There were no associated fractures with his injury. Our patient underwent staged irrigation and debridement of his shoulder with delayed tendoligamentous reconstruction of the skeletonized proximal humerus. After reconstruction, he was immobilized for 3 weeks and then began a progressive shoulder rehabilitation protocol. He healed with no evidence of infection, residual instability, or avascular necrosis at his 4-month follow-up examination. At that point, he had regained functional use of his shoulder for activities of daily living and had no pain. His range of active motion was limited to 90° of flexion and abduction, 0° of external rotation, and internal rotation to the L4. He had complete resolution of a sensory and motor axillary neuropraxia that resulted from his initial injury. It was felt that the patient had potential for continued gains in range of motion and strength.

Our patient is only the second description of an open glenohumeral dislocation with no associated fractures of the proximal humerus. This skeletonization of the proximal humerus represents a complex soft tissue injury that severely compromises the functional capacity of the shoulder. Understanding the nature of the injury and the involved structures and maintaining a sound treatment algorithm allow orthopedic surgeons to maximize the patient's functional outcome.

Figure: Preoperative photographs prior to initial irrigation and debridement. Gross debris is visualized around the open wound (A). Photograph of the degloving of the proximal humerus (B).
Shoulder dislocations are common injuries. These injuries most often involve damage to the anterior glenoid labrum, glenoid, and humeral head (ie, Hill-Sachs lesion). Luxatio erecta humeri is a unique shoulder dislocation injury characterized radiographically by inferior dislocation of the humeral head below the glenoid and clinically by hyperabduction of the affected arm. By definition, these injuries are unilaterally considered closed injuries. However, in the realm of high-energy trauma, enough force can be dissipated to violate the entire soft tissue envelope surrounding the shoulder girdle, generating an open injury.

This article presents a case of a young man involved in a motorcycle accident in which he sustained an open posterior-inferior glenohumeral dislocation with complete skeletonization of the proximal humerus. There were no associated fractures with his injury. The literature on this type of injury is limited; almost all other descriptions of open glenohumeral dislocations describe an open luxatio erecta with associated greater tuberosity fracture. Only 1 other report of an open shoulder dislocation with isolated soft tissue skeletonization was found in the literature.

**Case Report**

A 25-year-old right-hand-dominant man was brought by ambulance to our Level I trauma center after being involved in a motor vehicle accident in which his motorcycle was struck by another vehicle. He was thrown from the motorcycle and landed on an outstretched hyperabducted arm. The patient was unable to give any additional history about the mechanism of his injury.

On initial examination, his humeral head was visualized in the posterior aspect of his axillary fold (Figures 1A, B). There was gross contamination of the wound, which measured 6 cm² (Figures 1A, C). All of his rotator cuff tendons and glenohumeral ligaments appeared avulsed from the proximal humerus (Figure 1D). No obvious fractures or chondral injuries were visualized on initial examination. The patient had intact radial and ulnar pulses; his neurologic examination showed decreased sensation in the axillary and lateral antebrachial cutaneous distributions. His strength was 4/5 with elbow flexion/extension. Shoulder strength was unable to be tested due to gross deformity and pain.

Radiographs and computed tomography revealed complete open posterior-inferior shoulder dislocation with no evidence of proximal humeral or scapular fracture (Figures 2A, B). The patient also had multiple rib fractures, nonoperative thoracic spine fractures, and bilateral pulmonary contusions. He was stabilized according to Advanced Trauma Life Support protocol and taken emergently to the operating room for irrigation and debridement and reduction of the glenohumeral joint.

At the initial procedure, the patient was found to have avulsed all of the rotator cuff tendons, the capsule, the glenohumeral ligaments, the long head of the biceps, and the pectoralis major tendon (Figure 1D). The gross debris was cleared, all non-viable tissue was removed, and the wound was copiously irrigated with pulse lavage. The humeral head was reduced, the wound closed over a drain, and the shoulder immobilized (Figure 2C, D). The patient was continued on intravenous antibiotics for 72 hours postoperatively and was evaluated by our shoulder service for glenohumeral joint reconstruction.

Two days after his initial irrigation and debridement, the patient’s wound was clean and dry; no recurrent deformity was appreciated. The patient had dense numbness in his axillary nerve distribution and moderate decreased sensation in his lateral antebrachial cutaneous distribution. At that point, plans were made to perform a repeat irrigation and debridement and glenohumeral reconstruction 3 days after the initial procedure.

The patient was placed in the beach-chair position. An extended anterior approach to the shoulder was undertaken, and once through the deltopectoral interval, the shoulder was grossly unstable (Figure 3). Obvious avulsions of all 4 of the rotator cuff tendons were evident. The glenohumeral ligaments and capsule were avulsed off the humerus, along with the...
long head of the biceps tendon and pectoralis major tendon. The shoulder was again irrigated copiously with pulse lavage.

The glenohumeral joint was reconstructed in step-wise fashion. Multiple 3-mm bioabsorbable anchors were placed along the rim of the humeral head. Sutures were then passed through the glenohumeral ligaments and capsule and then tagged. The 4 avulsed rotator cuff tendons were identified and mobilized. A bed of bleeding bone was established at the articular margin, and multiple bioabsorbable suture anchors were placed. The accompanying sutures were passed using a free needle in mattress fashion (Figure 4).

Once all sutures had been passed, suture management was performed, and the capsular and glenohumeral ligament sutures were tied in standard fashion. The rotator cuff sutures were then tied at the articular margin, and a second row of anchors was used more laterally, creating a double-row repair, thus optimizing cuff compression. Once the capsule and rotator cuff were repaired, a biceps tenodesis was performed in the bicipital groove, and the pectoralis major was repaired back to its native bed using bioabsorbable suture anchors (Figure 4B).

