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Simultaneous bilateral resection total shoulder arthroplasty with anatomic antibiotic cement spacer retention

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Periprosthetic shoulder infection (PSI) is a challenging problem that may lead to shoulder pain, dysfunction, and even death. The reported incidence of infection after shoulder arthroplasty ranges from 0% to 4%.[7,14,16] Recent developments have improved our ability to diagnose and to treat this condition.

To date, there is no consensus on the optimal treatment of patients with PSI. To our knowledge, no reports of simultaneous bilateral resection total shoulder arthroplasty (TSA) and cement spacer placement exist in the literature. We report one such case with a 25-month follow-up.

Case report

A 66-year-old, right-hand–dominant man presented to our clinic for evaluation of bilateral painful TSA. Past medical history included hypertension, prostate cancer in remission, fatty liver, alcoholism, obstructive sleep apnea, and bilateral total hip arthroplasties performed 3 and 4 years before presentation.

He had undergone bilateral TSA 14 months before presentation (right) and 26 months before presentation (left) at an outside institution (ReUnion TSA; Stryker, Kalamazoo, MI, USA). The patient did well until 3 months before presentation, when he developed bilateral shoulder pain and stiffness. Two weeks later, he developed septic arthritis of the right wrist and underwent open irrigation and débridement, with synovial fluid cultures positive for *Staphylococcus aureus* (methicillin-sensitive *S. aureus*). The patient was prescribed 6 weeks of intravenous cefazolin and noted that his shoulder symptoms resolved while he was taking antibiotics.

Approximately 10 days after completion of antibiotics, the patient's shoulder symptoms returned to a level worse than they had been previously. He presented to an outside emergency department, where aspiration of the left shoulder, which was more symptomatic, yielded a white blood cell count of 57,000/μL, erythrocyte sedimentation rate (ESR) of 86 mm/h, and C-reactive protein (CRP) level of 9 mg/L. Synovial aspirate and blood cultures were positive once again for *S. aureus*. The patient underwent bilateral arthroscopic shoulder irrigation and débridement. The glenoid components were noted to be loose bilaterally but were retained. Cultures again grew *S. aureus*, and the patient was prescribed intravenous cefazolin and rifampin. It was at this point that the patient was transferred to our care.

On presentation to our clinic, the patient was afebrile with diffuse erythema of both deltopectoral incisions without frank drainage or fluctuance. The arthroscopic portal incisions bilaterally were healing well with no evidence of infection. The patient had painful and restricted active and passive range of motion. Radiographs obtained in our office demonstrated oversized humeral head components with humeral bone resorption at the calcar bilaterally and evidence of a grossly loose glenoid component on the right side (Fig. 1). Laboratory studies were notable for a white blood cell count of 7.3×10^9/L, ESR of 94 mm/h, and CRP level of 11.5 mg/L.

Given the clinical presentation and chronicity of the infections, the decision was made to proceed with bilateral resection TSA and placement of antibiotic spacers. The operative plan was to begin with the more symptomatic side and, if the patient was hemodynamically stable, to continue with removal of components from the contralateral side.

This study was conducted under the approval by the Institutional Review Board at Stanford University: Protocol ID#15922, IRB#5136.

