Nonstandard glenoid components for bone deficiencies in shoulder arthroplasty

Akin Cil, MDa, John W. Sperling, MD, MBAb, Robert H. Cofield, MDb, *

aDepartment of Orthopaedics, University of Missouri, Kansas City, MO, USA
bDepartment of Orthopedic Surgery, Mayo Clinic and Mayo Foundation, Rochester, MN, USA

Background: Glenoid bone deficiencies may be addressed by specialized components. The purpose of this study is to evaluate the clinical and radiographic outcomes of 3 different types of nonstandard glenoid components.

Materials and methods: Thirty-eight patients with a mean age of 65 years (range, 34-84 years) underwent a primary or revision anatomic shoulder arthroplasty with one of 3 nonstandard glenoid components: a polyethylene component with an angled keel for posterior glenoid wear without posterior subluxation; a polyethylene component with 2 mm of extra thickness for central glenoid erosion; or a posteriorly augmented metal-backed glenoid component for posterior glenoid wear and posterior subluxation. Average clinical follow-up was 7.3 years (range, 2-19 years) or until revision surgery.

Results: At the most recent follow-up, 24 patients had no, mild, or occasionally moderate pain. Mean elevation improved from 91° to 126°, and mean external rotation improved from 24° to 53°. Thirteen patients had moderate or severe subluxation preoperatively, and 11 had subluxation at follow-up. On radiographic evaluation, 3 glenoid components had loosened and 3 were at risk for loosening at an average 5.5 years of follow-up. Seven patients had revision surgery: 4 for instability, 1 for osteolysis, 1 for component loosening with osteolysis, and 1 for a periprosthetic fracture. Three additional patients had removal of glenoid components, 2 for infection and 1 for loosening. Ten-year survival rate free of revision or removal of the angled keel component was 73% (95% CI: 75.3-70.7); of the extra thick (+2 mm) component, 69% (95% CI: 65-73); and of the posteriorly augmented metal-backed glenoid component, 31% (95% CI: 35.6-26.4).

Conclusions: The effectiveness of nonstandard glenoid components in addressing glenoid bone deficiencies is compromised by an increased rate of component loosening and by only partial success in eliminating subluxation.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Glenoid components; shoulder replacement; bone deficiency

Glenoid wear is a challenging problem for primary and revision anatomic shoulder replacement. For a successful outcome, not only the cartilage and bone deficiencies should be corrected but also soft tissue laxity or contractures should be addressed.18 Bone deficiency has been traditionally corrected by asymmetric reaming of the glenoid to create neutral version1,4,6,8 or bone grafting of the deficient area.1,9,12,21,24 Asymmetric reaming shortens the length of the glenoid vault, narrows the glenoid fossa, and moves the joint line medially, which not only can compromise fixation of the glenoid component but also can

IRB, Mayo Foundation (IRB Modification #Mod10-003944-01).
*Reprint requests: Robert H. Cofield, MD, Mayo Clinic, 200 First St SW, Rochester, MN 55905, USA.
E-mail address: cofield.robert@mayo.edu (R.H. Cofield).

1058-2746/$ - see front matter © 2014 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2013.09.023
cause coracoid or acromion impingement leading to decreased arm elevation. The bone grafting has inconsistent results, such as graft incorporation problems, ongoing instability, and increased rate of glenoid component loosening.

The other option for addressing the glenoid wear may be nonstandard glenoid components. However, there is a dearth of literature on nonstandard glenoid components to guide clinical practice. There is also an ongoing interest from implant manufacturers to address this critical problem. However, clinical and radiographic performance of these components has seldom been assessed. Therefore, we have compiled our experience of use of nonstandard glenoid components to address glenoid wear. This study evaluates the outcome of 3 different types of glenoid components to determine the clinical and radiographic outcomes, including complications and the need for revision surgeries in primary or revision arthroplasty with glenoid bone loss with or without instability.

