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Two-day staged bilateral reverse shoulder arthroplasty for traumatic proximal humerus fractures: A case report

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Institutional review board approval was not required for this case report.

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Abstract

Introduction: Bilateral proximal humerus fractures (PHF) is an injury with a rare etiology in the elderly population. Although reverse shoulder arthroplasty (RSA) is the preferred surgical option for unilateral 3 and 4-part PHFs, there is paucity of literature on the utility of simultaneous or shortly staged bilateral RSA performed for this injury. In this case, we present an 80-year-old woman with bilateral 3 and 4-part PHFs due to a fall off of a treadmill who underwent near-simultaneous bilateral RSA.

Case Description: The patient’s shoulders were immobilized for only two weeks postoperatively followed by initiation of activities of daily living and physical therapy. Satisfactory results were achieved at 5-months as the patient had active 130 degrees forward flexion, 80 degrees abduction, 30 degrees external rotation, and internal rotation to her buttock with no associated pain. All follow-up radiographs showed a stable RSA without evidence of scapular notching, dislocation, loosening, or failure. At two years postoperation, the patient’s active range of motion was relatively unchanged with 120 degrees forward flexion, 100 degrees isolated abduction, and 10 degrees external bilaterally. Abduction and external rotation strength were 3/5 bilaterally. The American Shoulder and Elbow Surgeons score was 91.6 for both arms.

Discussion: In this report, we presented a case in which a geriatric patient with bilateral, traumatic PHFs was successfully treated with two-day staged RSA. We are the first to demonstrate favorable outcomes after allowing earlier independent range of motion at two-weeks postoperatively in a patient treated with RSA for fracture. We also show that early use of the arms for daily activities may be beneficial to regaining range of motion quickly and achieving functional independence faster. Larger studies are needed to further evaluate the efficacy of bilateral RSA without
prolonged immobilization in order to guide surgical decision making when caring for highly at-risk populations.

Level of evidence: Case Report

Keywords: Reverse total shoulder arthroplasty, proximal humerus fracture, Bilateral, Staged, early motion

Proximal humerus fractures (PHF) are a common injury in our elderly patient population. In general, treatment options for PHF consist of conservative management, open reduction and internal fixation (ORIF), hemiarthroplasty (HA), and reverse shoulder arthroplasty (RSA). For geriatric patients, RSA has become the preferred surgical option for 3 and 4-part PHFs as it has been associated with better functional outcomes with fewer reoperations than ORIF and HA. Although many studies have been done to evaluate what operative treatment is best for these injuries in our older patient population, few have compared RSA to nonoperative treatment. Three studies have recently evaluated this and their findings have been controversial although two, found that patients undergoing RSA had better range of motion and outcome scores than patients treated non operatively. To add to this dilemma, whether RSA performed in the acute setting (< 4-6 weeks postoperatively) has better outcomes than when done in a delayed fashion, or as a revision for a failed hemiarthroplasty or ORIF also remains controversial but many studies do indicate that better clinical and patient reported outcomes are achieved when these fractures are treated acutely.
There is paucity of literature though on what to do with bilateral simultaneous proximal humerus fractures in the elderly patient. Some notable concerns of bilateral shoulder arthroplasty, or any bilateral surgery for that matter, is that the patient will be under anesthesia longer or require two anesthesia events, have a higher estimated blood loss, a longer hospital stay, and an extensive physical rehabilitation. Furthermore, patients may experience increased difficulty with activities of daily living and become susceptible to reinjury due to lack of sufficient contralateral support. Few reports have been published on the treatment of bilateral PHFs, with only a few cited cases in the geriatric population caused by falls, seizures, and electrocutions.\textsuperscript{2-4, 7, 11, 19} Due to the rare etiology of this injury, there is a need for a better understanding of patient outcomes after bilateral RSA for fracture to guide orthopedic surgeons in managing patients with bilateral displaced PHFs as well as how to handle their postoperative rehabilitation and restrictions. In this report, we present a case of an 80-year-old woman with bilateral 3 and 4-part PHFs due to a fall-off of a treadmill who underwent near-simultaneous bilateral RSA with early range of motion for activities of daily living (ADLs) allowed postoperatively. Consent was obtained from the patient for this case report.

