J Shoulder Elbow Surg (2014) 23, e149-e157

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Nonstandard glenoid components for bone deficiencies in shoulder arthroplasty

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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 version[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).

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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.[6,18] The bone grafting has inconsistent results, such as graft incorporation problems,[9,21,24] ongoing instability,[1,9,24] and increased rate of glenoid component loosening.[9,21,24]

The other option for addressing the glenoid wear may be nonstandard glenoid components.[7,14] 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 radiologic 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 I).

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.[5] 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.