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Surgical Management of Simultaneous Bilateral Proximal Humerus Fractures: 2 Case Reports

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Abstract

Bilateral proximal humerus fractures are relatively uncommon. We present a case report detailing the simultaneous surgical management of two patients with bilateral proximal humerus fractures; one young patient treated with bilateral open reduction and internal fixation, and one geriatric patient treated with bilateral reverse total shoulder arthroplasties. Simultaneous bilateral shoulder surgery has logistical challenges, and thus, the purpose of this report was to offer a method for repeatable, safe, and efficient surgical positioning and operating room set up for simultaneous bilateral shoulder surgery as illustrated by two cases.

Keywords: Simultaneous; Bilateral; Proximal Humerus; Arthroplasty; ORIF; Positioning

Introduction

Proximal humerus fractures present following a bimodal distribution due to low energy trauma in the elderly and higher energy trauma in the younger population. These fractures are common in the elderly,1 however, comminuted fractures necessitating operative intervention account for only 3% of proximal humerus fractures [2]. The simultaneous treatment of bilateral proximal humerus fractures is a difficult undertaking due to surgical positioning challenges related to anesthesia, the need for the availability of two shoulder surgeons, and the post operative recovery with immobilization and mobility restrictions bilaterally. Though not common, simultaneous bilateral surgery can is important to consider for bilateral injuries that would become more difficult to manage on a delayed fashion. Given the bilateral nature of these injuries, a staged approach does not offer any significant advantages to the rehabilitation course as a period of immobilization is required for both surgical and nonsurgical management. The aim of this case report is to present two cases of simultaneous bilateral shoulder surgery for proximal humerus fractures with a focus on surgical positioning, anesthesia set up, and acute post operative rehabilitation.

Simultaneous Bilateral Open Reduction and Internal Fixation (ORIF)

A 27-year-old right-hand dominant male presented to the emergency department after a suspected seizure. Radiographs and computed tomography (CT) showed bilateral proximal humerus fractures, with a posterior fracture dislocation of the humeral head on the left and a comminuted 4-part fracture on the right (Figures 1-3). The patient had no pre-existing shoulder pain, dysfunction, or limitations to his activities of daily living prior to the injury with a body mass index (BMI) of 20.9. He had no history of seizure prior to this event; however, alcohol withdrawal was the likely cause.

Figure 1: AP and Axillary radiographs of patient 1's right shoulder showing comminuted 4-part fracture of the proximal humerus.

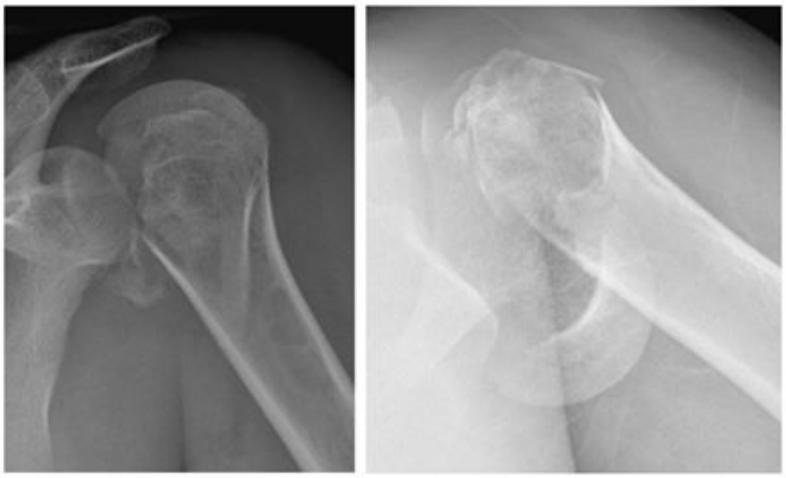

Figure 2: AP and Axillary radiographs of patient 1's left shoulder showing posterior fracture dislocation of the humeral head.