Materials and methods

We have retrospectively reviewed a total of 38 consecutive patients who had primary (25) or revision (13) shoulder replacement with 3 types of nonstandard glenoid components between January 1989 and December 2007. The 3 different glenoid component designs were used on the basis of the location of the glenoid wear and presence or absence of posterior subluxation. An angled keel glenoid component was used to accept the posterior glenoid wear as-is when there was no or mild joint subluxation intraoperatively (18 shoulders). A standard glenoid component was not used in this situation as the keel of a standard component might have caused anterior glenoid wall perforation and suboptimal fixation. An extra-thick (2 mm, total thickness 6 mm) glenoid component was used to reposition the joint line to normal to optimize shoulder biomechanics when there was predominantly central glenoid erosion (12 shoulders). A posteriorly augmented metal-backed glenoid component was used in 8 shoulders with posterior wear and posterior subluxation to correct the posterior wear and to decrease subluxation (Figs. 1 and 2). A standard glenoid component was not used in this situation as it would not have addressed the posterior capsule laxity and instability, and eccentric reaming would have removed the dense subchondral bone and shortened the glenoid vault, resulting in suboptimal fixation. To be included in this study, patients had preoperative evaluation, operative reports, a minimum of 2 years of clinical follow-up, and a minimum of 1 year of radiographic follow-up. Also, 4 patients who had less than 2 years of follow-up are included in the analysis. Two of them had early postoperative infection, and the components had to be removed to control infection. The other 2 had early posterior dislocations after surgery and required humeral head revisions with soft tissue repairs. In 3 cases, preoperative anteroposterior or axillary views could not be found, and they were not analyzed radiographically. The mean follow-up of 38 patients who had primary or revision shoulder replacement with these types of nonstandard glenoid components was 7.3 years (0.1-19 years) (Table 1).

Twelve of the procedures were performed on women and 26 were performed on men. The mean age at the time of surgery was 65 years (range, 34-84 years). Twenty-four of the procedures involved the right and 14 involved the left upper extremity. The primary diagnoses for the 25 primary shoulder arthroplasties were osteoarthritis in 22 patients, post-traumatic arthritis in 2 patients, and rheumatoid arthritis in 1 patient. The cause of revision in the remaining 13 patients was failed hemiarthroplasty in 5 and aseptic loosening or instability of a total shoulder replacement in 8 of the patients.

Operative techniques

A deltopectoral approach was used in 30 cases, and an anteromedial exposure with the deltoid being incised from the clavicle and anterior aspect of the acromion was used in 8 of the shoulders. There was no deltoid healing problem in these cases. The subscapularis was tenotomized 1 cm proximal to its insertion on the lesser tuberosity in 14 patients; it was elevated and reattached with sutures through the lesser tuberosity in 23 patients; and Z-plasty was performed to lengthen the subscapularis tendon in 1 patient.

During surgery, 26 rotator cuffs were intact; 6 rotator cuffs were attenuated (thinner than normal). Six shoulders had full-thickness tears; 2 had an isolated subscapularis tear, 2 had an isolated supraspinatus tear, and 2 had supraspinatus and infraspinatus tears. All of the full-thickness tears were completely repaired. The lesser or greater tuberosities had a nonunion in 1 and a malunion in 1. The results of infection blood work including erythrocyte sedimentation rate, white blood cell count, and C-reactive protein were normal in the revision cases. Intraoperative cultures were also negative in these cases.

When an all-polyethylene angled keel component was used, the glenoid surface was prepared with approximately 5° of posterior version; the keel slot was prepared orthogonal to the body of the scapula. To prepare the bone of the glenoid for the extra-thick (+2 mm) component, a small central pilot hole was drilled to the far cortex to assess the depth of the glenoid vault. In all cases, the vault was deep enough to permit standard glenoid preparation with a surface reamer, guide-directed central, superior, and inferior drill holes, and then connection of the drill holes with a bur to form the slot for the keel of the component. When the augmented, metal-backed glenoid component was used, the glenoid was prepared to a slight concavity with a bur, accepting the 5 to 10 mm of posterior glenoid wear. A guide was then placed on the glenoid surface, and added contouring was performed to create an exact fit of the guide to the bone. By use of holes in the guide, 3 drill holes were placed orthogonal to the body of the scapula to fit the 3 columns and 2 screws of the glenoid component.

The nonstandard glenoid components implanted at the time of surgery were all Cofield glenoid components (Smith & Nephew, Memphis, TN, USA). The humeral components implanted at surgery were Cofield humeral components (Smith & Nephew) in 33 shoulders, Biomet humeral components (Biomet, Warsaw, IN, USA) in 4 shoulders, and Neer humeral components (3M Company, St. Paul, MN, USA) in 1 shoulder. During glenoid component implantation, limited cancellous grafting was done in 5 shoulders, and a small structural glenoid graft was placed in 1 shoulder. All-polyethylene components (30 shoulders) were cemented, and metal-backed components (8 shoulders) were noncemented. During humeral component insertion, cancellous bone grafting was done in 4 shoulders, and of the 38 humeral components, 25 were noncemented and 13 were cemented.
Clinical analysis

