J Shoulder Elbow Surg (2020) 29, e338–e340

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Intrathoracic central glenoid screw: a case report

Jeffrey J. Frandsen, MD*, Robert Z. Tashjian, MD, Peter N. Chalmers, MD

Department of Orthopaedic Surgery, University of Utah, Salt Lake City, UT, USA

Keywords: Reverse total shoulder arthroplasty; total shoulder arthroplasty; central glenoid screw; intrathoracic central glenoid screw; reverse total shoulder arthroplasty complication; altered glenoid anatomy complication

Reverse total shoulder arthroplasty (rTSA) was developed and first reported on by Grammont et al in 1987 and has since had a significant expansion of use for a variety of indications, including rotator cuff arthropathy, proximal humeral fractures, and revision arthroplasty.[1,3] The reported complication rate for rTSAs ranges from 0%-68%.[5] Wierks et al[5] described intraoperative and postoperative complications including glenoid fracture, calcar fracture, poor screw fixation, infections, dislocations, and brachial plexus injuries. One aspect of Grammont's design that has been incorporated into all subsequently developed rTSA implants is screw fixation for the baseplate. The location of screw fixation includes peripheral screws around a central post or around a larger central screw.

This case report describes an unreported complication of rTSA in which a long central baseplate screw was placed through the scapula, the subscapularis fossa, and the chest wall and then into the thoracic cavity.

Case report

The patient is a 64 year-old man with a medical history of atrial fibrillation (AFib) on dabigatran, grade 2 heart failure with preserved ejection fraction, asthma, hyperlipidemia, hypertension, early-onset dementia, and obstructive sleep apnea. He underwent a rTSA at an outside hospital 15 days before presenting to our service. The surgeon described in the operative report that there was "very little bone stock left within the glenoid" and that the "glenoid bone would only accept 3 peripheral locking screws." The operative report records 150 mL of blood loss. During the initial rTSA, a Zimmer Biomet prothesis (Zimmer Biomet Inc., Warsaw, IN, USA) was used with a mini humeral stem, 28-mm baseplate, 36-mm standard glenosphere, +10 humeral tray, +3 retentive humeral bearing, central screw for glenoid baseplate, and 3 peripheral locking screws. The length of the glenoid screws was not documented.

In preparation for the initial rTSA, he stopped taking his dabigatran that he was prescribed for his underlying Afib 5 days prior to surgery and started it again on postoperative day 1. He tolerated the procedure well, but the day after his surgery complained of increasing shortness of breath, dyspnea on exertion, and chest pain. He was found to be in AFib with rapid ventricular response and was given metoprolol, which normalized his rhythm and brought his heart rate to the 80s and 90s. He was seen fit for discharge on postoperative day 3 and was sent home with instructions to follow up with his PCP to obtain home oxygen. He developed progressive dyspnea on exertion and was seen by his PCP on postoperative day 6, able to walk only 4-5 steps before being profoundly out of breath. He was noted at that time to be hypoxic to the low 80s on room air, hypotensive, and in AFib. Laboratory tests were drawn that showed elevated D-dimer and brain naturietic peptide levels, so the patient was sent to an outside emergency department where subsequent imaging and workup showed that he had a saddle pulmonary embolus, for which he was transferred to our institution.

Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was not required by our Institutional Review Board.

*Reprint requests: Jeffrey J. Frandsen, MD, Department of Orthopaedic Surgery, 590 Wakara Way, Salt Lake City, UT 84108, USA.

E-mail address: frandsen.jeff@gmail.com (J.J. Frandsen).

