Partial resurfacing of the humeral head with the Hemicap implant has recently become available. Previously, the use of resurfacing in the glenohumeral joint has been used for the treatment of osteoarthritis, cuff tear arthropathy, rheumatoid arthritis, and avascular necrosis. The technique has provided significant pain relief as well as improved function in all pathologies in the available short to midterm follow-up studies. The advent of the Hemicap implant provides the treating physician with an option of a more limited resurfacing for focal defects, such as those occurring with avascular necrosis and Hill-Sachs and reverse Hill Sachs lesions from instability.

The use of resurfacing to treat damage of the articular surface of the humeral head has evolved since its introduction. Initial implants provided complete articular surface replacement as an alternative to a standard stemmed arthroplasty of the proximal humerus. More recent implant technology has provided the ability to selectively resurface the articular surface with the Hemicap prosthesis (Arthrosurface, Franklin, MA). With this selective resurfacing for isolated lesions, the treating physician leaves much of the native and undamaged cartilage intact. This is particularly useful for Hill-Sachs lesions, reverse Hill-Sachs lesions, and avascular necrosis. In addition, the implant can be used in conjunction with biological resurfacing of the glenoid in selected young patients with glenohumeral osteoarthritis. The advantages of resurfacing include preservation of the native bone stock, decreased risk of humeral fracture both intraoperatively and associated with postoperative trauma, maintenance of the native head shaft angle, and improved ease of revision if necessary. Currently, there are limited reports in the literature examining the outcomes associated using the modern resurfacing implants of the entire humeral articular surface. This is a review of the indications and outcomes currently reported in the literature for the use of selective and complete humeral resurfacing.

Development and Design

Humeral resurfacing was developed in the 1970s and original reports included a component designed for implantation in the hip. Over time and after multiple subsequent derivations, the prosthesis has evolved. Today, most commercially available prostheses are a centrally pegged, press-fit, bony ingrowth resurfacing with radii of curvature that try to match the anatomic variations present in the proximal humerus. The Hemicap (Arthrosurface) prosthesis is unique in its design. It is available in 4 diameters ranging from 25 to 40 mm. These implants have varying radii of curvature and are either symmetric or asymmetric in orthogonal planes. Fixation to the proximal humerus is obtained by a tapered-post cannulated screw, which, couples with the cobalt-chrome alloy articular surface via a Morse tapered peg. This design facilitates the implant’s use, either in a centrally placed region of the articular surface or in an eccentric region, such as the lesions seen with instability.

The normal anatomy of the proximal humerus has a large range of variation, with a retroversion between 0° and 55° and has a neck shaft angle between 120° and 135°. Maintaining native position of the articular surface has significant implications as variations in the position and thickness of the articular surface can markedly change the mechanics of the joint. This has been documented by Harryman, et al as well as Jobe and Iannotti. An understanding of this complex anatomy and soft-tissue interactions is what makes the use of a resurfacing implant attractive. Humeral neck osteotomies associated with a standard humeral implant use relies on the surgeon’s ability to recreate all of these parameters for balancing. The use of a stemless resurfacing of the humeral head allows the surgeon to use to intact humeral anatomy to guide...
the placement of the prosthesis. In a cadaveric study, Hammond et al.14 showed that resurfacing more closely restore the geometrical center of the humeral head in comparison with a stemmed implant.

In addition, if the proximal humerus has a significant metaphyseal or diaphyseal deformity, the use of a stemmed implant may be more difficult or impossible. This is especially true in the cases of healed malunions of the proximal humerus or an acquired or congenital dysplasia of the proximal humerus. Finally, in the presence of anterior instability, large Hill-Sachs lesions in the posterior humeral head may be present, or for posterior instability a reverse Hill-Sachs lesion may be present along the anterior aspect of the humeral head. The Hemicap prosthesis (Arthrosurface) is optimized in treating these situations by allowing resurfacing of the selected area. For instability, additional concomitant periglenoid procedures may be necessary to address the pathology adequately.