**Case Report**

*Presentation*

An 80-year-old woman (BMI, 29.07 kg/m\textsuperscript{2}) with a history of cervical stenosis was admitted to the Emergency Department at our Level 1 trauma center due to a traumatic fall-off of her treadmill. The patient attempted to catch herself before ultimately landing on the ground but denied any head injury. There was no previous history of trauma to either upper extremity nor any other relevant past medical history. She lived independently and used no assistive devices. The patient presented with severe pain in both shoulders with the slightest motion or palpation. No focal neurological or
vascular deficits were noted. Radiograph (Figure 1) and computed tomography (Figure 2) imaging determined the patient suffered an acute 3-part (right) and 4-part (left) PHF.

Additionally, head and cervical CT scans were ordered in the setting of an elderly patient who fell. There was no traumatic abnormality within the cervical CT imaging. However, there were signs of cervical spondylosis superimposed upon developmental narrowing of the cervical spinal canal, resulting in multilevel stenosis and cord compression at the C4-C5 level but the patient was asymptomatic at this time. There were no traumatic abnormalities with the head CT. The patient was admitted. Considering the patient’s age, sex, traumatic fracture pattern and activity level, we deemed surgical intervention would be the best option for her. The surgeon felt that RSA using a fracture stem with a robust tuberosity repair to allow early range of motion was indicated. We selected a staged bilateral RSA 48 hours apart to not have a prolonged single anesthesia event given the patient’s age.

**Surgery**

Both procedures were done under general anesthesia without regional anesthesia due to the patient being on anticoagulants at the time of surgery. For the left side, the patient was positioned in a beach chair position at about 45 degrees of hip flexion and given weight-based antibiotics and tranexamic acid prior to surgical incision. A standard deltopectoral approach was used. The biceps was then identified and tenotomized for later tenodesis. The greater and lesser tuberosities were identified, sutures were passed through the supraspinatus and infraspinatus to get control of the greater tuberosity. The lesser tuberosity was then identified and tagged as well. On the right shoulder it was osteotomized as it was not fractured. The humeral head was then removed. The axillary nerve was identified and protected throughout the procedure. After clearing the cavity of any bony fragments or other articular pieces, the glenoid was then exposed and prepared. The
labrum was removed and the glenoid was gently reamed. Then glenoid baseplate and glenosphere (38 mm) were then placed in slight inferior inclination at the inferior edge of the glenoid. The humerus was prepared by reaming and the stem was trialed to decide the appropriate height for stability and tuberosity repair. The stem was then cemented using two bags of low viscosity cement under pressurization. The stem was placed in 20 degrees of retroversion as the surgeon believes this does not place undue stress on the greater tuberosity to allow for healing. The tuberosities were reattached with non-absorbable suture. The stem used has designated suture holes for the greater and lesser tuberosity. Number 5 non absorbable suture was used: two for the greater tuberosity, two for the lesser tuberosity, and two “around the world sutures” that cerclage the greater and lesser tuberosities together. The surgeon also places two drill holes in the shaft and places two sutures from the shaft to the tuberosities in a figure of eight fashion to prevent superior migration. Finally, morselized bone graft from the humeral head was added prior to suturing to enhance healing potential. Both shoulder range of motion and stability were deemed to be adequate. Two days later, the contralateral right shoulder was repaired using the same technique. Surgical time from incision to close was 3 hours and 55 minutes on the right and 3 hours and 51 minutes on the left. The estimated blood loss was 200 mL and 150 mL respectively. There were no perioperative complications.