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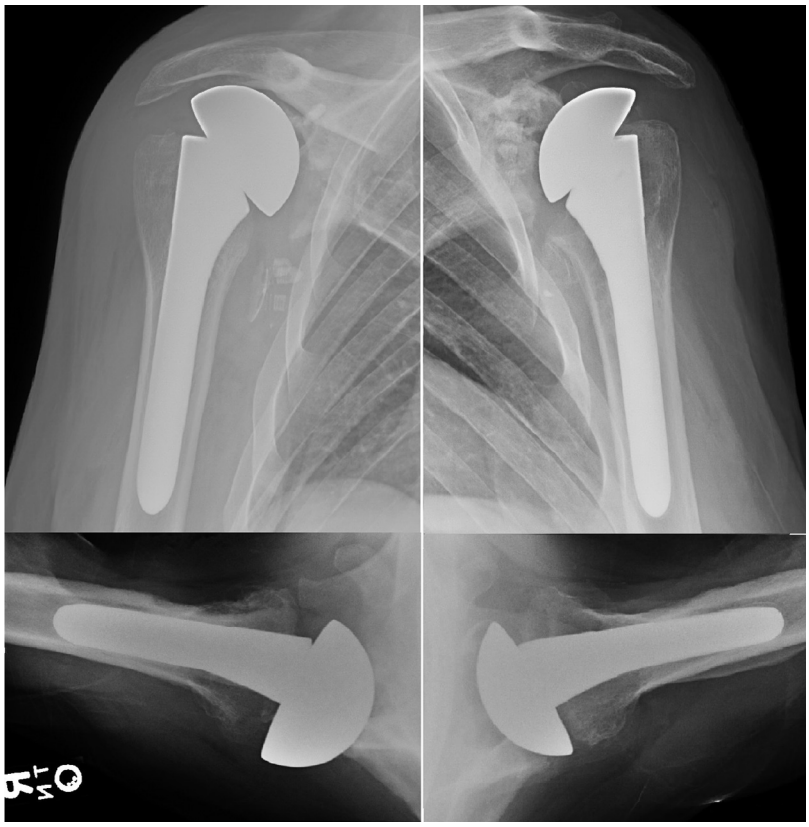

Figure 1 Preoperative Grashey anteroposterior and axillary lateral radiographs.

Surgical procedure

Surgery was performed in the beach chair position (T-MAX; Smith & Nephew, Andover, MA, USA) with both shoulders prepared and draped. The patient's prior deltopectoral incision was used to approach the right shoulder. Abundant purulent material was noted within the joint, and multiple specimens were obtained for microbiologic analysis. The subscapularis tendon was torn and retracted with poor muscle and tendon quality; it was not amenable to later repair. The remainder of the rotator cuff was thin but intact. The humeral component was well fixed, and the glenoid component was completely loose and displaced inferior to the glenoid. All components were extracted, and the glenoid surface, peg holes, and humeral medullary canal were thoroughly cleansed. A thorough débridement of all nonviable soft tissue and irrigation were performed.

At this point, given the relative ease of resection and the patient's hemodynamic stability, we proceeded with the contralateral side. A similar surgical approach and technique were employed on the left side. The subscapularis was released and was amenable to later repair. The remainder of the rotator cuff was thin but intact. Seven culture specimens of fluid and tissue were taken from each side.

Bilateral antibiotic cement spacers (StageOne; Biomet, Warsaw, IN, USA) were made and placed in a press-fit fashion in 30° of retroversion relative to the forearm axis; 1 g of vancomycin powder was added to each bag of cement, which already contained gentamycin. Two deep drains were placed in each shoulder, and the subscapularis was repaired on the left side using a polydioxanone (PDS) suture (Ethicon, Johnson & Johnson, Somerville, NJ, USA) through bone tunnels. Both shoulders were placed in sling immobilization (UltraSling II; DonJoy, Vista, CA, USA).

Cultures from both sides failed to grow any organisms. The orthopedic infectious disease service was consulted and recommended a continued course of intravenous cefazolin on the basis of cultures and sensitivities from prior procedures and also intraoperative clinical findings that clearly demonstrated deep infection. The patient was discharged to a skilled nursing facility on postoperative day 5 with both incisions appearing benign.

The patient was then seen for follow-up on postoperative day 11. Given right shoulder wound drainage and erythema, the patient was readmitted to the hospital and underwent repeated irrigation and débridement of the right shoulder. A large hematoma was evacuated, and no purulent material was noted. Drain output was minimal while the patient was in the hospital, and on postoperative day 2, the patient was discharged once again to his skilled nursing facility.

After surgery, the patient was placed in a sling once again and allowed immediate pendulum exercises, passive shoulder range of motion exercises, and unrestricted motion of the elbow, wrist, and hand bilaterally. At 6 weeks after surgery, slings were discontinued, and active range of motion was allowed. At 3 months after surgery, strengthening exercises were initiated. Serial postoperative radiographs were obtained at regular intervals, confirming stable position of the cement spacers and no evidence of static instability.