The shoulder was then taken through a range of motion (ROM) and noted to be stable. The wound was again copiously irrigated and suctioned dry. A single hemo-vac drain was placed deep in the wound, and the wound was closed in layers. The patient was immobilized and taken to recovery in stable condition.

The patient was immobilized for 3 weeks, with only gentle active ROM of the elbow, wrist, and hand allowed. This was done to protect the integrity of the reconstruction and in favor of stability over motion. He then began gentle passive ROM exercises of the shoulder for 3 weeks, focusing mostly on forward elevation (limit 120°) and external rotation (limit 30°). Active-assisted exercises then began for 3 weeks, followed by active ROM for 3 additional weeks. Finally, at the 12-week mark, he began strengthening exercises.

The patient’s progress with physical therapy was slow; most of his limitations revolved around residual weakness and limitations of active motion. At his 4-month postoperative examination, he was doing well with activities of daily living and was back working on light-duty status. He reported no residual instability symptoms and was pleased with his progress. His wounds were all healed with no signs of infection. His active forward elevation was 90°, abduction was 90°, external rotation was 0°, and internal rotation to the L4. His sensory neuropraxia resolved without complication, and he regained full motor function. Radiographically, his glenohumeral joint was concentrically reduced; no early evidence of avascular necrosis was present.

**DISCUSSION**

Open glenohumeral dislocations are devastating high-energy injuries that threaten the viability and functionality of the involved extremity. Although much has been written about the diagnosis, treatment, and rehabilitation of shoulder dislocations, little has been written about open shoulder dislocations.

In a 1990 review article, Mallon et al. investigated the outcomes of open glenohumeral dislocations. They highlighted the importance of early surgical intervention to prevent avascular necrosis, which can occur in up to 30% of cases if not treated promptly. The authors emphasized the need for active rehabilitation to regain motion and strength, while maintaining stability.

**Table 1: Summary of Key Points**

<table>
<thead>
<tr>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early surgical intervention is crucial to prevent avascular necrosis.</td>
</tr>
<tr>
<td>Active rehabilitation is essential for regained motion and strength.</td>
</tr>
<tr>
<td>Maintenance of stability over motion is recommended initially.</td>
</tr>
</tbody>
</table>

The study by Mallon et al. also underscored the importance of close follow-up and early intervention to address any complications that may arise. They concluded that open glenohumeral dislocations are severe injuries that require a multidisciplinary approach to ensure the best possible outcomes for patients.
reported 86 cases of luxatio erecta, and found only 2 cases with an open gleno-
humeral dislocation. Middledorf was the first to report on this injury pattern,
describing an open luxatio erecta humeri with a large laceration over the deltoid.
The patient subsequently died of wound sepsis. At autopsy, it was found that the
patient had an inferior glenohumeral dislocation with an associated greater tuber-
osity avulsion fracture.

In 1977, Lucas and Peterson reported an open anterior shoulder dislocation. No
description of the patient’s soft tissue injury was reported. The patient ultimately
developed avascular necrosis of the humeral head and had a poor functional out-
come. An unreported patient with an open luxatio erecta was seen by Dr. Rockwood,
MD, and Dr. Wirth, MD, at the University of Texas HSC in San Antonio (M. Wirth,
oral communication, May 2008).

In 1996, Davison and Orwin reported an open luxatio erecta that occurred as a
result of a farm equipment injury. Their patient also had an associated greater tu-
berosity avulsion fracture, along with an avulsion of the subscapularis tendon, and
dislocation of the long head of the biceps tendon. After thorough irrigation and de-
bridement, the glenohumeral joint was reduced. The greater tuberosity fracture was
reduced but did not require fixation. The subscapularis was repaired to the lesser
tuberosity, and the biceps tendon was reduced and repaired to the bicipital groove.
Postoperatively, their patient developed arthrofibrosis that required manipulation
under anesthesia. The patient obtained good early post-manipulation motion, but
ultimately his motion deteriorated and he required a second manipulation with shoul-
der arthroscopy and debridement. At 18 months of follow-up, the patient had 120°
of active abduction and forward flexion, 40° of internal and external rotation, and
nearly full return of rotator cuff strength.

His patient had an isolated skeletonization of the proximal humerus after a motor
vehicle accident, similar to our patient. Immediate irrigation and debridement,
open reduction, and repair of the tendon avulsions were performed. The patient
was immobilized in a shoulder spica cast for approximately 2 months. His recovery
was complicated by a transient wound infection that resolved after repeat irrigation
and debridement; he also developed avascular necrosis of the humeral head. His
functional recovery was limited—to only 70° of abduction—and was believed to be
the result of damage to the suprascapular and axillary nerves. He also had residual
pain in the shoulder, which was believed to be secondary to avascular necrosis. Our
patient also had limited ROM, but he was still in the early stages of his rehabilита-
tion.

Our patient is only the second description of an open glenohumeral dislocation
with no associated fractures of the proximal humerus. This skeletonization of the
proximal humerus represents a complex soft tissue injury that severely compro-
mises the functional capacity of the shoulder. In this injury, as in other open inju-
ries, early irrigation and debridement and early empiric antibiotic treatment are of
utmost importance.

As others have expressed, we feel that early surgical reconstruction followed by
early rehabilitation of the involved shoulder provides the best opportunity for a
reasonable functional outcome. Using a stepwise approach to reconstruction be-
ginning with the deeper capsule and ligamentous structures and working outward
to the rotator cuff, biceps, and pectoralis allows for a more solid reconstruction
and offers the patient the best chance for a successful functional outcome. Open
dislocations of the glenohumeral joint are rare injuries. Understanding the nature of
the injury and the involved structures and maintaining a sound treatment algorithm
allow orthopedic surgeons to maximize the patient’s functional outcome.
REFERENCES