Patients who have an arthroplasty performed at our institution are prospectively observed in our department’s joint registry. Clinical data are recorded on shoulder analysis forms preoperatively and at each follow-up visit. Patients who are unable to return for follow-up visit are contacted by our registry personnel and answer a validated shoulder questionnaire, which records pain, motion, satisfaction, and American Shoulder and Elbow Surgeons (ASES) functional questions. Pain is reported on a scale of 1 (no pain) to 5 (severe pain), with active motion in the seated position measured for elevation, external rotation, and internal rotation (the ability of the thumb to reach posterior vertebral segments). Overall results were classified by a modified Neer rating system as excellent, satisfactory, or unsatisfactory (including those with a reoperation). Also, the ASES shoulder scoring system was used to grade the results of surgery.

Figure 1  The three darker shaded areas on the left side of the illustration outline glenoid bone deficiencies. Illustrated on the right are the extra-thick glenoid component (A), the angled keel component (B), and the posteriorly augmented metal-backed glenoid component (C).
Radiographic analysis

Three projections were used for radiographic analysis: true anteroposterior views with external rotation and internal rotation of the humerus plus an axillary view. Preoperative radiographs and operative assessment were analyzed to classify glenoid morphology according to the Walch classification.23 Ten glenoids were classified as A1, 2 glenoids as A2, 9 glenoids as B1, and 14 glenoids as B2. Two observers determined the presence of glenohumeral subluxation, periprosthetic lucency, and shift in component position and reached a consensus.16,17,20 Glenohumeral subluxation was evaluated with regard to direction and the amount of translation of the center of the humeral head or prosthetic head relative to the center of the glenoid or glenoid component. It was graded as none, mild (translated <25%), moderate (translated 25%-50%), or severe (translated >50%). Periprosthetic lucency was graded as none, 1 mm or less incomplete, 1 mm complete, 1.5 mm incomplete, 1.5 mm complete, or 2 mm or more complete for both humeral and glenoid components. In addition, the 2 observers compared the early postoperative and final follow-up radiographs to judge whether the glenoid or humeral components had shifted or changed in position.

To integrate radiolucent lines and change in component position, the width of lucent lines, whether the lines were complete or incomplete, and the shift in component position were collated. A glenoid component was radiographically at risk for clinical loosening if both of the observers identified medial migration or tilt of the component or if a complete radiolucent line was present, 1.5 mm or greater in width. A humeral component was radiographically at risk for clinical loosening if both observers identified tilt or subsidence of the component or if a radiolucent line 2 mm or greater in width was present in 3 or more zones.16,17,20

Figure 2  Anteroposterior (A) and axillary (B) views of a 60-year-old man with posterior glenoid wear and subluxation. Immediate postoperative radiographs (C, D) show that the posterior bone deficiency and posterior subluxation are corrected. However, at 8.5 years of follow-up, there is posterosuperior subluxation and glenoid loosening with polyethylene wear, requiring reoperation (E, F).
Nonstandard glenoid components for bone deficiencies

d153

Statistical analysis

Results are reported for the last follow-up visit or the visit before reoperation. Because of the large number of reoperations, the results are also reported for those not undergoing further surgery.

Descriptive statistics were reported as number (percentage) and mean (range) as appropriate. The association between discrete risk factors, such as gender and presence of a rotator cuff tear, with outcomes, such as humeral or glenoid lucency, glenoid morphology, and subluxation, was assessed with the Fisher exact test (discrete) or Wilcoxon rank sum test (continuous) as appropriate. The associations of the clinical and functional outcomes with gender, rotator cuff status, rotator cuff repair, primary versus revision shoulder arthroplasty, and subluxation grade were assessed with 2-sample \( t \)-tests. Comparisons of preoperative with postoperative outcome for pain, active forward elevation, and external and internal rotation were made with a paired \( t \)-test. An analysis of variance was used to test for differences in pain, active abduction, and external and internal rotation among the patients with 3 different Neer grades. Survival free of any revision or reoperation was estimated by the Kaplan-Meier survival method, reoperation estimated as a function of time since surgery. Estimates were reported along with 95% confidence intervals. The \( \alpha \) level was set at .05 for statistical significance. Statistical analyses were conducted with SPSS (Windows version 18; SPSS Inc, Chicago, IL, USA).

