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Use of a Reverse Shoulder Arthroplasty Following a Fracture-Dislocation with a Brachial Plexus Palsy

Jennifer Kurowicki, MD¹, Jacob J. Triplet, DO², Derek D. Berglund, MD³, Thomas Zink, DO², Samuel Rosas, MD⁴, and Jonathan C. Levy, MD³

¹Department of Orthopaedics, School of Health and Medical Sciences, Seton Hall University, South Orange, New Jersey

²OhioHealth Doctors Hospital, Columbus, Ohio

³Holy Cross Orthopedic Institute, Fort Lauderdale, Florida

⁴Department of Orthopaedic Surgery, Wake Forest School of Medicine, Winston-Salem, North Carolina

Abstract

Case: An 80-year-old woman sustained a fracture-dislocation of the proximal aspect of the humerus with a near-complete brachial plexopathy, which was successfully managed acutely using a reverse shoulder arthroplasty (RSA) with repair of the greater and lesser tuberosities. The palsy, which was confirmed with nerve conduction studies, recovered uneventfully along with functional improvement of the shoulder. At the most recent follow-up, there was complete resolution of the plexopathy, with excellent, pain-free range of motion.

Conclusion: Acute RSA with tuberosity repair may be a reasonable treatment modality in the setting of an acute brachial plexus palsy following a comminuted fracture-dislocation of the proximal aspect of the humerus in an elderly patient.

Proximal humeral fractures are the third most common osteoporotic type of fracture (after wrist and hip fractures) treated by orthopaedic surgeons, accounting for approximately 4% to 5% of all fractures^{1–3}. Subtle injury to the brachial plexus often is unappreciated clinically in this setting; however, nerve injury detected via electromyography has been reported with up to 67% of fractures^{4,5}. Recently, complicated fractures and fracture-dislocations are being managed with reverse shoulder arthroplasty (RSA), particularly in the elderly population^{6,7}. Since functional recovery after RSA is felt to be dependent on deltoid function, surgeons may hesitate to proceed with RSA in the setting of a potential axillary nerve injury or brachial plexopathy.

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We present the unique case of an elderly patient who developed a traumatic brachial plexus palsy after a fracture-dislocation of the proximal aspect of the humerus, which was effectively managed with an RSA.

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

Case Report

An 80-year-old woman presented to the emergency department (ED) following a ground-level fall. The medical history was noteworthy for arteriosclerotic heart disease, hypertension, and a seizure disorder. On arrival to the ED, she was experiencing pain and swelling of the right shoulder. Radiographs demonstrated a valgus-impacted fracture-dislocation of the proximal aspect of the humerus, with comminution and displacement of the greater tuberosity fragment (Fig. 1). She was neurovascularly intact. Because of the bone quality, the severity of the injury, and a concern regarding additional displacement of the fracture, a closed reduction was not attempted. The shoulder was placed in an immobilizer, and she was admitted for further evaluation.

The following morning, there was decreased sensation in the radial and median nerve distributions. Furthermore, decreased function of the triceps, the biceps, the wrist extensors, the wrist flexors, the finger extensors, the finger flexors, the extensor pollicis longus, and the intrinsic muscles of the hand was noted, suggesting involvement of the radial, musculocutaneous, median, and ulnar nerve distributions. This was highly concerning for a developing brachial plexus palsy. The deltoid was not assessable because of the severity of the pain. Because of the impending nature of the neurologic status, she was immediately scheduled for surgery with definitive management using an RSA with tuberosity repair.

Intraoperatively, the head and shaft of the humerus were displaced anteroinferiorly, and were reduced easily without damage to the major vessels. The axillary nerve was visualized and noted to be intact. A cemented RSA prosthesis was implanted using the DJO Monoblock Reverse Shoulder Prosthesis (DJO Surgical), utilizing the “black-and-tan” technique⁶. The greater and lesser tuberosities were repaired using a previously described technique⁶. Postoperatively, the shoulder was placed in an immobilizer, and the patient was discharged the next day. She was instructed to wear the immobilizer for the initial 6-week period, and she was encouraged to initiate pendulum exercises 3 times daily. Occupational therapy was consulted to assist with passive movement and splinting of the hand and wrist.

At the 6-week follow-up appointment, active range of motion (AROM) for forward elevation was limited to 40°, and external rotation was limited to 15°. The patient reported continual numbness and weakness of the right arm. This lack of improvement was felt to be secondary to the unresolved brachial plexopathy. Nerve conduction studies performed at 6 weeks confirmed a moderate-to-severe brachial plexopathy involving the median, ulnar, and radial nerves, with the most severe changes noted at the posterior division/radial nerve distribution. She was instructed on self-directed supine shoulder active-assisted exercises, and

encouraged to use the extremity for light activities of daily living with a 2-lb (0.9 kg) weight restriction.

After 3 months, the patient was encouraged to continue self-directed stretching and strengthening exercises and was able to return to full activity within her comfort level. At 5 months, active forward elevation had improved to 100°, and external rotation had improved to 50°. Internal rotation was limited to the level of the sacrum. Manual isometric strength was 5 of 5 in all planes. At 6 months postoperatively, anatomic healing of the tuberosity was observed on radiographs (Fig. 2), and there was clinical resolution of the plexopathy, with restoration of a functional arc of shoulder motion (Video 1). At 1 year, active forward elevation had increased to 140°, and external rotation was measured at 60°. Active internal rotation had improved to the level of T12. The patient-reported outcomes included a Simple Shoulder Test (SST) score of 10, an American Shoulder and Elbow Surgeons (ASES) total score of 95, a Single Assessment Numeric Evaluation (SANE) score of 90, and a visual analog scale (VAS) pain score of 0. There were no reported instability events during the postoperative period, and the shoulder remained functional and stable. Clinical findings suggested complete resolution of the brachial plexopathy; the decision was made to not perform another nerve conduction study.