1058-2746/$ - see front matter
https://doi.org/10.1016/j.jse.2020.04.044

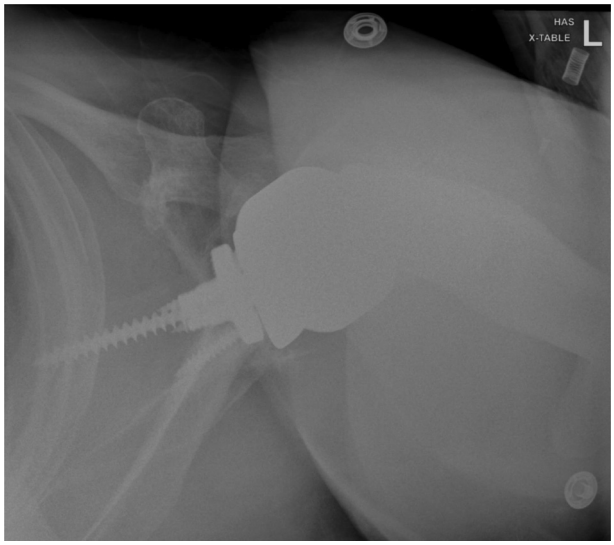

Figure 1 Axillary radiograph showing extension of central glenoid screw past ribs.

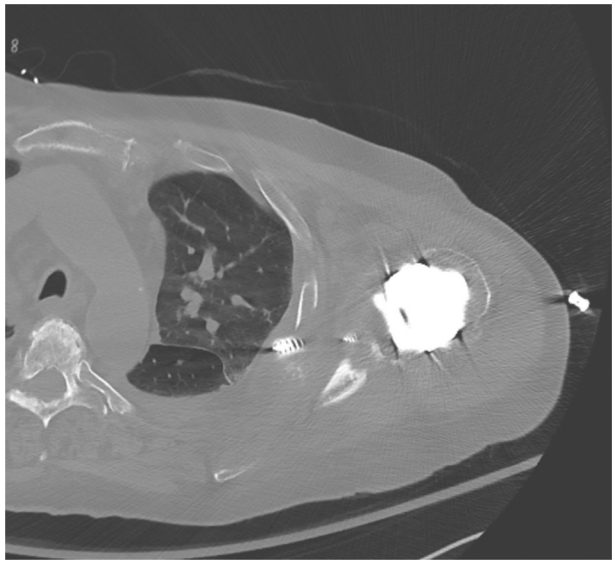

Figure 2 Coronal section of CT shoulder showing extension of central glenoid screw into pleural space.

On presentation at our institution, a repeat computed tomography angiogram (Fig. 1) was performed, which demonstrated no acute worsening of his pulmonary emboli but showed bilateral pleural effusions, a small pericardial effusion, and multifocal pulmonary infarctions. It also demonstrated that the central screw from the glenoid component transversed the left fourth and fifth ribs and extended into the pleura/peripheral parenchyma of the upper lobe of the left lung. The shoulder radiographs taken at presentation to our hospital that were originally read as normal were rereviewed by radiology and it was noted that protrusion of the screw into the thoracic cavity could be seen on the axillary radiograph (Fig. 2).

At that time, orthopedics was consulted. On physical examination, the patient had continued pain in his left shoulder, was unable to abduct his arm, could forward-flex 10°, and had intact sensation throughout all nerves of upper arm. Because of his concomitant therapeutic anticoagulation, large pulmonary embolism, and tenuous medical status, the decision to place another glenoid component was considered not to be in the patient's best interest. The patient thus underwent urgent removal of the glenoid component and conversion to a hemiarthroplasty. Intraoperatively, the baseplate was found to be grossly loose. With a member of the cardiothoracic surgery present, the screws were removed and the patient's vital signs, ventilation, and oxygenation remained stable and normal. A 50-mm central glenoid screw was removed along with 3 peripheral screws measuring 22, 22, and 26 mm, respectively (Fig. 3). A humeral head was placed on the stem that was retained. At 2.5 weeks postoperatively, the patient remained on oxygen but was doing well with regard to his shoulder. He had improvement in his pain compared with preoperatively, active forward elevation of 110°, and active external rotation in adduction of 50°. Multiple unsuccessful attempts were made to contact the patient to schedule further follow-up, but the patient returned to his home in a neighboring state and was lost to follow-up.

Figure 3 Screws removed from primary rTSA construct. Note the 50 mm length of the central glenoid screw.