Complications and reoperations

At the time of surgery, 1 patient had a proximal humerus fracture during extraction of the humeral component and had a transient postoperative brachial plexus palsy. During the early follow-up period, 3 patients had removal of components. Two of these reoperations were due to deep infection in primary arthroplasties with component removals at 1.6 and 4.6 months from their surgery. One patient who had supraspinatus and infraspinatus tendon repairs at the time of surgery developed superior subluxation and glenoid component loosening and had arthroscopic removal of the glenoid component at 1.5 years (Table II).

During the follow-up interval, 7 additional patients had revision of humeral or glenoid components. Two of the revisions happened in the early postoperative period (2.7 and 3.3 months from implantation) because of persistent posterior dislocation (Walch type B2 glenoids). Two other patients (Walch type A1 glenoids) had revision surgery secondary to anterior instability at 2.2 years and 6.7 years, requiring humeral head exchanges with anterior soft tissue repairs. One patient with a loose humeral component had a radiographic subluxation.
periprosthetic humerus fracture 5.5 years after the surgery, requiring revision. One patient with glenoid loosening and humeral osteolysis had a humeral component fracture and required revision at 8.1 years from the index surgery. One patient with a metal-backed glenoid component had polyethylene wear with metallic synovitis and severe glenoid osteolysis, requiring revision at 8.0 years. When these 10 cases that were reoperated on were examined in detail, Walch glenoid type ($P = .361$), primary versus revision replacement ($P = .532$), glenoid component design used ($P = .218$), rotator cuff repair at the time of surgery ($P = .508$), and presence of either preoperative ($P = .443$) or final follow-up ($P = .440$) subluxation were not found to be playing a significant role on these failures, probably because of the small number of patients undergoing reoperations (Table III).

### Survival analysis

The overall estimated survival rate for nonstandard glenoid components for bone deficiency in shoulder replacement surgery free of revision or removal was 90% (95% CI: 80%-100%) at 1 year, 86% (95% CI: 75%-97%) at 5 years, and 64% (95% CI: 45%-83%) at 10 years. Ten-year survival rate free of revision or removal of the angled keel glenoid component was 73% (95% CI: 75.3-70.7); of the extra-thick (+2 mm) glenoid component, 69% (95% CI: 65-73); and of the posteriorly augmented metal-backed glenoid component, 31% (95% CI: 35.6-26.4) (Fig. 3).

### Radiographs

At an average radiographic follow-up of 5.5 years (0.1 to 18 years, including those having reoperations), 2 humeral components and 6 glenoid components were identified to be at risk for loosening radiographically (Table IV). Both of the at-risk humeral components underwent revisions. Three of the glenoid components had also undergone revision or removal. The remaining 3 glenoid components at risk had shifted in position during the follow-up interval (Table III). The estimated survival rate for radiographic glenoid loosening at final follow-up was 97% (95% CI: 90.4%-100%) at 2 years, 93% (95% CI: 84%-100%) at 5 years, and 79% (95% CI: 58.4%-99.6%) at 10 years. There was no significant association between the glenoid component and humeral component loosening at the most recent follow-up ($P = .345$).

Preoperatively, 3 shoulders had no or mild radiographic subluxation, and 13 shoulders had moderate to severe subluxation with anterior subluxation in 1, superior subluxation in 4, and posterior subluxation in 8 shoulders. At the time of most recent follow-up, 8 shoulders had no or mild subluxation; 11 had moderate to severe subluxation, with 3 of them in the anterior direction, 3 in the superior direction, and 5 in the posterior direction. Six of these patients were subluxating preoperatively; however, 5 patients newly developed these subluxations during the follow-up period. There was no significant association between subluxation at the most recent follow-up and type of glenoid component used ($P = .289$), Walch glenoid type ($P = .646$), rotator cuff tearing ($P = .075$), preoperative subluxation ($p = .197$), radiographic glenoid ($p = .479$) or humeral ($P = .7$) loosening, or patients having a reoperation ($P = .32$) (Table III).

