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Case Report: Watching and Waiting? A Case of Incomplete Glenosphere Seating With Spontaneous Reversal in Reverse Shoulder Arthroplasty

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Abstract

Introduction: Reverse shoulder arthroplasty is a useful procedure with broadening applications, but it has the best outcomes when used for rotator cuff tear arthropathy. However, this procedure is not without complications. While scapular notching and aseptic loosening are more common complications that have been extensively studied in the literature, dissociation of the glenoid component and incomplete glenosphere seating has not received much attention. Specifically, little research has explored appropriate management of incomplete seating of the glenosphere component, and no gold standard for treatment of this complication has emerged.

Methods: In the case described here, an elderly patient with an incompletely seated glenosphere component post-operatively opted to pursue conservative management in order to avoid revision surgery if possible.

Results: The partially engaged, superiorly directed components in this case exhibited spontaneous complete and symmetric seating of the glenosphere between six and twelve months post-operatively, indicating that conservative management of this complication in low-demand patients may be a viable option to avoid the risks associated with revision surgery.

Conclusion: Further research should be pursued to explore what patient and prosthesis design factors may be suited to observation with serial radiographs when incomplete seating of the glenosphere component occurs.

Keywords

reverse shoulder arthroplasty, glenosphere dissociation, glenosphere seating, Morse taper, glenosphere incomplete seating, rotator cuff arthropathy, cuff tear arthropathy, complications of total shoulder arthroplasty

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Introduction

Reverse shoulder arthroplasty (RSA) is a well-established procedure to treat rotator cuff tear arthropathy by replacing the arthritic joint and moving the center of rotation of the shoulder inferiorly and medially thereby engaging the functional capacity of the deltoid to elevate the arm in the absence of a functional rotator cuff.[1] For this indication, 10-year implant survivorship is 89%, with 90% patient satisfaction at a mean of 4.3 years.[2–4] However, RSA complication rates range from 13-25% after primary arthroplasty surgeries and 37-69% of revisions.[5,6] Reported complications include scapular notching, aseptic loosening, temporary postoperative neurapraxia, and intraoperative fracture.[5,7]

Glenosphere dissociation is the third most common mode of failure in reverse total shoulder arthroplasty and has been reported to occur in approximately 1.8% to 5.1% of cases, with reported incidence as high as 12.2%.[8,9] Glenosphere dissociation has been observed with various implants designs, including designs with a centrally threaded screw for glenosphere fixation as well as designs that rely solely on the Morse taper. In the

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latter subset of designs, glenosphere dissociation is the most frequent mode of failure.[9]

Inadequate engagement of the Morse taper has been identified as a cause of acute dissociation.[10–13] Incomplete seating of the glenosphere on the scapular baseplate can result in suboptimal angulation or poor union of the components, allowing eventual baseplate-glenosphere separation, which has been confirmed by biomechanical, clinical, and retrieval studies.[11,13] Several mechanisms have been proposed to explain improper engagement of the Morse taper between the baseplate and glenosphere components, including inadequate reaming of the glenoid, inadequately seated baseplate screws, implant design, and interposed soft tissues.[14]

This case report describes a patient with incomplete post-operative glenosphere seating whose implant underwent spontaneous correction with conservative management observed through serial radiological studies. Our case may indicate that for superiorly directed, partially engaged glenospheres with a Morse taper alone for fixation, non-operative management and close follow-up with serial x-rays can provide a viable, beneficial course of action by avoiding the morbidity and mortality associated with surgical revision of an RSA implant.

Case Report

Patient Presentation

The patient is a 72-year-old, retired, right hand-dominant, cane-ambulating female with a medical history of hypertension, stage III chronic kidney disease, gout, gastroesophageal reflux disease, and a BMI of 33.1, who presented to the orthopedic clinic with persistent left shoulder pain and disability unimproved by chronic narcotic pain medication use. She described severe pain without paresthesias that was worse with overhead activity and had limited active range of motion (AROM). The patient was initially treated conservatively with a series of subacromial corticosteroid injections with mild and diminishing improvement over eight months prior to referral to the senior author. She had continued decline in active forward flexion to 70° with decreased strength to 2/5 in flexion and external rotation.

