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Whole humeral head osteochondral allograft with glenoid bone block augmentation after chronic locked bilateral anterior shoulder dislocations in an adolescent patient: a case report

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Approximately 96% of shoulder dislocations are in the anterior direction with an incidence of 23.9/100,000 person years.[20] Anterior dislocations are easier to diagnose than their less common posterior counterparts as they tend to have a clear mechanism of injury and more obvious radiographic findings. The paucity of literature on chronic anterior dislocations since the classic articles by Flatow et al[7] and Rowe[18] is indicative of their rarer occurrence.

Surgical challenges associated with glenoid and humeral head reconstruction are magnified in the setting of patients who present with chronic locked shoulder dislocations.

This results in some patients and surgeons choosing nonoperative treatment, particularly in lower demand elderly patients or those with significant medical comorbidities.[7] In the classic series of Flatow et al,[7] over 40% of the patients with chronic anterior dislocations were treated without surgery. In younger active patients, the functional losses associated with nonoperative treatment of a locked dislocation are associated with significant disability.

Here we present a case of an adolescent teenager who had chronic bilateral locked anterior shoulder dislocations that was treated with bilateral fresh whole humeral head osteochondral allograft (OCA) and glenoid reconstruction using bone block augmentation and the lessons learned from this unique case. By definition, fresh allografts have been harvested within 24 hours of the donors' death and are typically stored at 4°C before being transplanted into a recipient host within 28 days of harvest.

Case report

This is the case of a healthy 16-year-old male who presented with bilateral locked anterior shoulder dislocations (Figs. 1 and 2). The patient presented with unclear history and would not admit to a specific traumatic event. The referring outside surgeon initially performed an open reduction and soft-tissue stabilization procedure on the right side several months before the patient presented to our clinic, with radiographs demonstrating right shoulder subluxation and humeral head collapse (Figs. 3 and 4) and left shoulder anterior dislocation (Fig. 2). On examination of the right shoulder, he had external rotation to 5 degrees, abduction to 15 degrees, and forward flexion to 100 degrees. On examination of the left shoulder, he had essentially no active elevation motion of shoulder, and his external rotation was −35 degrees. We decided to first proceed with treatment of the right shoulder because this shoulder was more painful and imaging showed rapid degeneration of the glenohumeral joint.

A magnetic resonance image (Figs. 5 and 6) of the right side confirmed bipolar glenohumeral bone loss with approximately 40% bone loss of anterior-inferior glenoid, a large Hills-Sachs lesion, and posttraumatic collapse of the humeral head. Given the rapid and progressive degenerative changes seen on imaging, we were concerned about potential chronic infection. We, therefore, performed

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Figure 1 AP of the right shoulder demonstrating initial presentation of chronic locked anterior dislocation. *AP*, anteroposterior.

Figure 2 AP of the left shoulder demonstrating initial presentation of chronic locked anterior dislocation. *AP*, anteroposterior.

Figure 3 AP image of the right shoulder showing subluxation and humeral head collapse seen after the initial open reduction and soft-tissue stabilization procedure. *AP*, anteroposterior.

Figure 4 Axillary view of the right shoulder showing humeral head collapse.

an arthroscopic biopsy with planned staged reconstruction. Arthroscopic exam confirmed Outerbridge grade 4 chondromalacia of the humeral head and glenoid, consistent with what was seen on imaging. The arthroscopic biopsy technique used was described by Dilisio et al.[4] Cultures grew *Cutibacterium acnes.* At the recommendation of infectious disease, the patient was placed on 6 weeks of intravenous vancomycin. He was then transitioned to enteral minocycline for 9 months.