<table>
<thead>
<tr>
<th>Table II</th>
<th>Reoperations and glenoid component type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary cause of reoperation</td>
<td>Angled keel (n = 18)</td>
</tr>
<tr>
<td>Infection</td>
<td></td>
</tr>
<tr>
<td>Superior instability + glenoid loosening</td>
<td>1 patient</td>
</tr>
<tr>
<td>Posterior instability</td>
<td>1 patient</td>
</tr>
<tr>
<td>Anterior instability</td>
<td>1 patient</td>
</tr>
<tr>
<td>Late periprosthetic humeral fracture + humeral loosening</td>
<td>1 patient</td>
</tr>
<tr>
<td>Humeral component fracture + glenoid loosening</td>
<td>1 patient</td>
</tr>
<tr>
<td>Polyethylene wear and metallic synovitis</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table III</th>
<th>Failure analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical failure (n = 10)</td>
<td>Clinical or radiographic failure (n = 13)</td>
</tr>
<tr>
<td>Walch glenoid type</td>
<td></td>
</tr>
<tr>
<td>A1 (n = 10)</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>A2 (n = 2)</td>
<td>0</td>
</tr>
<tr>
<td>B1 (n = 9)</td>
<td>2 (22%)</td>
</tr>
<tr>
<td>B2 (n = 14)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td>Preoperative subluxation</td>
<td></td>
</tr>
<tr>
<td>No/mild (n = 22)</td>
<td>5 (23%)</td>
</tr>
<tr>
<td>Moderate/severe (n = 13)</td>
<td>4 (31%)</td>
</tr>
<tr>
<td>Glenoid component design</td>
<td></td>
</tr>
<tr>
<td>Angled keel (n = 18)</td>
<td>4 (22%)</td>
</tr>
<tr>
<td>Extra thick (n = 12)</td>
<td>2 (17%)</td>
</tr>
<tr>
<td>Augmented metal backed (n = 8)</td>
<td>4 (50%)</td>
</tr>
</tbody>
</table>

In 3 cases, preoperative anteroposterior or axillary views were not locatable, and they were not analyzed radiographically.
Result rating (Table I)

Evaluation according to the modified Neer rating system revealed that 11 shoulders had excellent, 11 shoulders had satisfactory, and 16 shoulders (10 of which were reoperated on) had unsatisfactory results. At the time of final follow-up, the mean ASES shoulder score for all shoulders was 55 points (8-100). For the 28 shoulders not undergoing reoperation, the mean ASES score was 61 (8-100).

Discussion

Our thinking that special glenoid component configurations to address peripheral or central bone deficiencies would be a substantial step in improving surgical outcomes has not proved to be true. The experience with use of these nonstandard glenoid components in primary or revision shoulder arthroplasty during an intermediate follow-up period averaging 7.3 years revealed mediocre clinical and radiographic results for this difficult problem. Compared with above 90% 10-year survival rate free of revision or removal of the different all-polyethylene glenoid components,³ the survival rates of the angled keel glenoid component (73%) and extra-thick (+2 mm) glenoid component (69%) were found to be suboptimal. Among all 3 components, the posteriorly augmented metal-backed glenoid component 10-year survival rate fared the worst (31%). The evaluations with Neer rating revealing 42% unsatisfactory results and the mean ASES score of 55 at the time of final follow-up emphasize the mediocre outcome. However, those not requiring further surgery generally were doing well clinically; and of those requiring future surgery, only 3 reoperations were due to glenoid-focused.

![Figure 3](image)

**Figure 3** Survival analysis. (A) The survival rate free of component removal or revision for all 3 types of components. (B) The survival rate free of component revision or removal for each of the 3 types of components.
issues, with the others due to infection in 2, instability related to capsule and rotator cuff laxity in 4, and a peri-prosthetic fracture in 1. This emphasizes that glenohumeral arthritis or failed total shoulder arthroplasty with severe glenoid deficiency will likely be difficult surgery that is more prone to not only the general arthroplasty-associated complications but also capsule and rotator cuff incompetence that may seem to be addressed at the time of surgery but proves not to be a durable correction.

Thus, glenoid wear remains a challenging problem. Asymmetrical reaming of the glenoid without a special glenoid component to create neutral version has been used in several clinical studies, and successful recentering of the humeral head in the transverse plane was achieved in 86% to 91% of the reported cases. With average follow-up ranging from 2 to 3.5 years, they report 90% to 95% age-adjusted Constant scores, although the patients with significant posterior wear did have lower Constant scores. Revision rates with use of standard glenoid components with or without bone grafts to augment glenoid defects range between 0% and 16.3%. However, there is a limit to correction of retroversion; cadaveric studies have revealed that as the retroversion to be corrected increases, the glenoid width is decreased to the point at which even the smallest glenoid component cannot be placed without overhanging the bone, and medializing the glenohumeral joint line can lead to peg penetration through the scapular neck. As a result, a smaller glenoid component and insufficient correction of retroversion can lead to continued instability in these cases. There are 2 studies currently published addressing glenoid wear with nonstandard glenoid components. Earlier, our group described 13 patients (14 shoulders) with a posteriorly augmented all-polyethylene keeled glenoid component for treatment of posterior glenoid bone deficiency as we thought this might be the most useful design of glenoid augmentation. After an average follow-up of 5 years, 14% had unsatisfactory results by the Neer rating and only 1 glenoid component was radiographically loose. However, not unlike patients in the current study, 3 patients continued to have posterior subluxation and 2 patients developed anterior subluxation. As a result of the continued subluxation, the use of the component to address posterior glenoid bone wear was discontinued. Gunther and Lynch described 7 patients with severe glenoid wear addressed with custom-made, patient-specific inset glenoid components. After an average 4.3 years of follow-up, the ASES score was 94 points. On radiographic examination, none of the glenoids were loose and none of the patients had postoperative subluxation. The inset technique seemed to be a good short-term solution in their hands.