Discussion

Herein, we described the case of an 80-year-old woman who sustained a fracture-dislocation of the proximal aspect of the humerus and quickly developed a brachial plexus palsy that was successfully managed with an RSA and tuberosity repair. While proximal humeral fractures are relatively common in the elderly, an associated brachial plexopathy is rare. Importantly, this case illustrates that these nerve palsies may not be evident on initial examination; they may ensue subsequently in the following days, as previously reported^{4,8}. Relief of the neurologic compression or stretch is important to minimize damage and hasten recovery. A thorough neurovascular examination is important to understand the distribution of nerve compromise and help dictate treatment, even though examination may be unreliable following acute trauma⁴.

While RSA has gained popularity in successfully treating proximal humeral fractures in the elderly, surgeons may be hesitant to consider this option in the setting of a concomitant axillary nerve injury or brachial plexopathy. Concerned about a loss of function or prosthetic instability, the surgeon may elect to delay treatment until nerve recovery has occurred. This may create additional reconstructive challenges and delay the recovery for these patients. In our patient, an RSA was performed acutely to manage a fracture-dislocation of the proximal aspect of the humerus with a concomitant brachial plexus palsy. We emphasize the importance of the tuberosity repair in the setting of a plexopathy to provide intrinsic joint stability because the repaired tuberosities function as an internal splint to maintain a located joint in the setting of a potentially nonfunctioning deltoid.

Utilization of RSA for proximal humeral fractures recently has grown in popularity^{6,7,9}. Fractures in the elderly often pose reconstructive challenges because of poor bone quality, deformity, comminution, and periarticular soft-tissue damage, as well as potential coexisting

rotator cuff pathology and associated arthrosis¹⁰. With unreliable results reported using hemiarthroplasty for similar fractures in the elderly¹¹, the predictability of RSA in restoring function has fostered a growth in its utilization. Nonetheless, with a concomitant brachial plexus injury, surgeons often are hesitant to consider RSA, which is typically dependent on the deltoid for both stability and functional recovery.

The risk of neurologic injury after displaced proximal humeral fractures has been previously documented^{4,12–15}. The true prevalence of neurologic involvement after shoulder fractures and dislocations may be underestimated. Stableforth reported a 6.2% rate of brachial plexus injuries after proximal humeral fractures¹⁵. However, more recent studies have disputed these findings. In a prospective study of 215 patients who sustained anterior shoulder dislocations or fractures, Visser et al. evaluated the rate and severity of nerve injury⁴. They noted disorders with electromyography in 62% of patients, with the axillary nerve being the most common and severely involved nerve. In a more recent study, Visser et al. showed axonal denervation and solitary nerve injury in 67% and 15% of patients, respectively¹⁶. They concluded that clinical examination alone is not reliable to detect axonal nerve injury and that these injuries have a good prognosis for recovery, with almost all cases recovering within 12 to 45 weeks¹⁶. These findings are consistent with our case report. Lack of substantial clinical improvement at the 6-week interval suggested an unresolved plexopathy. Furthermore, clinical examination in the ED revealed no neurologic impairment, and there was a dramatic decline in nerve function the following day. Nonetheless, by 6 months, a near-full recovery of upper-extremity function was observed.

Use of RSA in this setting is not without risk, and care must be taken to minimize further plexus injury. Placement of the RSA prosthesis typically requires lengthening of the humerus, which has been associated with acute postoperative nerve injury outside of the fracture setting¹⁷. When performing RSA for acute fracture in the setting of a known traumatic brachial plexopathy, attention should be directed toward minimizing humeral lengthening during prosthetic selection and implant placement. The surgeon might consider prosthetic options that create additional stability, utilizing larger glenospheres and more constrained humeral sockets¹⁸.

The obvious concern relates to resolution of any axillary nerve palsy because, traditionally, RSA has been contraindicated in patients with severely impaired deltoid function related to axillary nerve injury¹⁹. Fortunately, nerve lesions that are sustained along with fractures of the proximal aspect of the humerus recover well⁴. It is important to maintain stability of the shoulder during nerve recovery. This can be achieved through prosthetic selection as well as by careful and secure repair of the greater and lesser tuberosities. Tuberosity resection in the setting of axillary nerve palsy can result in prosthetic instability that may be quite difficult to resolve (Fig. 3).

In summary, brachial plexopathies after complex fractures of the proximal aspect of the humerus in the elderly can be managed effectively with use of an acute RSA. Given the concern for prosthetic instability, emphasis on proper implant selection and secure tuberosity repair is essential.

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Fig. 1.
Preoperative anteroposterior radiograph demonstrating a valgus-impacted fracture-dislocation of the proximal aspect of the humerus with comminution and displacement of the greater tuberosity fragment.

Fig. 2.
Anteroposterior postoperative radiographs of the right shoulder taken at the 10-day (**Fig. 2-A**), 6-month (**Fig. 2-B**), and 12-month (**Fig. 2-C**) follow-up, documenting anatomic healing of the greater tuberosity.

Fig. 3. Anteroposterior radiograph of a patient treated with an RSA and tuberosity excision in the setting of an unappreciated axillary nerve palsy. The prosthesis remained unstable despite 2 revision attempts.