At his most recent follow-up (25 months), the patient has completed 6 weeks of intravenous cefazolin followed by 3 months of oral cephalexin. His infectious markers have normalized (white blood cell count, ESR, CRP level). His shoulders are pain free, and he requires no opiates or other anti-inflammatories or analgesics. He has been able to resume activities of daily living without significant limitations (Fig. 2) with bilateral active elevation of 130°. Radiographs of his shoulders demonstrate stable positions of bilateral cement

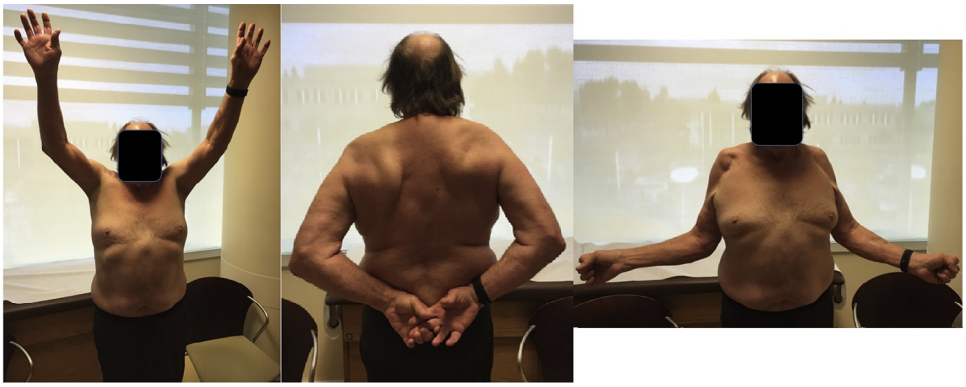

Figure 2 Forward elevation, internal rotation, and external rotation at 25-month follow-up.

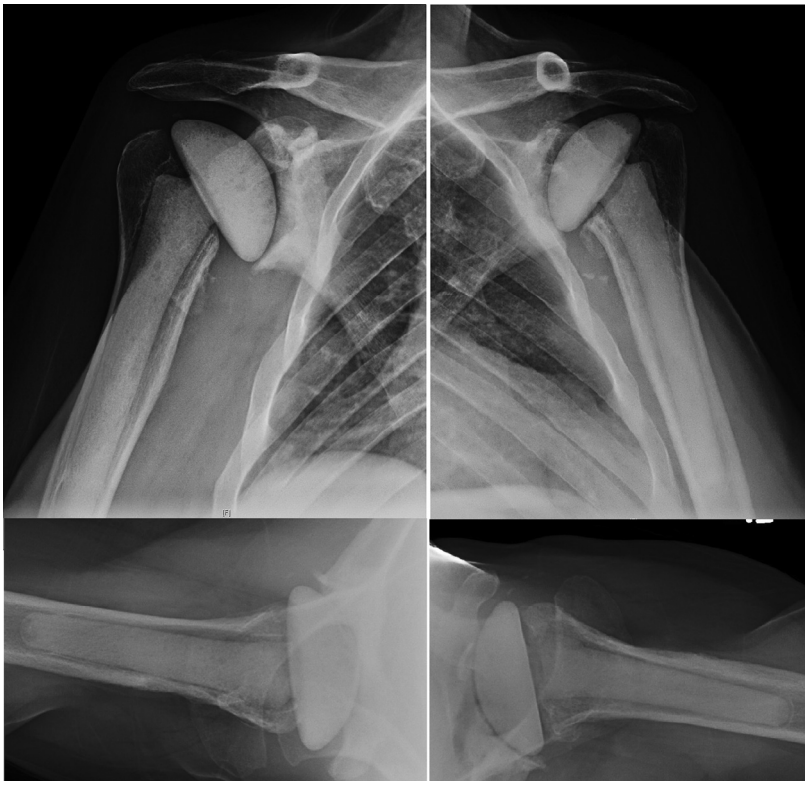

Figure 3 Postoperative Grashey anteroposterior and axillary lateral radiographs.

spacers (Fig. 3). Pleased with his outcome, the patient is not interested in reimplantation unless symptoms of pain and dysfunction return.

Discussion

Shoulder arthroplasty is the fastest growing segment of the arthroplasty market.[3] Given the increasing volume of shoulder arthroplasties performed, the burden of PSI is only expected to grow.[10] Although the reported incidence of PSI is less than in reports in the hip and knee arthroplasty literature, the consequences can be equally devastating.[4,5,10] This is the first reported case of simultaneous bilateral resection TSA with antibiotic cement spacer placement.