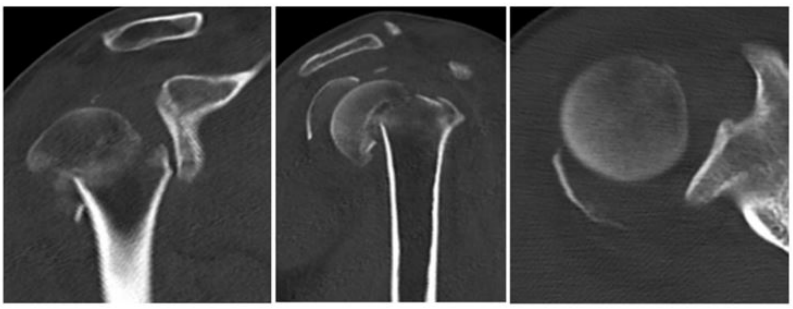

Figure 3: Coronal, Sagittal, and CT views of patient 1's right shoulder demonstrating comminuted 4-part fracture of the proximal humerus.

Given the patient's age, pre-injury functional status, and the fracture patterns, the patient elected to proceed with bilateral open reduction and internal fixation after a thorough discussion of the risks, benefits, and alternatives.

He was taken to surgery one day after admission. The patient was provided bilateral ultrasound-guided supraclavicular bupivacaine blocks by a board-certified anesthesiologist and general endotracheal anesthesia. He was placed into the beach-chair position with bilateral upper extremities both prepped into the sterile field. The operating room table was turned 180 degrees so that the feet were turned towards anesthesia. Peripheral intravenous and arterial-line access was obtained in the patient's feet. The secure airway, circuit, and cardiac leads brought to midline and were run down the center of the patient toward the feet where they could easily be accessed and monitored by the anesthesia team frequently throughout the case to ensure a secure airway was maintained. Sequential compressive devises were placed on the patient's calves for mechanical deep vein thrombosis prophylaxis during the case. A Spider2 arm positioner (Smith + Nephew, London, UK) was used to position the patient's right arm. It was not technically feasible to fit two separate apparatuses for the Spider2 arm positioner on the bed given the large footprint of the battery and mechanism attaching to the bed. Therefore, an arm positioner was selected for the more challenging side and a padded mayo was selected for the other side (Figure 4).

Figure 4: Clinical photographs of surgical positioning. The upper left image depicts set up to enable bilateral sterile preparation. The upper right image depicts the ventilator tubing and cardiac leads running down the center of the patient towards the feet where the anesthesia team is set up. The bottom image depicts the patient after bilateral sterile drapes are applied.

Two separate operating room setups were used with two sets of sterile trays, and implants, one for each side. The C-arm fluoroscopy unit was brought in from the head of the bed opposite of the anesthesia team where it could easily be transitioned from one side of the patient to the other without interfering with either surgical team.

A standard deltopectoral approach was on the right. Due to the comminution and bone loss, an anatomic reduction was not possible. With a goal of restoring overall head/neck/shaft alignment and rotation, an acceptable reduction was achieved by using a tenaculum to reduce the humeral head onto the glenoid. Next, C-arm fluoroscopy was used to confirm an appropriate head/neck-/shaft alignment, and the fracture was fixed using a 4-hole proximal humerus locking plate (Stryker, Kalamazoo Michigan, USA) with locking screws proximally and nonlocking cortical screws distally.

As the left shoulder incision was being closed, attention was turned to the right shoulder which had been sterilely prepped and draped before the start of the contralateral side. Again, a standard deltopectoral approach was used.

#2 Fiberwire sutures (Arthrex, Naples Florida, USA) were placed into the bone tendon interval of the greater and lesser tuberosity fragments and a tamp was used to elevate the impacted anatomic neck fracture to obtain reduction. Intra-operative C-arm fluoroscopy was again used to achieve near anatomic reduction of fracture fragments that were held in place using Kirschner wires. Definitive fixation was obtained using a 3-hole proximal humerus plate (Stryker, Kalamazoo Michigan, USA) using proximal locking screws and distal non-locking cortical screws. The length of the case was 3 hours and 11 minutes, and the estimated blood loss for the case was 150 mL per side for 300 mL total. He was admitted back to the general care floor with no complications. On post operative day 3, the patient was discharged to home.