Imaging

Preoperative x-rays demonstrated cuff tear arthropathy with superior humeral migration and narrowing of the acromiohumeral interval consistent with Hamada stage II (Figure 1(A) and (B)). An MRI was performed which further demonstrated moderate arthritic changes in the glenohumeral joint, and full width, full thickness tearing of the supraspinatus, infraspinatus, and subscapularis tendons with medial retraction and advanced fatty atrophy (Figure 2(A) to (I)). The long head of the biceps tendon exhibited partial tearing and medial dislocation from the bicipital groove. A preoperative CT was performed which also demonstrated degenerative changes, mild anterior subluxation of the humeral head, 4.3 cm of bone stock at the center of the glenoid, and normal glenoid retroversion (Figure 3(A) to (C)). Loose bodies were noted in the glenohumeral joint and bicipital groove.

After a year of conservative management from the onset of symptoms with functional decline and decreasing relief with corticosteroid injections and pain medications, the patient elected to proceed with RSA.

Surgical Technique

A RSA was performed by the senior author using a Zimmer Trabecular Metal 36 mm baseplate/glenosphere set for implantation. After receiving two grams of preoperative cefazolin and a regional block, the procedure was performed under general anesthesia in a modified beach chair position. A deltopectoral approach was utilized and superficial and deep dissection were carried out, taking care to identify and protect the cephalic vein. The long head of the biceps tendon was identified, freed, and tagged for later reattachment to the pectoralis major tendon. The axillary nerve was identified and protected. The subscapularis was torn and not amenable to repair. Humeral osteophytes were resected. The shoulder was dislocated and the proximal humerus was nearly devoid of rotator cuff tissue with significant cartilage degeneration. The teres minor insertion was intact. Sequential humeral reamers were used from the Zimmer RSA set until the appropriate size was identified with a good canal fit in order to apply the intramedullary humeral cutting guide. The humerus was cut in approximately 10° of retroversion. The secondary and conical reamers were applied in sequence, and a trial stem was placed.

The degenerative labrum was then removed circumferentially from the glenoid. The 36 mm glenoid baseplate guide fit well on glenoid face and was centered on the glenoid in the medial to lateral dimension, and as inferiorly as possible while obtaining sufficient backside support. Glenoid cartilage was removed by manual scraping. A targeting guide wire was placed and the starting hole for the glenoid baseplate was drilled without perforation. Sequential reamers were then used to remove the cortical bone, as well as to correct the inclination to neutral or slight inferior tilt and version to neutral. After irrigation, a 36 mm glenoid baseplate with a 15 mm central trabecular metal post was impacted. The inferior and superior screw holes were then drilled, the screw lengths were measured, and the screws were inserted with a good bite for fixation. The

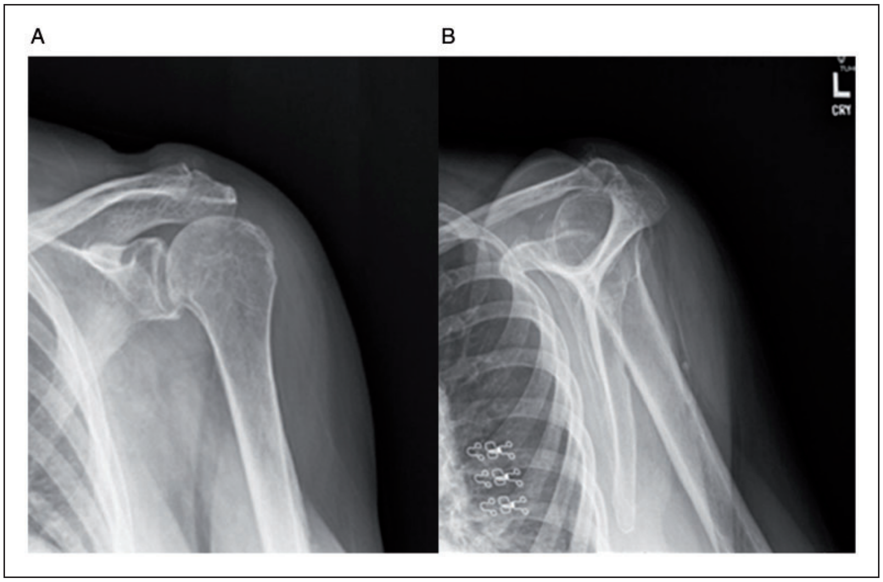

Figure 1. A, An anteroposterior radiograph in external rotation. B, A trans-scapular Y-view of the left shoulder demonstrating arthropathy of the acromioclavicular and glenohumeral joints with bony hypertrophy at the greater tuberosity.

