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Polyethylene dislocation after a reverse total shoulder arthroplasty with an intact glenohumeral joint

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Since its approval for use in the United States by the Food and Drug Administration in 2003, reverse total shoulder arthroplasty (RTSA) has increasingly become the treatment of choice for elderly individuals with rotator cuff arthropathy. In 2011, one-third of shoulder arthroplasty procedures were RTSAs, with primary indications being osteoarthritis, rotator cuff tear, and rotator cuff arthropathy.[13,16] Long-term outcomes after RTSA have shown a high survival rate and good clinical results in patients with a minimum 10-year follow-up period.[3] Acceptance has been growing for the use of RTSA not only in cases of rotator cuff arthropathy but also in patients with severe proximal humeral fractures, malunion or nonunion, revision arthroplasty, or instability, as well as in younger patient populations.[1,6,9,14] These wider indications for RTSA have led to an incidence of RTSA that is increasing at a faster rate than that of standard anatomic total shoulder arthroplasty.[5] However, as the total number of RTSA procedures continues to increase, so too will the number of postoperative complications. Infection, instability, aseptic loosening, nerve palsy, periprosthetic fracture, and polyethylene (PE) dissociation have all been recognized as potential complications after an RTSA.[17] In addition, patient factors such as an increased body mass index (BMI), advancing age, osteopenia, and medical comorbidities, along with implant-related choices such as the use of retentive liners, may contribute to complication rates.

In this case report, we present a unique presentation of PE dissociation and dislocation secondary to a traumatic event with subsequent reduction of the humeral tray into the glenosphere articulation. Maintained shoulder motion after the injury delayed the initial presentation, but a thorough evaluation of postoperative radiographs and a clinical history of trauma led to a timely diagnosis and uncomplicated revision shoulder arthroplasty. To our knowledge, there is only 1 other reported case of this particular scenario in the literature, in which a significant delay in diagnosis and treatment occurred secondary to the subtle nature of the presentation.

Case history

The patient was a 61-year-old woman with a BMI of 51.3 who presented with a history of an undifferentiated mixed connective tissue disorder, which progressed to involve her right shoulder. She was treated aggressively for this and was prescribed 30 mg of prednisone daily but still had progressive pain and dysfunction. At the time of presentation, examination of the right shoulder showed pseudoparalysis. Radiographs (Fig. 1) and magnetic resonance imaging demonstrated chronic remodeling and collapse of the humeral head, which may have been attributed to the patient's chronic steroid use. Magnetic resonance imaging also displayed retracted tears of the subscapularis, supraspinatus, and infraspinatus, as well as a large effusion consistent with an inflammatory arthritic joint or potentially a neuropathic joint.

The patient consented to an elective right-sided RTSA performed by the senior author to manage the bony and soft-tissue deformity. Surgery proceeded with the Lima SMR system (Lima LTO, San Daniele del Friuli, Italy) and placement of a 36-mm eccentric glenosphere prosthesis, a press-fit humeral stem, and a retentive PE liner as the soft-tissue envelope appeared severely compromised at the time of the index procedure. After placement of the final prosthesis, there was no evidence of soft-tissue or bony impingement, no abnormal coaptation was noted with rotation, and the shoulder displayed excellent stability. No intraoperative

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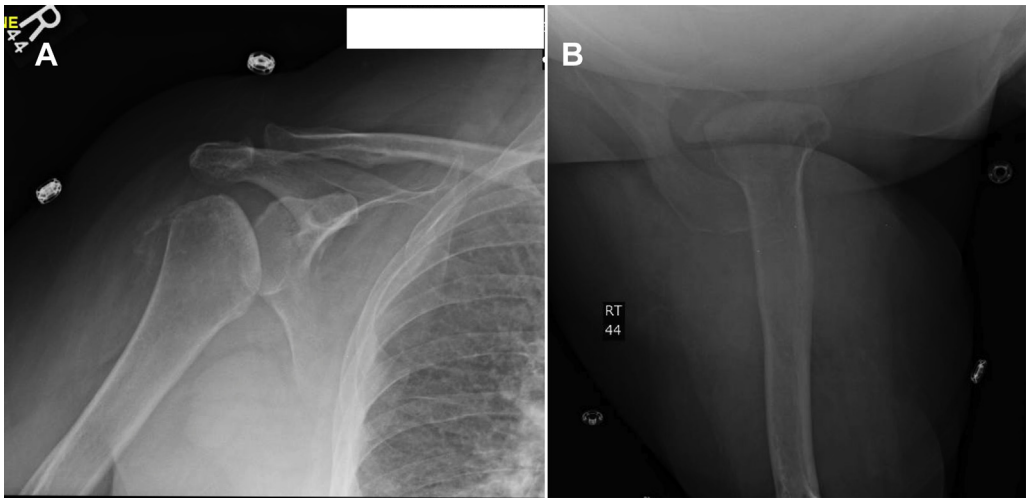