Postoperative follow-up

The patient was discharged to a rehabilitation facility a week after her initial hospital presentation. Her shoulders were immobilized and kept non-weight bearing for only two weeks postoperatively followed by initiation of activities of daily living and physical therapy (PT). During her PT sessions, the patient was allowed to practice passive range of motion (ROM) with forward flexion to 150 degrees and external rotation to 20 degrees bilaterally. No internal rotation
or abduction was permitted until 10 weeks postoperatively. She was not required to wear her sling after two weeks though and was allowed to use her arms as tolerated but without lifting more than a few pounds so she could attempt to care for herself independently. She was back to living independently at home by 6 weeks post procedure. Satisfactory results were achieved at 5-months as the patient had active forward flexion of 130 degrees, abduction of 80 degrees, external rotation to 30 degrees, and internal rotation to her buttock with no associated pain. She could do all of her activities of daily living without issue. She was very satisfied with her procedure.

All follow-up radiographs leading up to the two-year visit were taken at our associated clinic and showed a stable RSA without evidence of dislocation, loosening, or failure (Figure 3 & 4). There was no significant scapular notching and the tuberosities healed well.

At two years postoperation, the patient’s active range of motion was relatively unchanged with forward flexion of 120 degrees, isolated abduction of 100 degrees, and external rotation of 10 degrees bilaterally. Abduction and external rotation strength were 3/5 bilaterally. She was complaining of weakness and numbness in the arms with some radicular pain (5/10) and had a positive Hoffman’s test during her physical exam. Advanced cervical imaging showed multilevel cervical spondylosis with cord compression at the C4-C5 and now C5-C6 levels that likely accounted for this pain. She was not seen again for her shoulders but we did contact her at 26 months postoperatively to obtain an American Shoulder and Elbow Surgeons score for another study which was 91.6 for both sides. This indicates that her radicular pain had likely subsided. She unfortunately passed from COVID-19 forty-two months after her surgeries. The patient provided consent for this case report.

**Discussion**
In this report we show the clinical and radiological success of near-simultaneous RSA for bilateral displaced PHFs in a geriatric patient who we allowed early range of motion on, removing her slings at 2 weeks. There is currently no standard surgical treatment for bilateral displaced proximal humerus fractures in the geriatric population. Due to the high risk of complications associated with multiple procedures but also the risk with a lengthened anesthesia events if fixed in one operative setting, there is concern about performing any operative procedure for these injuries. At the same time though, we need to return this patient population to their baseline activity level as quickly and safely as possible. We demonstrate with this case report that bilateral RSA for displaced proximal humerus fractures in a geriatric patient is both safe and effective at restoring function and relieving pain.

In a recent retrospective study examining complications with elective bilateral staged total shoulder arthroplasty (TSA), it was determined that surgeons should wait a minimum of three months between operations due to increased risks of venous thromboembolism, blood transfusions, revision arthroplasty, and periprosthetic fracture. After the three-month threshold, there was no significant increase in complications. \(^{16}\) Waiting three months for patients with bilateral proximal humerus fractures though is not feasible.

Our patient had both early and long-term favorable functional and radiographic outcomes up to the two-year postoperative mark after having her RSAs two days apart. This was the first report to show good outcomes though by allowing earlier range of motion to allow her to get back to independence sooner. We removed her slings at 2 weeks postoperatively and let her use her arms as tolerated. There are five other case studies in the literature that we are aware of that reported on bilateral staged or near simultaneous RSA for bilateral PHF in the elderly population, but they all immobilized the patient for 4-6 weeks. \(^{2, 4, 7, 11, 22}\) All of the case reports demonstrated
return to functional motion as demonstrated in Table I. Although our bilateral RSA was staged across two days due to concerns of time under anesthesia, our report adds further evidence for RSA as a viable strategy for treating bilateral PHFs in geriatric patients who sustained low-energy trauma. More importantly, we are the first to allow our patients to use their arms as tolerated at two weeks postoperatively. There is one randomized trial in reverse total shoulder arthroplasty not for fracture done previously that found no difference in outcomes or complications between patients immobilized postoperatively and those allowed to use their arm as tolerated. They believed that early range of motion in the elderly patient may be more beneficial to allow independence.\textsuperscript{10} To our knowledge though, this has not been studied in reverse for fracture and the concern for many is that early motion will lead to tuberosity displacement or resorption leading to poor function. We did not find this to be the case though, as our patient regained her function quickly, going back to living independently by 5 weeks after surgery, and did not have any issues with tuberosity displacement or resorption. We believe using a fracture stem with suture specific holes as well as a robust tuberosity repair and adding bone graft from the humeral head all contribute to an increase likely hood of successful tuberosity healing. We also do not believe that early motion has led to an increased risk of tuberosity resorption in our RSA for fracture patients. The senior author currently only places these patients in a sling for comfort postoperatively and allows them to use their arms for activities of daily living, even for unilateral injuries. We believe it is imperative to mobilize these patients early to decrease time required at a rehabilitation facility and also to achieve independence sooner.