Our experience presented in this manuscript is both clinically and radiographically worse than reports in the literature. A major problem is the ongoing instability. Of 38 shoulders, 11 still had moderate to severe instability despite our efforts to correct the glenoid bone wear with nonstandard glenoid components and to adjust tension in the shoulder capsule and rotator cuff. Five of 10 reoperations in our series stemmed from ongoing instability (1 superior, 2 posterior, and 2 anterior) that could not be controlled. Because of the limited number of patients in each group, we did not have enough power to detect significant differences in clinical or radiographic outcomes among Walch glenoid types. However, in assessing patients who were reoperated on, of 14 Walch B2 glenoids, 3 (21%) underwent reoperation. One was due to infection, but 2 were due to early postoperative instability with persistent posterior dislocation that we were not able to correct with nonstandard glenoid components. Walch et al recently reported on their experience with biconcave glenoids; 5.4% of their cases had a revision due to postoperative posterior dislocation, and their overall rate of revision surgery was 16.3% of biconcave glenoid patients, similar to our experience. The 2 other cases that required a reoperation due to anterior instability during our follow-up were graded as Walch type A glenoids at the time of index surgery, in which hemiarthroplasties were converted to total shoulder replacements. Both of these patients had anterior subluxation in the preoperative period. Bonnevialle et al also reported this type of problem in their series of revision shoulder replacements addressed with reimplantation of glenoid components and concluded that soft tissue insufficiency of the anterior shoulder capsule and subscapularis tendons is underestimated, and this may explain the failure of our 2 nonstandard glenoid components.

The main limitation of this study is the small number of patients in each group of implants used. Also, we can provide only midterm outcome at this stage. Subluxation evaluation with radiographs and assessment at surgery rather than with computed tomography scans is a potential weakness of this study. The main strength of the study is reporting the creative development of special glenoid components to address clinically identifiable bone deficiencies (Fig. 1) and to prospectively observe a consecutive series of patients for whom surgery is based on bone loss and instability criteria.

There is still controversy about how to manage glenoid bone loss. In this study, we have attempted to address glenoid bone wear with a combination of nonstandard components and adjustment of soft tissue tension by altering humeral head size. However, some cases of glenoid loosening do occur, and associated soft tissue issues seem to be the major problems leading to reoperations. Although these special glenoid components may facilitate addressing bone loss at surgery, their frequency of use will be low and their effectiveness is marginal—at best. Therefore, use of all 3 components has been discontinued in our practice. We now rely on altered reaming, bone grafting, or use of reverse shoulder arthroplasty glenoid component to address the bone loss issue, favoring reverse arthroplasty when soft tissues are affected to the extent that anatomic arthroplasty will not be likely to control the instability.
Conclusions

The role of 3 types of nonstandard glenoid components in anatomic shoulder arthroplasty to correct peripheral or central bone deficiency is uncertain as outcomes were compromised by both component issues and instability. As a result, the use of these 3 types of special components has been discontinued. Recent literature on B2 glenoids treated with reverse shoulder replacement seems to be promising and manages the postoperative instability in patients older than 65 years. Pursuit of innovative glenoid component designs in anatomic arthroplasty is necessary for younger patients as reverse arthroplasty may not be appropriate and hemiarthroplasty results in unsatisfactory outcomes in many patients with eccentric posterior glenoid wear.

Disclaimer

John W. Sperling receives royalties from Biomet.
Robert H. Cofield receives royalties from Smith & Nephew for glenoid component design and royalties from DJO.
Akin Cil, his immediate family, and any research foundations with which he is affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

References