After he completed his antibiotic course of minocycline, the patient subsequently underwent size-matched fresh whole humeral head OCA procedure utilizing the technique previously described by McCarty and Cole[11] and anatomic OCA glenoid reconstruction using distal tibia allograft (DTA) as described by Provencher et al.[16] Intraoperatively we found a Hill-Sachs lesion of 30% of the humeral head, grade 4 chondromalacia of the entire humeral head, as well as a 40% anterior glenoid defect (Fig. 7). The whole fresh humeral head allograft was secured with 4 headless 4.5-mm Bio-Compression Screws (Arthrex Inc., Naples, FL, USA). A DTA was cut to match the glenoid defect and was fixed using two 4.0-mm cancellous screws (DePuy Synthes, Raynham, MA, USA). Cultures (4/4) at this procedure grew *C. acnes*. The patient was then placed on vancomycin for additional 4 weeks and was then

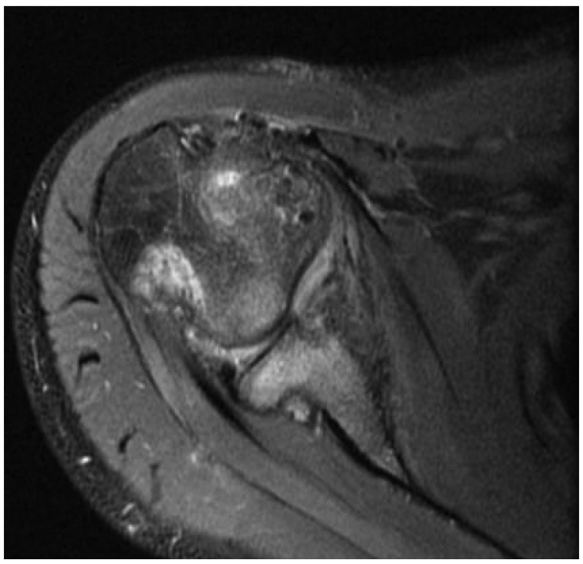

Figure 5 MRI T2 axial cuts of the right shoulder showing anterior glenohumeral subluxation, large Hills-Sachs lesion, and anterior glenoid bone loss. *MRI*, magnetic resonance imaging.

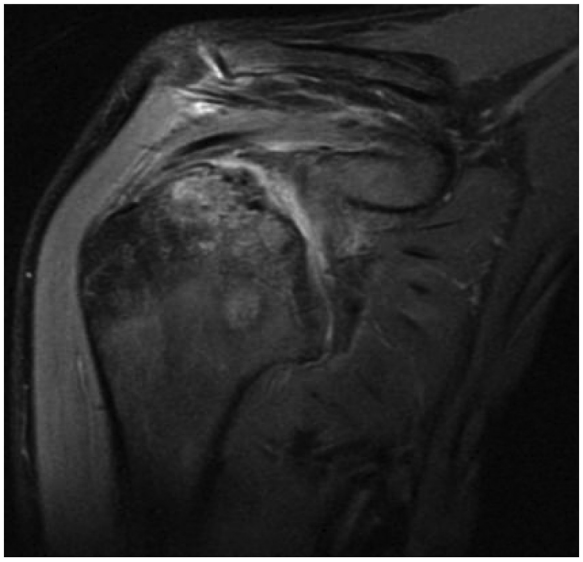

Figure 6 MRI T2 coronal of the right shoulder showing humeral head collapse. *MRI*, magnetic resonance imaging.

transitioned for a year of oral minocycline. Two-year follow-up radiographic (Figs. 8 and 9) and computer tomography (CT) scan (Fig. 10) images have demonstrated maintained reduction of the glenohumeral joint and incorporation of the humeral OCA and DTA. External rotation improved to 35 degrees, abduction 80 degrees, and active forward flexion to 125 degrees. At his most recent postoperative visit, the patient reported significantly less pain and was very satisfied at his improvement.

We then turned our attention to the left shoulder. Initial radiographs (Fig. 2) and magnetic resonance image (Fig. 11) of the left shoulder revealed a chronic locked anterior shoulder dislocation and a bipolar lesion with a large Hill-Sachs defect and a 30% glenoid defect. Nine months after definitive treatment of the right side, the patient underwent an open reduction with Latarjet coracoid transfer on the left side. Intraoperatively he was found to have a large Hills-

