CHAPTER 8 – FOCAL RESURFACING OF HUMERAL-HEAD DEFECTS

Pradeep Kodali, Anthony Miniaci
8.1 Introduction

Traumatic shoulder instability is extremely common in athletes. It is usually due to abnormal abduction, external rotation, and extension force on the shoulder, causing it to exceed normal limits of gleno-humeral motion and resulting in anterior dislocation. A characteristic anteroinferior capsulolabral injury occurs and has been deemed the essential lesion in anterior shoulder instability [1–3]. A posterosuperior humeral-head defect (Hill-Sachs lesion) is noted in 93% of cases [4]. This bone defect, if large enough, may contribute to failed soft tissue stabilization that occurs in 8–18% of patients [4–6]. Large defects lead to an articular arc mismatch that, at lesser degrees of external rotation, will engage with the anteroinferior glenoid, causing instability [7]. Treatment typically entails a combined procedure to address the soft tissue injury and bone defect. For large Hill-Sachs lesions, surgical options include nonanatomic techniques, such as the remplissage procedure [4, 8], or anatomic techniques. Purchase et al. [8] used an arthroscopic remplissage technique and had only a 7% chance of recurrent instability. Anatomic techniques include either matched humeral-head allograft or resurfacing arthroplasty with HemiCAP® (Arthrosurface, Franklin, MA, USA) [9]. Allograft transplantation for Hill-Sachs lesions has been described and yields good outcomes in most case reports [10–12]. One series of 18 patients with humeral-head defects >25% of the humeral-head diameter and treated with structural allografts showed no evidence of recurrent instability 2 years after surgery [13]. Recently, due to the difficulty of obtaining matched allografts, patients have lent toward electing a resurfacing procedure, which have yielded positive early results (unpublished data). Our preference is anatomic reconstruction, which is the focus of this chapter.

8.2 Indication/Algorithm

Our indication for treating humeral-head defects relies largely on physical examination in combination with imaging studies identifying a large humeral-head defect. In our experience, apprehension with the arm at 45° of abduction and 45° of external rotation indicates a significant bony injury, contributing to instability in a functional range of motion. If there is no apprehension with this maneuver, then a soft tissue procedure will likely suffice. Preoperative workup includes plain radiographs [anteroposterior (AP), true AP, axillary, scapular Y], computed tomography (CT) scan, and a magnetic resonance imaging (MRI) study. Although there are various radiographic techniques to quantify the size of the humeral-head defect [14–16], there is no universally accepted method or criterion that dictates treatment. Recently, Sekiya et al. [17], in a biomechanical study, showed that defects as small 12.5% of the humeral head affect stability and may benefit from allograft transplantation [17]. Kaar et al. [18], in another biomechanical study, showed that defects that are five eighths of the radius of the humeral head affect stability. We use the various imaging studies to determine the extent of soft tissue injury and confirm the presence of a large humeral-head or glenoid-rim defect. A combination of a large humeral-head defect with positive physical exam findings necessitates addressing the bony injury, thus requiring an open procedure.