Discussion

This case demonstrates that violation of the thoracic cavity is possible with long screw fixation of the baseplate during rTSA. This case demonstrates the importance of understanding glenoid anatomy and screw trajectory, especially in the setting of glenoid deformity. In particular, with retroversion, if the component is placed perpendicular to the face of the deformed glenoid, the central screw projects

toward the thoracic cavity. In the setting of B2, B3, and C-type glenoids, surgeons should be aware of this potential issue.[4]

One way to mitigate this issue is to be aware of what central screw lengths can be considered reasonable. Frankle et al[2] discussed the differences in perforation distance (distance between the articular surface and the exit along the scapular spine). They discovered that a normal glenoid had an average standard centerline perforation distance of 29 mm, and a scapular spine, a centerline perforation distance of 43 mm. An abnormal glenoid as defined in their article had an average standard centerline perforation distance of 20 mm and a scapular spine centerline perforation distance of 35 mm. The *Zimmer Biomet Comprehensive Reverse Shoulder System* surgical technique guide states the following in regard to screw placement in rTSA: ''Tip: The most common lengths of the central screw are 25-35 mm.''[6] In this case, the surgeon had placed a 50-mm screw in a B2 glenoid with significant bone loss. Thus, surgeons should be wary of central screw lengths in excess of 35-40 mm, especially in the setting of altered glenoid anatomy or altered glenoid component version. Implant manufacturers may also reconsider screws in excess of 45 mm in length. Similarly, this case highlights the potential importance of computer-assisted preoperative planning and patient-specific instrumentation as these were not used in the initial case and may have been a method to potentially avoid inappropriate screw length or baseplate positioning.

Conclusion

This case demonstrates an unreported complication of rTSA with intrathoracic penetration of a central baseplate screw due to altered anatomy, loss of native bone stock, and excess screw length. Surgeons should be aware this complication is possible and should be wary of baseplate screws in excess of 40 mm in length. Preoperative computer-assisted planning and patient-specific instrumentation should be considered in cases of severe erosion to potentially avoid inappropriate baseplate or screw placement.

Disclaimer

Jeff Frandsen, his immediate family, and any research foundations with which he is affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Robert Tashjian is a paid consultant for Zimmer/Biomet, Wright Medical, and DePuy -Mitek; has stock in Conextions, INTRAFUSE, Genesis, and KATOR; receives intellectual property royalties from Wright Medical, Shoulder Innovations, and Zimmer/Biomet; receives publishing royalties from Springer and the *Journal of Bone and Joint Surgery*; and serves on the editorial board for *Shoulder & Elbow* and the *Journal of the American Academy of Orthopaedic Surgeons*.

Peter Chalmers is a paid consultant for Arthrex and DePuy, serves on the editorial board for the *Journal of Shoulder and Elbow Surgery*, receives intellectual property royalties from DePuy, and has received other support from Tornier.

References

1. Flatow EL, Harrison AK. A history of reverse total shoulder arthroplasty. Clin Orthop Relat Res 2011;469:2432-9. https://doi.org/10.1007/s11999-010-1733-6
2. Frankle MA, Teramoto A, Luo Z-P, Levy JC, Pupello D. Glenoid morphology in reverse shoulder arthroplasty: Classification and surgical implications. J Shoulder Elbow Surg 2009;18:874-85. https://doi.org/10.1016/j.jse.2009.02.013
3. Grammont P. Etude et realisation d'une nouvelle prothese d'epaule. Rheumatologie 1987;39:27-38.
4. Walch G, Badet R, Boulahia A, Khoury A. Morphologic study of the Glenoid in primary glenohumeral osteoarthritis. J Arthroplasty 1999;14:756-60.
5. Wierks C, Skolasky RL, Ji JH, McFarland EG. Reverse total shoulder replacement: intraoperative and early postoperative complications. Clin Orthop Relat Res 2009;467:225-34. https://doi.org/10.1007/s11999-008-0406-1
6. Zimmer Biomet. Comprehensive reverse total shoulder system technique guide [PDF file]. 2018, p. 19. https://www.zimmerbiomet.com/content/dam/zimmer-biomet/medical-professionals/000-surgical-techniques/shoulder/Comp-RVS-ST-2019.pdf. Accessed December 29, 2019.