Figure 1 Preoperative anteroposterior (**A**) and axillary (**B**) radiographic views of right shoulder displaying significant humeral head collapse.

complications were encountered. The patient was discharged home on postoperative day 1 after an uneventful stay. The standard postoperative protocol of the senior author includes use of a sling for 2 weeks, followed by only self-directed passive and active range-of-motion exercises until 6 weeks, with strength training reserved until after 6 weeks.

At 1.5 weeks postoperatively, the patient presented for her first follow-up visit. At this time, she noted only mild pain and was extremely satisfied with her surgical procedure. She tolerated gentle passive range of motion to 40° of forward flexion, 10° of external rotation, and 30° of abduction. Radiographs of the right shoulder demonstrated that the components were in the appropriate position and were well fixed and well aligned (Fig. 2). The patient was instructed to continue home exercises and wean from using the sling at the 2-week postoperative mark.

The patient was next seen at her 7-week postoperative visit. At this time, she reported consistent shoulder pain rated as 5 of 10 but much improved vs. that prior to surgery. She related that she was very satisfied with surgery and would elect to undergo the procedure again. She did, however, admit to a recent fall in which she reached out with the right arm to catch herself and felt a pop with severe shoulder pain for several minutes. The pain quickly resolved, and she continued to progress with motion and strength. On examination, she was able to perform 100° of active forward flexion, 20° of active external rotation, and 70° of active glenohumeral abduction. Radiographs of the right shoulder demonstrated decreased space between the humeral component and the glenosphere (Fig. 3). There was concern that the glenohumeral articulation had been compromised and perhaps the PE liner had dissociated from the humeral tray. A computed tomography (CT) scan of the right shoulder was performed and demonstrated a filling defect in the soft tissues anterior to the glenohumeral joint in the shape of the PE liner but with an intact glenohumeral articulation (Fig. 4). A revision right-sided RTSA was then scheduled.

Intraoperatively, discolored tissue was encountered, surrounding the undersurface of the deltopectoral interval, consistent with metallosis. Further exposure of the interval revealed the PE liner floating between the deltopectoral interval and the conjoint tendon; the PE liner was then removed. On entry into the joint, a large effusion was encountered. The glenosphere was articulating with the metal portion of the humeral tray. Secondary to the metallosis and the potential compromise of the polished surface of the glenosphere, it was replaced with one of the same size. The humeral stem and glenoid baseplate were stable and well fixed

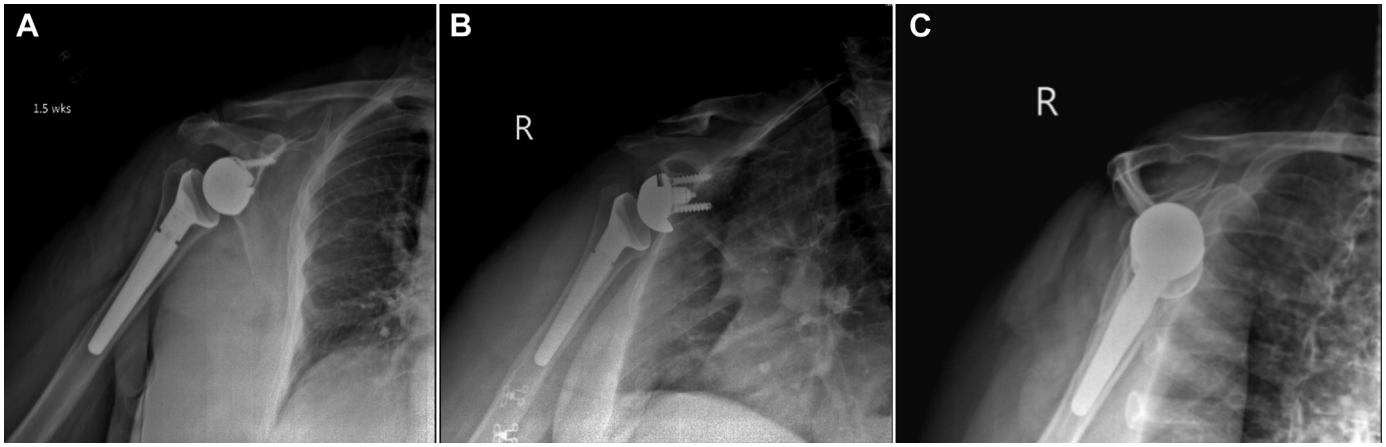

Figure 2 Initial post–reverse total shoulder arthroplasty anteroposterior (**A**), Grashey (**B**), and scapular-Y (**C**) radiographic views displaying well-fixed and well-aligned components.