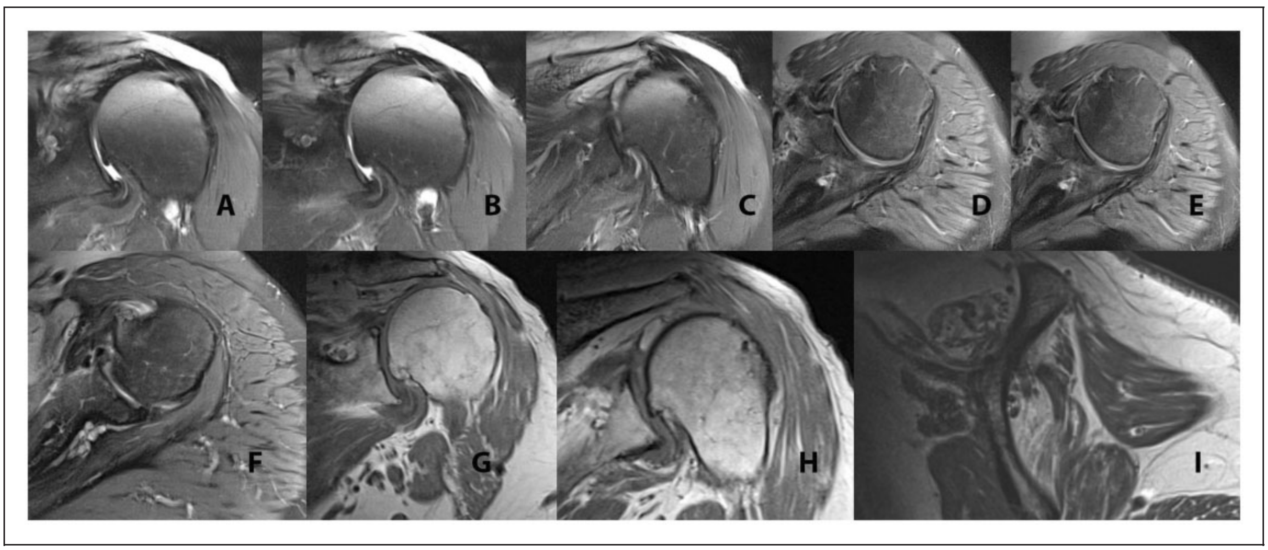

Figure 2. An MRI of the left shoulder (A–C) A T2 coronal series demonstrating complete tearing of the supraspinatus tendon with medial retraction to the glenoid (D–F) A T2 axial series demonstrating partial tearing and medial dislocation of the biceps tendon. G and H, A T1 coronal series demonstrating good deltoid bulk without atrophy. I, A T1 sagittal image demonstrating marked fatty atrophy of the supraspinatus and infraspinatus muscles.

locking caps were applied. The 36 mm glenosphere with Morse taper fixation alone was impacted onto the baseplate. The fixation was tested for stability with manual traction and rotation and was found to be securely seated intraoperatively. After irrigating and drying the humeral canal, Palacos G cement was inserted with finger packing and the Zimmer non-porous coated reverse stem was inserted and impacted securely in approximately 10° of retroversion. A 36 mm +0 polyethylene liner was trialed and then impacted securely. The shoulder was reduced, and passive range of motion (PROM) was tested and had sufficient stable range. An axillary nerve tug test confirmed that the nerve was in continuity and not under increased tension. The arm was irrigated, a medium Hemovac drain was placed, and one gram of Vancomycin powder was placed in the wound. The deep and superficial tissues were closed in the standard fashion. The patient was placed