Postoperatively, the patient was placed in bilateral slings with abduction pillows and made non-weight bearing bilaterally. The patient was allowed to start pendulums immediately postoperatively bilaterally. Passive range of motion exercises were also initiated immediately after surgery with forward elevation gradually progressing from 0-90 degrees to 0-170 degrees of forward flection, and passive external rotation from 0-30 degrees initially to 0-90 degrees over a 12-week period. Physical therapy was started at 6 weeks after weaning from the slings.

At his most recent follow up 4 weeks post operatively, he had improvement in his shoulder pain, however the patient was then subsequently lost to follow-up. The patient was not compliant with sling wearing and advanced his range of motion independently. He demonstrated active range of motion of forward elevation to 75 degrees on the right and 100 degrees on the left, as well as external rotation to 5 degrees on the right and 10 degrees on the left at 4 weeks. Post operative radiographs at that time showed loss of reduction of the greater tuberosity fragment of the right shoulder and stable alignment on the left (Figures 5-6).

Figure 5: Postoperative AP and axillary radiographs of patient 1's right shoulder.

Figure 6: Postoperative AP and axillary radiographs of patient 1's left shoulder.

Simultaneous Bilateral Reverse Total Shoulder Arthroplasties (rTSA)

A 65-year-old right-hand dominant female with past medical history of type 2 diabetes and obesity (BMI 48.6) presented to the emergency department after a ground level fall. Radiographs and CT of the bilateral shoulders revealed that she had a posterior fracture dislocation of the humeral head on the right, and on the left, she had a 4-part valgus proximal humerus fracture with medial hinge disruption (Figure 7-8).

Figure 7: AP radiograph as well as coronal and axial CT images or patient 2's right shoulder demonstrating a posterior fracture dislocation of the humeral head.

Figure 8: AP radiograph as well as coronal and axial CT images or patient 2's left shoulder demonstrating 4-part proximal humerus fracture.

Given the patient's age and the known high risk for avascular necrosis (AVN) of her humeral heads with these fracture patterns,3 we elected to proceed with bilateral reverse total shoulder arthroplasties.

The patient was positioned in a nearly identical fashion as described for patient 1 in this series, with the only difference being the lack of intraoperative C-arm fluoroscopy utilization. The procedure was performed simultaneously by two surgeons in beach-chair position. 1 gram of tranexamic acid was given by our anesthesia colleagues prior to making the first incision. On the left side, a deltopectoral approach to the shoulder was undertaken. The humerus was reamed and broached with an acceptable fit obtained, and the glenoid was prepped. Next, the definitive humeral implant was placed using bone graft to give a good fit by utilizing impaction grafting. The final implants used were a size 13 x 83 mm humeral stem, a size 40 mm regular glenosphere set at D offset to the 6 o'clock position, a 40 mm 0+ humeral polyethylene bearing, and a mini baseplate with corresponding central 6.5 mm non-locking screw and four peripheral 4.75 mm locking screws (Zimmer-Biomet, Warsaw Indiana, USA). The humeral head autograft was used under the greater tuberosity, and the greater and lesser tuberosities were tensioned down with racking hitch stitches and then figure-of-8 through the tuberosities to each other to compress them against the humeral shaft.

A deltopectoral approach was also undertaken on the right shoulder. Tag sutures were placed in the greater and lesser tuberosity fragments. The humeral head was found to be dislocated posterior to the humeral shaft and was easily removed as it had no soft tissue attachments. The greater and lesser tuberosity fragments were tagged and then later incorporated into the final repair. The humerus was prepped for a size 13 x 83 mm stem and standard tray with 40 +3 bearing, and the glenoid was prepped for a size 40 mm standard glenosphere with D offset inferiorly and a mini baseplate (Zimmer-Biomet, Warsaw Indiana, USA). The greater and lesser tuberosities were repaired through bone tunnels to the humeral shaft using racking hitch stiches. Sutures were also passed through the greater tuberosity to the lesser tuberosity to secure the two together. The total length of the case was 2 hours and 19 minutes with an estimated blood loss of 500 mL in total. The patient was discharged to a transitional care unit on Post operative day 4.