One of the challenges facing shoulder arthroplasty surgeons is the lack of consensus in the diagnosis and treatment of PSI. The laboratory studies that may be used in the diagnosis of PSI include complete blood count with differential, interleukin 6, leukocyte esterase, ESR, CRP, and synovial fluid analysis. However, the sensitivities of serologic tests for PSI are notoriously low, probably because of the frequency of indolent infections caused by *Propionibacterium acnes*.[11] More recently, α-defensin testing of synovial fluid has been found to be a useful adjunct in the workup of PSI, with a reported sensitivity of 63% and specificity of 95%.[6] In this particular case, the presentation was clear, a sensitive organism (methicillin-sensitive *S. aureus*) was identified, and a focused antibiotic regimen was employed to successfully assist in eradicating the infection after surgical treatment.

Following irrigation, débridement, and resection arthroplasty for PSI, the surgeon has several options with regard to reimplantation. These include 1-stage reimplantation, 2-stage reimplantation, definitive treatment with an antibiotic cement spacer, and definitive

resection arthroplasty. Advocates of 2-stage reimplantation cite the most reproducible rates of infection eradication,[13,16] with 1-stage reimplantation recurrence rates widely varying from 0% to 46%.[2,6,8,13,16] However, a 1-stage approach offers considerable advantages over a 2-stage approach, including lower cost, shorter hospital stay, and less surgery. Whereas no consensus on a 1- vs. 2-stage approach has been reached, it is clear that patients treated with resection arthroplasty without reimplantation have inconsistent pain relief and profound functional limitations.[1,12]

Stine et al reviewed 30 cases of chronic shoulder infections managed with aggressive débridement and antibiotic cement spacers. Fifteen patients declined 2-stage reimplantation and retained their antibiotic spacers. At 2 years of follow-up, there was no significant difference in the Disabilities of the Arm, Shoulder, and Hand score, Simple Shoulder Test, or range of motion between those who underwent 2-stage reimplantation and those who opted to retain the cement spacer.[15]

Similarly, Levy et al reported on 14 patients who underwent resection arthroplasty and antibiotic cement spacer placement for PSI. Nine patients declined 2-stage reimplantation. At an average follow-up of 25 months postoperatively, these patients had significantly improved pain scores, functional scores, and range of motion, with all but 1 satisfied with their treatment.[9]

In contrast to cement spacers used in the treatment of periprosthetic hip and knee infection, those used in the shoulder can be considered for long-term retention. The shoulder is a non–weight-bearing joint, and therefore articulated cement spacers are not as prone to fracture or disengagement. Current designs allow greater modularity of cement spacers, which better re-create humeral head size and intramedullary stem diameter. The system used in this case allows the surgeon to select from 6 humeral stem diameters and humeral head sizes. With better restoration of native anatomy, this modularity may confer added stability and improved mechanics of the remaining rotator cuff. Such factors may diminish pain and improve function to a degree that a patient is able to avoid the risks of additional surgery for reimplantation. Furthermore, the antibiotic cement molds allow the surgeon the ability to customize the antibiotic composition of the spacer, which may lead to better infection clearance.

Whereas retention of antibiotic cement spacers is a viable option for some patients, not all will be satisfied with this approach. With an unresurfaced glenoid, some patients will continue to have pain with a cement spacer and desire a revision arthroplasty.[9] Furthermore, for patients with rotator cuff insufficiency, a reverse shoulder arthroplasty may be a better option for pain relief and functional restoration.[13,17] However, the reverse total shoulder in the revision setting imparts a greater risk of complications to the patient than in the primary setting and may be associated with less predictable outcomes.[17,18] In addition, patients with a reverse prosthesis frequently have postoperative lifting and activity restrictions in an effort to prevent early prosthetic loosening.

Conclusion

This is the first reported case of successful simultaneous surgical treatment of bilateral infected total shoulder replacements with retained antibiotic spacers. The patient cleared his infections and was pleased with his outcome, noting no pain and significant functional improvement. Definitive cement spacer retention after component resection may be considered a viable surgical treatment option for PSI.

Disclaimer

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