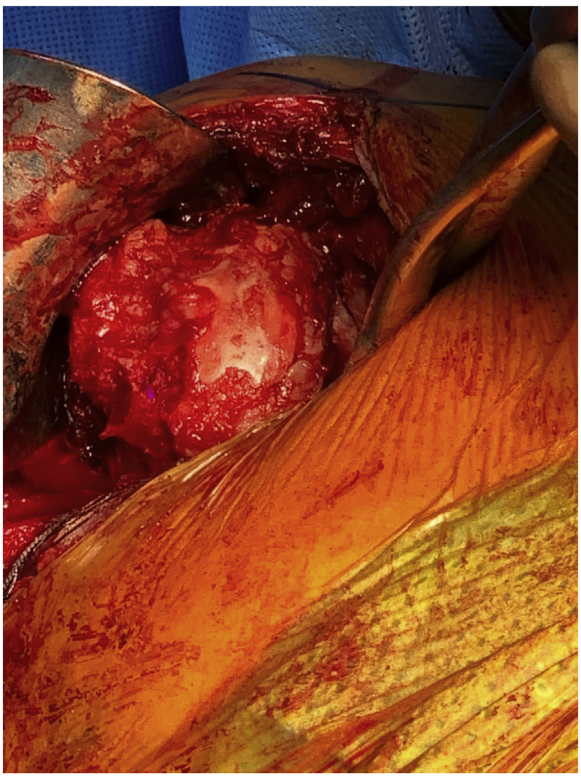

Figure 7 Intraoperative photograph or the right shoulder revealing a Hill-Sachs lesion and grade 4 chondromalacia of the entire humeral head.

Sachs lesion as well as grade 4 chondromalacia of approximately 10% of the remaining humeral head and a locked anterior dislocation of the glenohumeral joint. After open reduction and performing the Latarjet procedure, the shoulder was stable as the Hill-Sachs lesion did not engage the glenoid. Because the area of chondromalacia was small, we elected to observe the lesion, preferring to maintain the native humeral head in a teenager. At 2-month follow-up, the patient complained of increasing pain. Plain film radiographs (Fig. 12) and CT (Fig. 13) obtained showed progressive humeral head collapse. Given his satisfaction with the outcome on his right shoulder, he underwent the same size-matched donor fresh humeral head OCA procedure on the left side. Intraoperatively we noted the entire articular surface was collapsed (Fig. 14), which was a significant change from our index procedure. An osteotomy at the surgical neck was performed to remove the entire articular surface, and a size-matched fresh frozen humeral head osteoarticular allograft was stabilized as previously described (Fig. 15). At 1-year follow-up, his pain was decreased, and active range of motion has improved abduction to 80 degrees, forward flexion to 125 degrees, and external rotation to 10 degrees. Follow-up 1-year radiographs (Figs. 16 and 17) and CT (Fig. 18) demonstrated maintained position and integration of the coracoid transfer and humeral head allograft.

Discussion

Here we present a rare case of bilateral chronic locked anterior shoulder dislocations in an adolescent patient. Treatment of locked dislocations and their sequalae is difficult, especially in the young. Flatow et al[7] reported their case series of 17 locked anterior dislocations almost 30 years ago. In their study, 10 of the 17 patients elected to proceed with surgical intervention, of which 9 required arthroplasty due to degeneration to the articular surface. One patient with a dislocation for only 2 months had a preserved articular surface and

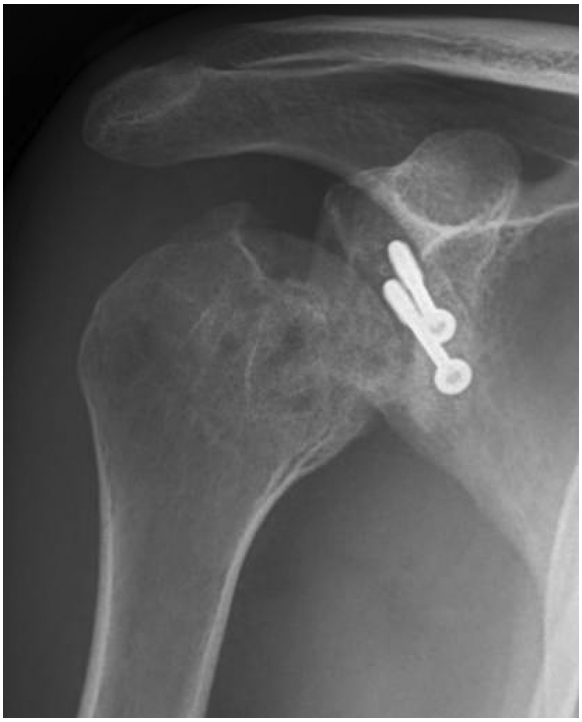

Figure 8 AP of the right shoulder performed at 2 years postoperatively showing good incorporation of both the osteochondral allograft of humeral head and distal tibia allograft. *AP*, anteroposterior.