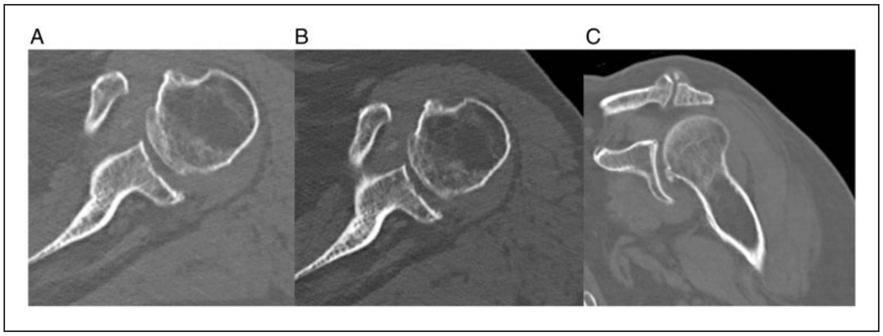

Figure 3. A and B, Axial CT images. C, A coronal CT image calibrated to a bone window demonstrating superior and anterior migration of the humeral head with arthritic changes of the glenohumeral and acromioclavicular joints including a large osteophyte in the glenohumeral joint and subchondral cystic changes with intraarticular loose body (B).

in a standard sling, extubated, and taken to the recovery room in stable condition.

Postoperative x-rays revealed incomplete seating of the glenosphere on the baseplate with cephalad tilt of the glenosphere without associated fracture or dislocation (Figures 4 (A) to (C) and 5). The imaging findings were explained to the patient along with possible courses of action. The patient desired to avoid reoperation and elected to be closely followed with serial x-rays. The patient's postoperative course was otherwise uncomplicated. At the 2-week visit, x-rays demonstrated unchanged incomplete seating of the glenosphere, but the patient was doing well with a clean, dry incision and intact neurovascular exam. At 6 weeks postoperation, the patient denied pain on gentle PROM to 90° of flexion and abduction with no change in her x-rays. She began formal physical therapy (PT) with PROM exercises and her sling was discontinued. At the 3-month visit, the patient reported great improvement over preoperative status, and now had AROM to 140° of flexion and 40° of external rotation with unchanged x-rays. At the 6-month visit, the patient had completed her course of PT and was doing well with home exercises despite unchanged x-rays (Figure 4(D) to (F)).

Significantly, at the 1-year follow-up visit the glenosphere had fully radiographically seated on the baseplate without surgical intervention or mechanical events (Figure 4(G) and (H)). The patient exhibited AROM to 140° of flexion and 50° of external rotation at the left shoulder and was proficient in ADLs that were impossible with her left arm preoperatively. The positioning of the implant remained stable at 18-month follow-up (Figure 4(I) and (J))

Discussion

When performing RSA, baseplate positioning, offset, and tilt must be optimized in order to decrease risk of scapular notching, aseptic loosening, dislocation, glenosphere dissociation, and other complications.[11,15,16] Incomplete glenosphere seating with spontaneous resolution is a rarely reported outcome of RSA that may be a viable alternative to surgical revision in certain RSA designs. Newer RSA designs utilize a Morse-taper for fixation, a central screw, or both, with improved prosthesis lifespan over early Grammont RSA threaded designs.[13,17,18] Care must be taken to avoid entrapping surrounding structures between implant components, as in vitro study of the glenosphere-baseplate union showed that improper component engagement reduced torsional capacity by 60%.[11] In cases of failed Zimmer RSA prostheses, 25% of failures were attributable to glenosphere-baseplate dissociation—its most common mode of failure.[9]

Incomplete glenosphere seating is multifactorial, and testing for appropriate seating of the glenosphere on the Morse taper intraoperatively is difficult. A properly seated glenosphere may require in excess of 4500 Newtons to dissociate intraoperatively, and even improperly seated glenospheres may seem cold-welded in place.[11] Overly aggressive manual testing runs the risk of damaging the glenosphere surface or intraoperative fracture.[14] Some prostheses have a threaded hole for T-handle attachment on the glenosphere to allow for manual distraction testing intraoperatively, but this method fails to assess rotational stability.[11] The author now uses both manual testing and a thin curved clamp to examine the glenosphere and ensure gap symmetry before impaction and again after impaction to ensure complete seating. In glenoid components that include a central fixation screw through the glenosphere, counting the number of screwdriver turns or using an electric torque screwdriver have been proposed evaluation methods.[14]

Intraoperative radiographs can be used to evaluate the glenosphere-baseplate construct, but appreciating subtle angulation of the glenosphere requires evaluation tangential to the baseplate which can be complicated by patient positioning, room size, available equipment, and