8.3 Technique: Humeral-head Resurfacing with Artificial Implant

We position the patient in a modified beach-chair position with the operative extremity free in order to allow adequate extension and external rotation of the arm. The deltopectoral approach is used even for posterior humeral-head defects, because with appropriate arm positioning and adequate capsular release, the defect is clearly visualized. In addition, the soft tissue injury can be addressed at the same time, eliminating the need for a separate incision. An 8- to 10-cm incision is made along the deltopectoral groove lateral to the coracoid process (Fig. 8.1). The incision can be extended proximally to...
the clavicle and distally along the medial border of the deltoid as far as needed. The cephalic vein is identified, and the interval is developed medial to the vein. It is important to visualize insertion of pectoralis major, and partial release of this may facilitate exposure. After dissection through the clavipectoral fascia, the subscapularis is identified (Fig. 8.2). A longitudinal incision is made through the subscapularis and capsule ensuring 1 cm of subscapularis tendon is left on the humeral side, facilitating later repair. The capsule is now separated from the subscapularis and tagged with a suture. The arm is positioned in extension and external rotation to place tension on the inferior capsule, and the capsule is released from the humerus using a cautery device. Adequate capsular release is integral to obtaining sufficient exposure of the Hill-Sachs lesion (Fig. 8.3). A humeral-head retractor is used to inspect the glenoid for labral pathology. If the classic Bankart lesion is seen, it is repaired with suture anchors. The sutures are passed through the labrum but are not tied until the conclusion of the resurfacing procedure. At this point, instrumentation for the HemiCAP resurfacing system is used. Appropriately sized
drill guide is chosen to ensure defect coverage (Fig. 8.4), and the guidewire is inserted in the center of the defect (Fig. 8.5). A cannulated drill that is present with the instrumentation system is used, and the hole is subsequently tapped to allow insertion of the taper post.
(Fig. 8.6). A centering shaft is placed into the taper of the taper post, and a contact probe is used to obtain offsets at the superior/inferior and medial/lateral margins (Fig. 8.7). These are recorded, and using the sizing card that comes with the instrumentation, the appropriate size of the articular component is chosen. The centering shaft and contact probe are removed, and the guide pin is replaced. The circular cutter is inserted over the guide pin to score the articular cartilage to subchondral bone, and the surface reamer (chosen based on
previously measured offsets) is used to ream to the taper post (Fig. 8.8). The sizing trial that also matches the previously determined offsets is inserted to ensure the implant is flush with the adjacent articular surface (Fig. 8.9). If it is not congruent, an upsized reamer is used for additional reaming, and the matched sizing trial is used to confirm congruency. The final implant is appropriately positioned.
Focal Resurfacing of Humeral-head Defects
and impacted into place (Fig. 8.10). It should be confirmed again that
the component is congruent with the articular surface. The joint is
copiously irrigated, and the sutures are tied to complete the labral
repair. The capsule is closed in pants-over-vest fashion to reduce any
capsular redundancy (Fig. 8.11). The subscapularis is repaired, and
the wound is closed in layered fashion.

8.4 Technique: Humeral-head Allograft

As described [19], an extended deltopectoral approach is used
similar to the technique described in the previous section. After
adequate exposure of the Hill-Sachs lesion, a saw is used to cre-
ate a chevron-shaped defect that is smoothed with a rasp

Fig. 8.10. Final implant positioned
Fig. 8.11. Capsule is closed
(Fig. 8.12). Defect base, height, and length are measured. At this point, a fresh-frozen side- and size-matched humeral-head allograft is used. This typically needs to be requested from a reputable tissue bank. If a matched graft is not available, we use non-matched grafts or femoral heads. Using a matched humeral-head allograft, a chevron-shaped wedge of approximately 2–3 cm larger for each dimension is taken from approximately the same quadrant. This wedge is then placed in the defect and any excess is trimmed so that the graft is press-fit and congruent to the surrounding articular surface. It is provisionally secured in place with 2 or 3 0.045-in. Kirschner wires that are sequentially replaced by 3.5-mm fully threaded cortical screws (Fig. 8.13). The
screw heads are countersunk below the level of the articular surface (Fig. 8.14). The joint is copiously irrigated, and the wound is closed in a similar fashion as described above.

### 8.5 Postoperative Rehabilitation

The patient is placed in a sling immediately and pendulum exercises initiated on postoperative day 1. Assisted range of motion to work on forward elevation and external rotation, limited to 20°, is the focus of the initial 6 weeks of rehabilitation. Care is taken to avoid excessive passive external rotation to protect the capsular and subscapularis repair. Assisted internal rotation exercises can be started 2 weeks after surgery. At 6 weeks, patients work on terminal stretching and begin a strengthening program. This is under the guidance of a physical therapist under whose guidance the patient will progress as tolerated. Full range of motion and strength is typically achieved by 6 months.

### 8.6 Complications

Risk of nerve injury, cephalic-vein injury, and subscapularis rupture inherent risks to the deltopectoral approach exist. No complications have been noted by us after using the HemiCAP implant. Graft resorption, hardware complications, and development of early osteoarthritis has been reported following humeral-head allograft transplantation [19].

### 8.7 Clinical Results

Literature on the application of resurfacing arthroplasty for humeral-head defects in the face of shoulder instability is scant. This is largely due to the fact that there are no clear criteria for determining clinically significant humeral-head defects. Furthermore, most patients are young, and there is a natural reluctance to place any artificial implant in young patients. Two reports of three cases noted good early results in using the HemiCAP implant for this purpose [9, 20]. To date, we have performed approximately 20 HemiCAP implants, with no recurrent instability (unpublished data). This technique is a promising option for large humeral-head defects associated with shoulder instability, though long-term results remain to be determined.

### References

Focal Resurfacing of Humeral-head Defects