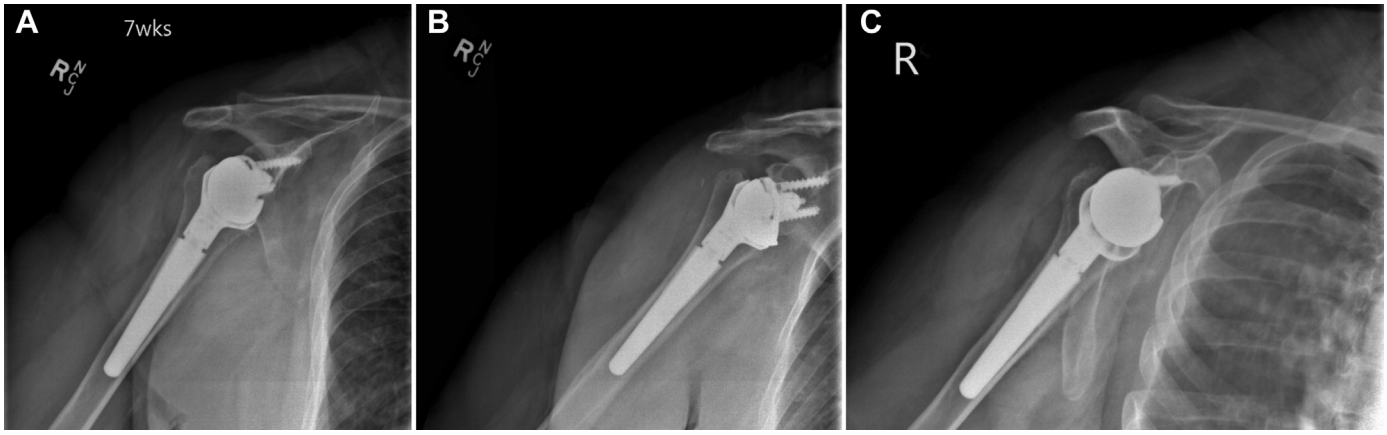

Figure 3 Anteroposterior (**A**), Grashey (**B**), and scapular-Y (**C**) radiographic views obtained 7 weeks after reverse total shoulder arthroplasty, displaying the overlap sign—decreased space between the glenosphere and humeral tray with an intact articulation.

with no evidence of osteolysis or loosening. The periprosthetic tissue was débrided of metallosis, which also coated the humeral tray and glenoid baseplate. PE liners were trialed, and although stability appeared adequate with the same retentive liner as used in the index surgical procedure, a decision was made to increase the PE thickness but to use a less constrained liner. The shoulder was irrigated and closed in standard fashion, with no intraoperative or immediate postoperative complications.

At 3 months after revision, the patient was doing well. She rated pain as 3 of 10 and was very satisfied with the surgical procedure. Her right shoulder displayed 90° of active glenohumeral abduction, 60° of external rotation, and 150° of forward flexion. Radiographs displayed a well-fixed and well-aligned right-sided revision RTSA (Fig. 5). The activity level will be gradually increased, and the patient will be monitored per our standard postoperative protocol.

Discussion

This case report illustrates an unusual complication unique to RTSA that has not been well identified in the orthopedic literature and that requires a high index of suspicion to identify. In this case, the patient presented at routine follow-up, not in a more urgent fashion, despite having a dislocated prosthesis, for 2 main reasons: First, she felt that the injury itself was not severe, as pain did occur but diminished to baseline within a few minutes. Second, she maintained her range of motion and continued to improve day by day afterward.