Post-operatively, rehabilitation consisted of no active or passive range of motion of her bilateral shoulders in bilateral slings for 4 weeks. She remained in her slings for 6 weeks, when she began activities of daily living using her shoulders. Her most recent follow up appointment was at 7 months after surgery at which she achieved forward elevation to 110 degrees on the right and 120 degrees on the left as well as external rotation to 30 degrees and internal rotation to her buttock bilaterally. Post-operative radiographs at that time showed stable alignment of well-fixed implants bilaterally (Figure 9-10). She returned to her desired level of activity and was happy with her outcome.

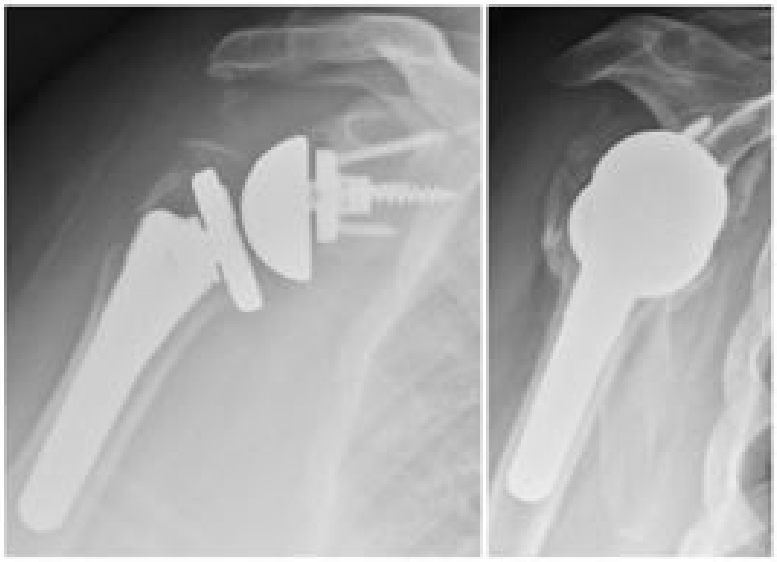

Figure 9: Post operative AP and scapular-Y radiographs of patient 2's right shoulder with rTSA

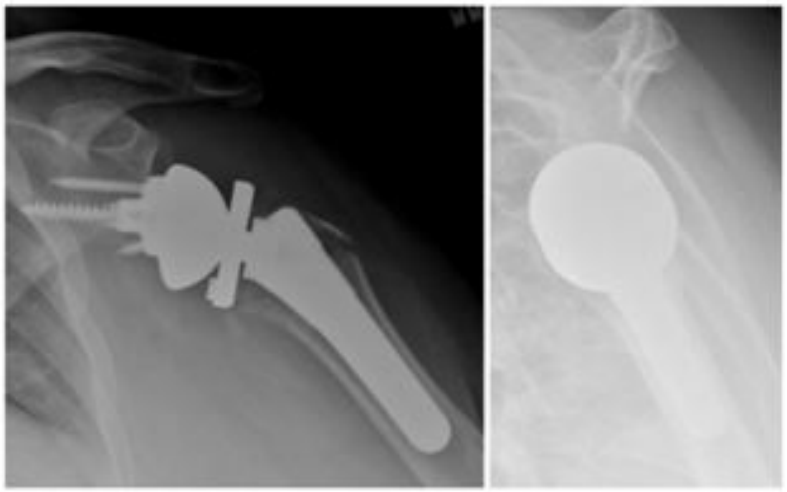

Figure 10: Post operative AP and scapular-Y radiographs of patient 2's left shoulder with rTSA

Discussion

Proximal humerus fractures in the younger population are typically caused by high energy mechanisms or epileptic convulsions [4-7]. In the geriatric population, these fractures typically result from low energy mechanisms. Simultaneous bilateral proximal humerus fractures are uncommon with a paucity of literature consisting only case reports, and the treatment of these patents with single stage surgery is exceedingly rare [8-18]. In our case series, both patients' injuries followed the published causative norms.