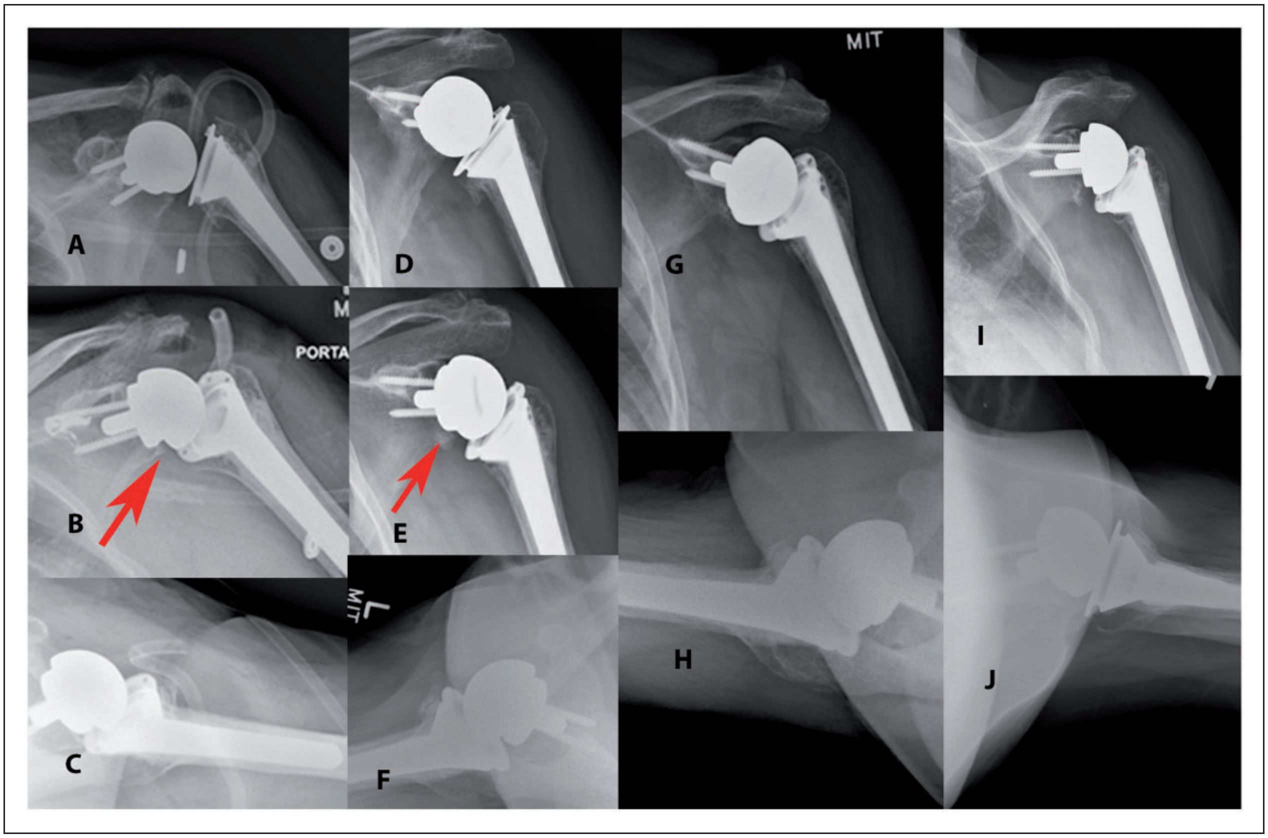

Figure 4. This figure shows the case of a patient with cuff tear arthropathy who underwent RSA for rotator cuff arthropathy. X-rays from same-day post-op (A–C), 6-month follow-up films (D–F), and 1-year follow-up films (G and H). This progression demonstrates incomplete seating of the glenosphere with cephalad tilting on immediate post-operative films, followed by spontaneous seating of the glenosphere between 6 and 12 months. I and J, 18-month follow-up demonstrating maintenance of complete seating of the glenosphere.