Figure 9 Axillary view of the right shoulder performed at 2 years postoperatively showing good incorporation of both the osteochondral allograft of humeral head and distal tibia allograft.

Figure 10 CT coronal image of the right shoulder at 2 years showing intact osteochondral allograft to humeral head and intact distal tibia allograft to glenoid defect. *CT*, computed tomography.

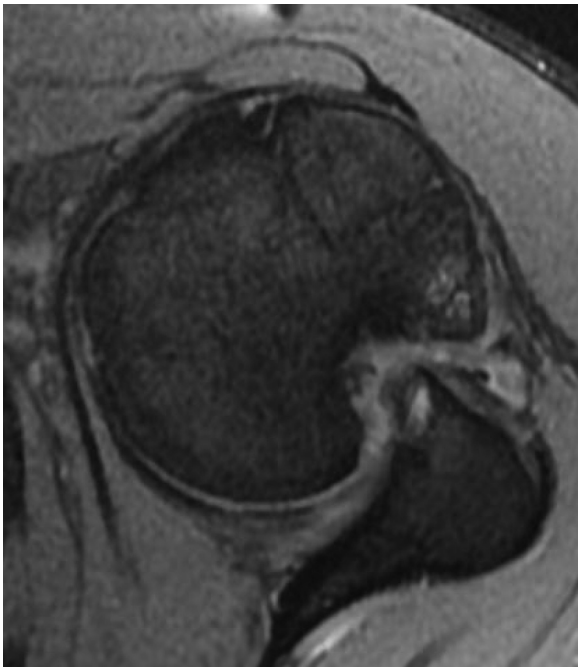

Figure 11 T2 MRI axial cut of the left shoulder shows locked anterior shoulder dislocations with a large Hills-Sachs defect. *MRI*, magnetic resonance imaging.

underwent an open reduction and Latarjet procedure. They noted that if the humeral head was dislocated for more than 6 months, the subchondral bone of the humeral head that was not engaged with the scapula becomes soft and can be indented by pushing on it. They referred to this phenomenon as the "ping-pong effect." When reduction of the glenohumeral joint is performed after chronic anterior shoulder dislocations for greater than 6 months, humeral head collapse can be observed, as it did in this patient. Unfortunately, in this case, the softening of the subchondral bone was only noted by observing humeral head collapse after the open reduction was performed. In retrospect, given the humeral head collapse of the right shoulder, we should have performed the OCA during the initial

Figure 12 AP view of the left shoulder shows a coracoid transfer and fixation with collapse of the humeral head. *AP*, anteroposterior.

Figure 13 CT coronal image of the left shoulder showing humeral head collapse after Latarjet procedure with intact coracoid transfer. *CT*, computed tomography.

reduction of the left side. One of the purposes of this report is to bring attention to this previously described "ping pong effect."

Management for shoulder instability depends on the acuity, age, and activity level of the patient, as well as the size of the humeral head and glenoid defects. Treatment options for chronic and recurrent dislocations include open soft-tissue reconstruction