Generally, bone preservation is a focus in the treatment of proximal humerus fractures that occur in young patients. An algorithm exists to help aid in surgical decision for proximal humerus fractures with favorable outcomes in younger patients undergoing ORIF [19]. A 2014 systematic review of the literature involving a combined 4500 patients with proximal humerus fractures also supported the notion that the young population (under 65 years old) can be reliably treated with ORIF, [20] making the decision to treat Patient 1 with ORIF straightforward.

Surgical decision making for complex proximal humerus fractures in the elderly population greater than 65 years old becomes more difficult due to the prevalence of osteoporosis. 3 and 4 part fractures and patterns with significant displacement are known to be at high risk for AVN of the humeral head.3,21 ORIF has also been found to result in significantly more complications and a higher reoperation rate than arthroplasty for proximal humerus fractures in geriatric patients [22]. It is important to consider that the risk of nonunion or malunion of tuberosities is another indication to consider reverse total shoulder arthroplasty over ORIF or anatomic total shoulder arthroplasty, as a reverse total shoulder arthroplasty will allow for the patient to better tolerate poor tuberosity healing or rotator cuff disfunction with less disability by utilizing the deltoid for active elevation [23-24]. Therefore, reverse total shoulder arthroplasty was the treatment for Patient 2 in this series.

This is the first report to our knowledge that details surgical positioning for simultaneous bilateral shoulder surgery. Our report offers a safe and repeatable method for positioning the patient to allow for unrestricted operative access as well as uninhibited access to the patient by our anesthesia colleagues. Prepping the patient in the described manner allows for decreased surgical time by eliminating the need to re-establish a second sterile field and allows for simultaneous procedures if two surgeons are available. Anesthesia has full access to the endotracheal tubing and cardiac leads under the drape in beach-chair position and can easily manage intravenous and arterial access in the patient's lower extremities.

An important factor in the clinical course for the patients in this report relating to simultaneous surgery is the necessity of a period of disability while post operative restrictions are in place. This necessitates a well-developed post operative plan for rehabilitation, and a period of reliance on family or skilled nursing care that lengthen the period of rehabilitation. A period of immobilization is necessary for tuberosity healing, however, extended periods of immobilization can lead to bone resorption and can limit healing [25]. rTSA patients should be made aware that the most predictable limitation after rTSA is related to internal rotation, which can impact activities of daily living such as toileting, hygiene, and putting on clothing items behind the back [26-27]. Rising from a chair can also be impacted because it requires both abduction and internal rotation which are limited after the procedure. Thus, a structured rehabilitation program with early passive range of motion and targeted physical therapy after a brief period of immobilization as described in this report is paramount. Structured preoperative discussion and expectation management is crucial, as the patient's ability to follow a period of immobilization will significantly impact their outcome. Patients that do not have an adequate support system or ability to comply with a period of complete reliance on a care provider due to bilateral shoulder immobilization post operatively are not good candidates for simultaneous bilateral shoulder surgery. Although patient 1 was lost to follow up and exact functional outcomes are unknown, Patient 2 was able to return to her desired level of activity and participate in all activities of daily living independently by following the described rehabilitation plan after surgery.

Conclusion

Our report illustrates a repeatable method for surgical positioning for patients undergoing bilateral shoulder surgery. Single-staged bilateral shoulder surgery for proximal humerus fractures appears to be a viable treatment option; however, long-term follow up with a larger sample size is needed to further investigate this topic.

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