Conclusion
In this report, we presented a case of a geriatric patient with bilateral proximal humerus fractures who was treated successfully with a two-day staged bilateral RSA and was allowed early independent range of motion at two weeks after surgery. The patient had strong clinical and radiographic outcomes at two years postoperation and was also able to achieve early independence, going back to living alone at two weeks after surgery. We show that two-day staged RSA for bilateral, traumatic proximal humerus fractures is a viable option for elderly patients. We also show that early use of the arms for daily activities may be beneficial to regaining range of motion quickly and achieving functional independence faster. In order to verify this finding though, larger studies are needed to further evaluate the efficacy of bilateral RSA without prolonged immobilization in order to guide surgical decision making when caring for highly at-risk populations.

References


20. Torchia MT, Austin DC, Cozzolino N, Jacobowitz L, Bell J-E. Acute versus delayed reverse total shoulder arthroplasty for the treatment of proximal humeral fractures in the


<table>
<thead>
<tr>
<th>Mechanism of Injury</th>
<th>Time in a sling</th>
<th>Forward Flexion (degrees)</th>
<th>Abduction (degrees)</th>
<th>External Rotation (degrees)</th>
<th>Outcome Scores</th>
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<tr>
<td>Wendling et al.(^{17})</td>
<td>Seizure</td>
<td>6 weeks</td>
<td>120 (R) 105 (L)</td>
<td>N/A</td>
<td>35 (R) 25 (L)</td>
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<tr>
<td>El Rassi et al.(^6)</td>
<td>Seizure</td>
<td>4 weeks</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Iijima et al.(^{11})</td>
<td>Fall</td>
<td>4 weeks</td>
<td>120 (R) 120 (L)</td>
<td>N/A</td>
<td>15 (R) 10 (L)</td>
</tr>
<tr>
<td>Ceri et al.(^3)</td>
<td>Fall</td>
<td>2 weeks</td>
<td>90 (R) 110 (L)</td>
<td>115 (L)</td>
<td>5 (R) 20 (L)</td>
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<tr>
<td>Azad et al.(^1)</td>
<td>Seizure</td>
<td>4 weeks</td>
<td>160 (R) 160 (L)</td>
<td>N/A</td>
<td>20 (R) 20 (L)</td>
</tr>
</tbody>
</table>

PSS, Penn Shoulder Score, ASES, American Shoulder and Elbow Surgeon’s Score, CMS, Constant-Murley Score, DASH, Disabilities of the Arm, Shoulder and Hand Score, N/A, not available, R, right shoulder, L, left shoulder.
Figure Captions:

Figure 1 - X-ray radiograph in AP View showing a) right and b) left bilateral proximal humerus fractures.

Figure 2 - CT scan with reconstruction of shoulder showing a) 3-part (right) and b) 4-part (left) bilateral proximal humerus fractures.

Figure 3 - Initial postoperative X-ray radiograph of the a) right and b) left shoulder showing bilateral reverse total shoulder arthroplasty.

Figure 4 - X-ray radiograph of the a) right and b) left shoulder showing bilateral reverse total shoulder arthroplasty at the two-year post-operative mark.

Table I - Review of reported cases examining the utility of bilateral reverse shoulder arthroplasty.