PE dissociation and dislocation with an intact glenohumeral articulation can easily be overlooked when a patient complains of vague shoulder pain but maintains satisfactory shoulder motion. To our knowledge, this complication has been described only once previously, by Nizlan et al[11] in 2009. In their case report, the patient fell 1 month after the index procedure, but the diagnosis was delayed 10 months because the patient displayed excellent range of motion despite persistent pain. Review of the radiographic images in the aforementioned article does show an unusual overlap of the components, but unfortunately, owing to the nature of the complication, it was not recognized until much later.

The 2018 Australian Orthopaedic Association National Joint Replacement Registry annual report documented component dissociation as a cause of revision in 0.9% of revision RTSA cases.[2] There have been additional studies identifying PE dissociation in RTSA but with drastically different presentations in comparison to our case. Patel et al[12] presented a series of 4 cases of this complication. Two of their patients presented with irreducible glenohumeral dislocations that required open reduction, and a diagnosis of a PE dissociation was made intraoperatively. The other 2 patients presented with mechanical symptoms, pain, and decreasing motion. Imaging demonstrated malpositioning of the humeral component, and in both instances, the PE liner was completely dissociated from the humeral component while still articulating

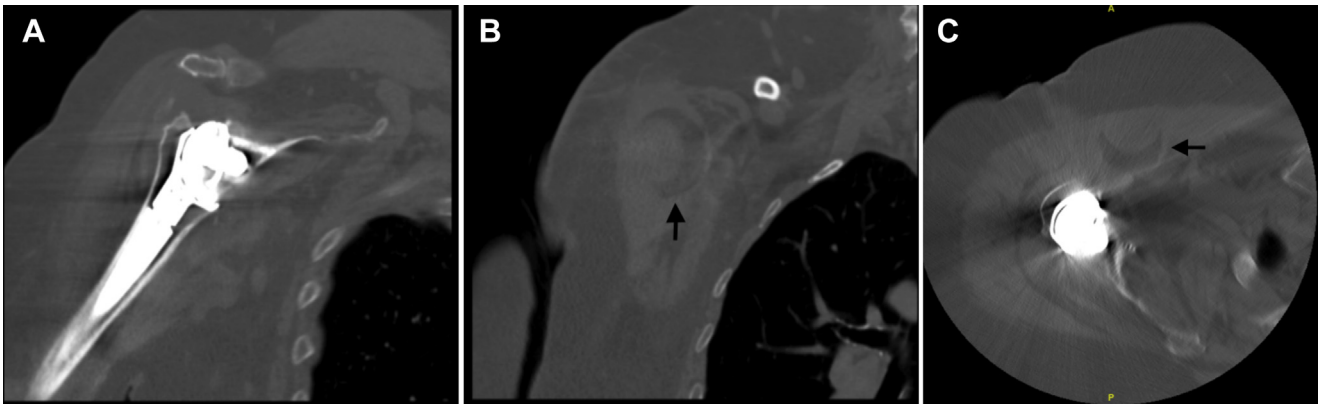

Figure 4 Coronal (**A, B**) and axial (**C**) slices of the right shoulder on computed tomography, displaying a metal-on-metal articulation between the glenosphere and humeral tray of a reverse total shoulder arthroplasty. The outline of the polyethylene liner can be seen in the anterior soft tissues (→).

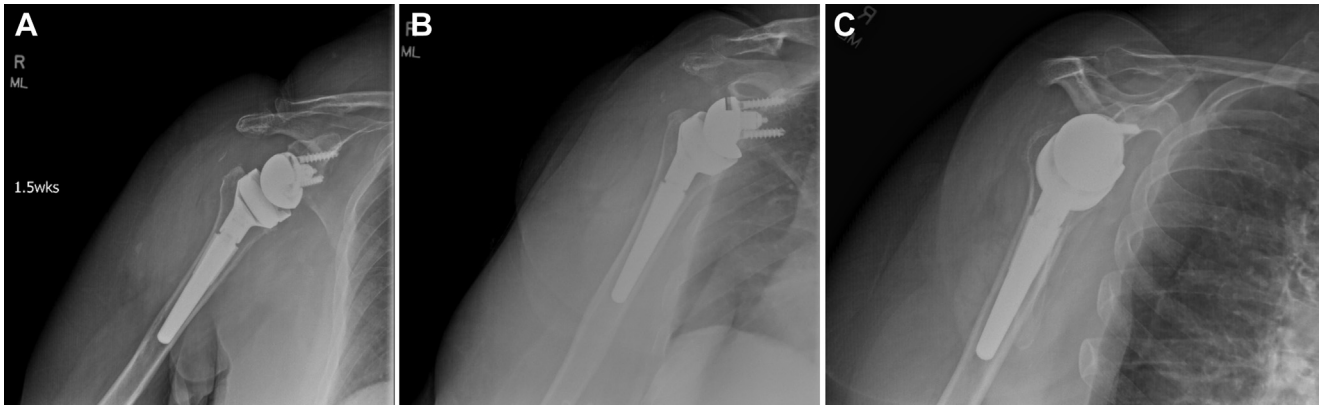

Figure 5 Anteroposterior (**A**), Grashey (**B**), and scapular-Y (**C**) radiographic views after revision reverse total shoulder arthroplasty, displaying well-fixed and well-aligned components.