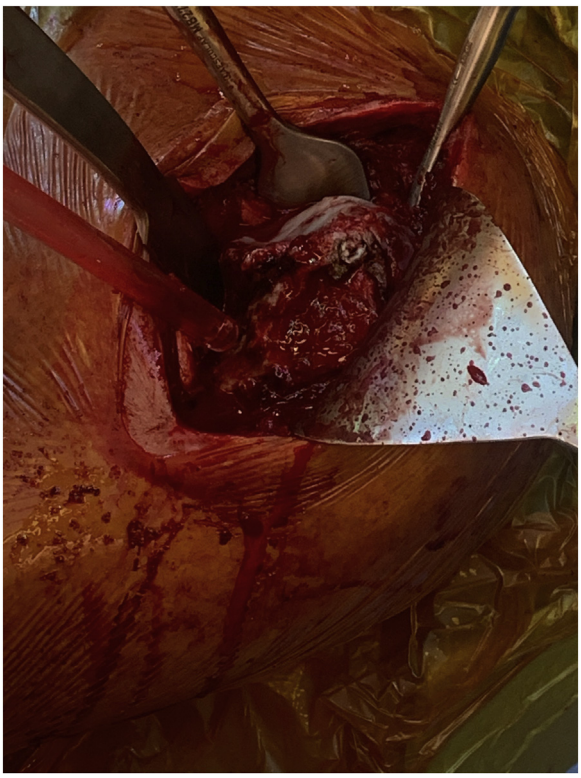

Figure 14 Intraoperative photograph of the left shoulder revealing collapse of the humeral head.

Figure 15 Introperative photograph of the left shoulder showing the whole humeral head fresh frozen osteochondral allograft.

Figure 16 AP view of the left shoulder shows an osteochondral humeral head allograft and coracoid transfer and fixation at 1-year follow-up. *AP*, anteroposterior.

Figure 17 Axillary view of the left shoulder shows an osteochondral humeral head allograft and coracoid transfer and fixation.

including the modified McLaughlin[3] method for posterior dislocations and remplissage for anterior dislocations.[8] It has been reported that glenoid bone loss greater than 25% of the anterior inferior glenoid diameter should be addressed with a bony procedure[9] like Latarjet[19] or DTA.[15] Bony augmentation procedures are associated with morbidity and complications. The Latarjet procedure has been associated with complications such as postoperative osteolysis, bone block nonunion or fracture, arthritis, neurologic complications, and recurrence of instability.[5]

In biomechanical studies, glenoid defects greater than 21% have been shown to cause persistent instability after soft-tissue procedure like Bankart repair.[10] Given the patient's large bilateral

Figure 18 CT coronal image of the left shoulder showing integration of the humeral head osteochondral allograft and Latarjet. *CT*, computed tomography.

glenoid defects of >30% bilaterally, he was indicated for bilateral glenoid augmentation. For the left glenoid, we chose to augment the glenoid defect with the Latarjet procedure because the glenoid articular cartilage was maintained. We elected to augment the right glenoid defect with a DTA due to the severe degenerative changes noted to the glenoid anteroinferior cartilage. DTA has been suggested as an alternative as it offers several advantages over the Latarjet. They include the use of dense subchondral allograft bone that has articular cartilage, the avoidance of the morbidity of coracoid transfer and nonanatomic sling, the conformity of the distal tibia to the shape of the glenoid, and the ability to customize the DTA to the size of the defect.[16]

Bony defects seen on both the humeral and glenoid sides are referred to as bipolar lesions.[2] In the young, glenohumeral joint preservation techniques for humeral head lesions include microfracture and autologous chondrocyte implantation for smaller humeral head lesions.[17] OCA is reserved for larger defects greater than 40% of the humeral head.[1,6,12] Arthroplasty is the preferred treatment for the older patients with chronically locked humeral head dislocations.[13,14]

Conclusion

The purpose of this case was to report on the educational lessons learned from treating a rare diagnosis of chronically locked bilateral anterior shoulder dislocations in an adolescent patient. Specifically, this report brings attention to the previously described but perhaps forgotten concept of the "ping-pong effect" in which the portion of the humeral head that is out of contact with the glenoid softens and collapses if reduced into the glenoid. We have not found any additional references to this phenomenon since the original classic publication almost 30 years ago by Flatow et al.[7] Patients that have had chronic locked anterior dislocations and remain unreduced for greater than 6 months should be specifically counseled of this effect and the possibility that the humeral articular surface could collapse after open reduction. This information is important to the shared decision-making process including surgeons and patients when contemplating surgical intervention options in this challenging scenario.

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