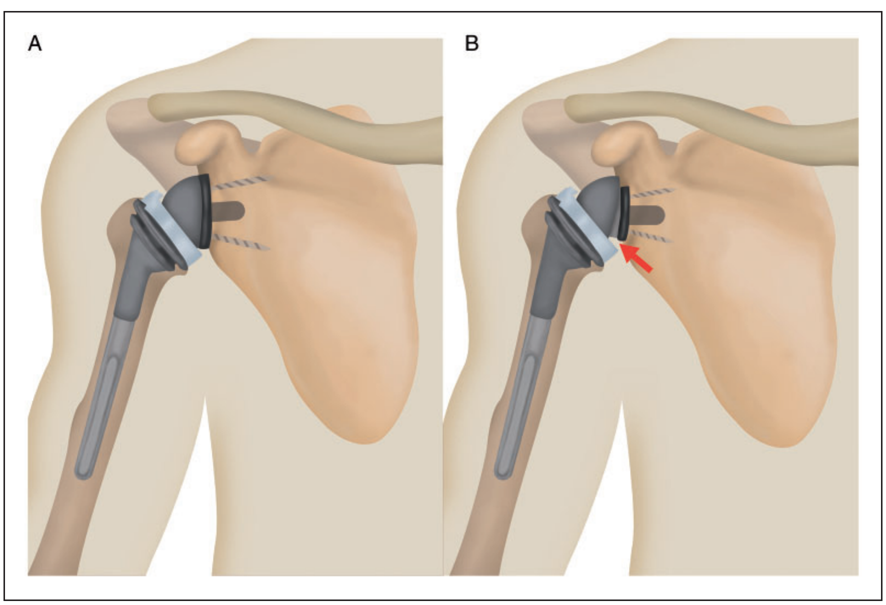

Figure 5. A, A graphical rendering of the reverse shoulder arthroplasty prosthesis. B, The incompletely seated glenosphere component with cephalad tilt as seen on post-operative x-rays.

technician skill and adds radiation exposure to the procedure.[13,14] Introducing more personnel and equipment to the surgical field can increase infection risk.

Larger glenospheres, while providing more postoperative ROM, are more technically difficult to position intraoperatively.[13] Increased incidence of glenosphere dissociation has been associated with large 40 mm and 44 mm glenosphere sizes when compared to smaller glenospheres, though this case used a 36 mm diameter glenosphere.[11] Baseplate thickness may also influence proper glenosphere seating, as thinner baseplates may result in the glenosphere directly contacting the glenoid bone, whereas thicker baseplates allow more bony clearance and less risk for incomplete seating.

RSA designs also exist with both medialized and lateralized glenoid components. Medialized designs may decrease shear forces at the glenoid-baseplate and baseplate-glenosphere interfaces, thereby reducing glenoid component loosening and late dissociation at the expense of increased rates of scapular notching, whereas lateralized designs have increased rates of aseptic loosening.[19] This case utilized a medialized glenoid component, which should theoretically decrease the risk of a partially engaged glenosphere from completely dissociating. The patient's obesity with a BMI of 33.1 is another notable factor that could have influenced the results. Obesity can induce a cam effect through excess soft tissue in the limb and trunk to promote instability of the prosthesis, and can also limit exposure.

Previous articles addressing glenosphere dissociation primarily utilized revision surgery to manage that complication.[17] While glenosphere dissociation is one of the possible endpoints of poor glenosphere-baseplate union, this case demonstrated spontaneous complete and symmetric correction rather than complete dissociation. In the absence of pain or dysfunction, this patient's desire to avoid revision surgery overruled her desire for a radiographically perfect outcome. The surgeon considered the patient's age, the type of prosthesis, demand on the limb, and commitment to follow-up, ultimately offering her the choice to monitor the prosthesis conservatively. In light of the spontaneous seating of the glenosphere on the baseplate one year post-operation, this population of RSA patients with incomplete glenosphere seating may benefit more from conservative management than revision.

Conclusion

While there is no gold standard for management of incompletely seated glenosphere components in RSA, this case demonstrates spontaneous seating of the glenosphere component with non-operative management within one-year follow-up in an elderly patient with low demand for the affected joint. A judicious approach must be taken when analyzing management of glenosphere complications on a case-by-case basis. Further studies may be useful to define what factors have positive prognostic value for spontaneous component seating.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Considerations

Formal written informed consent was obtained from the patient prior to reproduction of the details of the case and imaging studies.

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