with the glenosphere. In all 4 cases, there were obvious signs of a compromised glenohumeral articulation, declining function, and mechanical symptoms. Moreover, Garberina and Williams[7] presented a case of PE dissociation that was diagnosed with shoulder arthroscopy. Their patient had severe shoulder pain and dramatic worsening of function but with a well-fixed, reduced RTSA on radiographs. Arthroscopy identified a PE liner that articulated with the glenosphere but displayed obvious motion within the humeral tray with gentle palpation.

In contrast to these other examples of PE dissociation, our patient denied any mechanical symptoms or worsening pain or function, and besides admitting to a fall with a brief stint of increased pain, she was very pleased with surgery and would have elected to undergo the procedure again. This was consistent with the history provided in the case study of Nizlan et al.[11] In our patient, plain radiographs of the shoulder displayed no obvious signs of a dislocated or subluxated glenohumeral joint. However, excessive component overlap was noted on the routine imaging studies, which was integral in establishing the immediate workup with a CT scan.

The exact mechanism of PE dissociation is unknown, but shoulder instability and impingement may be contributing factors. Identifying risk factors for PE dissociation with and without dislocation is beyond the scope of this case report, but it is important to recognize that patient factors could contribute to this complication. First, our patient had a BMI of 51.3, which categorizes her as obese class III via the World Health Organization classification and at higher risk of postoperative complications, including instability, following a total shoulder arthroplasty.[10,15] Second, our patient had a diagnosis of an undifferentiated mixed connective tissue disorder. Even though adequate soft-tissue tensioning was obtained during the index procedure, compromised soft tissues and bone quality may have placed this patient at increased risk of shoulder instability. In addition, implant factors may contribute to shoulder instability. During the index surgical procedure, the senior author elected to use a retentive liner. Increasing liner constraint has been shown to decrease the impingement-free shoulder arc of motion, which may contribute to accelerated wear and glenohumeral dislocation from a levering-out mechanism.[8] Additional studies assessing the PE—humeral tray interface and the effect of increasing constraint would help to identify a potential risk of PE dissociation. Finally, on the basis of data from the Australian Orthopaedic Association National Joint Replacement Registry, a glenosphere size of less than 38 mm and a Lima SMR L1 component, both of which were used in our patient, have a higher risk of revision, which includes instability as a cause of revision.[2]

The importance of having a high index of suspicion and early diagnosis cannot be overstated. A delay in diagnosis can lead to extensive metallosis from glenosphere and humeral tray friction, as well as osteolysis, that can have severe implications for the patient. Boileau et al[4] reported on 3 cases of metal-backed glenoid loosening and severe osteolysis secondary to metallosis and PE wear. Of the glenoid components, only 1 was able to be revised with a stable cemented component whereas the other 2 required extensive bone grafting owing to cavitary defects. To avoid this potentially catastrophic complication, diagnosis of a dislocated PE liner and metal-on-metal contact must be made in a timely manner.

Our recommendation is that any history of shoulder trauma in a reverse shoulder arthroplasty patient warrants obtaining standard radiographs of the shoulder even in the presence of preserved function. As seen in our case and that of Nizlan et al,[11] the “overlap sign” (Fig. 3), consisting of an overlapping glenosphere and humeral tray with adequate alignment, can be identified on careful review. We consider this sign to be pathognomonic of PE liner dissociation and dislocation from the glenohumeral joint. A CT scan can confirm the diagnosis if in doubt, and early diagnosis is imperative to prevent or minimize complications that are well established as the result of ensuing metallosis.

Conclusion

The overlap sign on radiographs should lead to concern regarding PE dissociation in an RTSA. A CT scan can assist in the diagnosis. Early diagnosis and treatment are imperative to preventing complications of metallosis.

Disclaimer

Patrick Noud is a paid consultant for Techmah and Lima Corporate.

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