Indication and Outcomes of Surgery

Posttraumatic Arthritis and Osteoarthritis

The use of a resurfacing arthroplasty for degenerative joint disease is very attractive, especially in a younger patient because of the preserved bone stock in comparison with a standard shoulder arthroplasty. This procedure can be technically difficult if glenoid resurfacing is going to be attempted. Because the humeral head is not resected through an anatomic neck cut, visualization of the medial structures can be extremely challenging and at times impossible. In the past, some authors have attempted augmentations of the glenoid with an interposing soft-tissue graft with a variety of humeral implants, with mixed results.15-20 The use of a centered Hemicap (Arthrosurface) prosthesis in this situation has been reported, although reports on outcomes are limited with this prosthesis. However, the use of other resurfacing prostheses has been reported in the literature. Levy and Copeland2 published their results in 2001 reporting on their 14-year experience with their preferred resurfacing prosthesis. During this time, the prosthesis had undergone multiple modifications, and the report was solely on the results of the second of 3 designs. Their population included a heterogeneous group of 103 shoulders in 94 patients. The primary pathology present was osteoarthritis in 41. If exposure of the glenoid was not obtainable, the patient received a hemiarthroplasty only (35 shoulders). Of the patients with primary arthritis, 5 received hemiarthroplasties and 33 received a total shoulder replacement. Both groups saw significant improvements in range of motion and constant score. The outcomes for the patients receiving the total shoulder replacement were better than the hemiarthroplasty.

Avascular Necrosis

Avascular necrosis of the humeral head is similar to avascular necrosis of the femoral head. The disease starts with a focal area of the humeral head developing osteonecrosis, eventual subchondral fracture and collapse, and finally progressing to end-stage degeneration of the glenoid and humeral cartilage. In the early stages of the disease (Cruess stages I-III), the pathology can be adequately treated by addressing the defect on the humerus only. The Hemi-Cap (Arthrosurface) is ideal for this pathology. Preparation of the articular surface removes the sclerotic bone and placement of the cannulated screw effectively performs a core decompression of the metaphyseal region of the affected area.

Results have been published by Uribe and Botto-van Benden,21 who focused on the use of resurfacing in avascular necrosis of the humeral head. They reported result for 11 patients (12 shoulders) with a mean age of 56 years and a mean follow-up of 30 months. Significant improvement was reported in the patients’ functional outcome scores the mean range of motion had significant improvement over preoperative evaluation. Active forward elevation improved from 94 to 142°.

Instability

Bony defects associated with instability of the shoulder are common. These often are small and do not need any specific surgical intervention to correct the humeral defect. If the size of the lesion is significant and presents a risk for recurrence of the instability after a glenoid based procedure, options for the management of these defects include remplissage, allograft replacement of the defect, rotational osteotomy, and partial resurfacing. Reports of all of these techniques are limited in the literature; however,22–25 the use of a limited resurfacing of the defect using the hemi-Cap (Arthrosurface) provides many advantages. The prosthesis maintains the normal inclination and version of the proximal humerus as well as the balance of the soft tissues. It is generally recommended that if the defect involves more than...
40% of the humeral head that a standard stemmed hemiarthroplasty be placed. If the defect is appropriately sized for a hemiCap (Arthrosurface); however, most of the native cartilage of the humeral head is maintained. Figure 1 represents a large reverse Hill-Sachs lesion from a locked posterior dislocation in a 20-year-old male epileptic patient. Further imaging demonstrated the significant size of the lesion (Figs. 2 and 3). Attempts at closed reduction had failed. This patient was therefore, taken for an open reduction and had a selective resurfacing of the impacted area (Figs. 4 and 5).

Currently, there are limited studies available in the literature regarding the use of partial articular resurfacing for instability. Two case reports have been published with 3 reported cases.24,25 The follow-up for these patients has been 1-2 years, and their clinical outcomes have been good with no recurrent instability and good shoulder function with minimal reported pain. All 3 patients also underwent a simultaneous Latarjet coracoid transfer for the treatment of their instability.

**Discussion**

The Hemicap prosthesis (Arthrosurface) is a new and novel device in the armamentarium of the treating surgeon. It has provided a technique for the management of focal articular lesions of the humeral head. This is particularly applicable in the treatment of humeral head defects associated with instability, avascular necrosis and degenerative changes in the face of proximal humeral deformity.

The use of any resurfacing of the humeral articular surface provides the surgeon with the ability to maintain the ana-
tomic neck as well as the proximal humeral bone stock. Other advantages include optimization of the position of the humeral articular surface, decreased risk of intraoperative fracture, improved ease of revision if necessary and decreased risk of traumatic periprosthetic fracture with associated stress risers from an intramedullary stem. The maintenance of the proximal humeral bone stock can increase the difficulty of exposure of the glenoid.

References