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Outcomes of anatomic shoulder arthroplasty in primary osteoarthritis in type B glenoids

Paul C. Chin, MD, PhD[a], Michael E. Hachadorian, BS[b], Pamela A. Pulido, BSN[b], Michelle L. Munro, BS[b], Gokhan Meric, MD[b,c], Heinz R. Hoenecke Jr, MD[b,d,*]

[a]*Sterling Ridge Orthopaedics and Sports Medicine, The Woodlands, TX, USA*
[b]*Shiley Center for Orthopaedic Research and Education at Scripps Clinic, La Jolla, CA, USA*
[c]*Department of Orthopaedic Surgery, Balikesir University, Balikesir, Turkey*
[d]*Division of Orthopaedics, Scripps Clinic, La Jolla, CA, USA*

Background: Primary glenohumeral osteoarthritis with posterior wear of the glenoid and posterior subluxation of the humerus (Walch type B) presents a challenge to the treating surgeon. Our hypothesis was that glenoids with biconcavity (B2) would be associated with worse outcomes (functional scores and complications) than B1 glenoids.

Materials and methods: We retrospectively analyzed prospectively collected data on 112 anatomic total shoulder arthroplasties (104 patients) with B glenoids. Preoperative computed tomography identified 64 B1 glenoids and 48 B2 glenoids (50 and 37 available for follow-up).

Results: A significant difference between B1 and B2 glenoids was noted in average retroversion (11° vs. 16°; $P < .001$) and average posterior humeral subluxation (65% vs. 75%; $P < .001$). No significant difference was seen in mean age (69.5 vs. 69.2 years) or body mass index (28.5 vs. 27.4) at time of surgery. At average follow-up of 60 months (range, 23-120 months), glenoid component radiolucencies (51.6%, B1; 47.9%, B2), range of motion, preoperative and postoperative scores of the shortened Disabilities of the Arm, Shoulder, and Hand questionnaire, and patient satisfaction were not significantly different between the 2 groups. Four revisions (4.6%) were documented for acute postoperative infection (2.3%), subscapularis failure (1.1%), and glenoid loosening (1.1%).

Conclusions: Although biconcave glenoids commonly have more severe retroversion and posterior subluxation of the humerus, we were unable to find a clinical or radiographic difference in outcome of patients with B1 or B2 glenoids treated with anatomic total shoulder arthroplasty at intermediate-term follow-up. Continued clinical and radiographic follow-up of these cohorts will be necessary to assess any future divergence in outcome.

Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

Keywords: Anatomic total shoulder arthroplasty; primary osteoarthritis; biconcave glenoid; type B glenoid

Primary shoulder osteoarthritis is a debilitating condition characterized by progressive loss of shoulder function and pain. Roughly 20,000 to 25,000 total shoulder arthroplasties (TSAs) were performed in the United States

This study received approval from the Scripps Institutional Review Board: No. IRB-13-6297. All patients consented to participate.

*Reprint requests: Heinz R. Hoenecke Jr, MD, 10666 N Torrey Pines Rd, MS 116, La Jolla, CA 92037, USA.

E-mail address: hhoenecke@gmail.com (H.R. Hoenecke Jr.).

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in 2007, with the potential to reach >40,000 procedures by 2015.[2] Initial descriptions recognized that glenohumeral arthritis often involved posterior erosion of the glenoid and posterior subluxation of the humeral head, which led to a classification of type B glenoids.[16,17,21] Although modifications have been made to prosthesis design leading to a history of good to excellent clinical outcomes in the majority of cases, a subset of patients remain who have poor outcomes leading to revision surgery.[11,12,22] As of 2004, the revision burden in the United States was roughly 7%, but it will continue to increase as the rate of primary arthroplasties increases.[2] Revision surgeries are necessary for a variety of factors including stiffness, polyethylene wear, periprosthetic fracture, infection, instability, rotator cuff tears, and component loosening.[12,20]

Prior work has documented the various morphologies of arthritic glenoids before surgical replacement and has recognized that roughly 32% of patients have a type B glenoid shape characterized by posterior subluxation of the humeral head and posterior wear of the glenoid.[21] Type B glenoids are composed of groups, B1 and B2. Biconcave glenoids (type B2) generally have more severe retroversion and posterior subluxation of the humerus. Attempts to correct the abnormal wear during implantation of the total shoulder prosthesis may lead to abnormal mechanics and joint reaction forces that may predispose the glenoid component to loosen and subsequently to fail.[7,8,11,12] Recently, Walch noted a 16% rate of revision surgery at an average follow-up of 77 months in patients treated with TSA for arthritis with biconcave glenoids. In that report, B2 glenoids with a neoglenoid retroversion of >27° carried a 44% risk of complication.[22]

Thus, elucidating a preoperative clinical or radiographic measure to predict the likelihood of failure would add tremendous benefit to treating patients with shoulder osteoarthritis.[9,10,13]

The purpose of this study was to assess the radiographic characteristics and clinical outcomes of anatomic TSA in patients with primary osteoarthritis with type B glenoids. Our hypothesis was that glenoids with biconcavity (B2) would be associated with worse outcomes, including decreased functional scores and higher rates of component loosening, complications, and revisions.

Methods

A retrospective analysis of prospectively collected data was used to identify 2 patient cohorts with type B glenoids (B1 and B2) who underwent anatomic TSA with a minimum follow-up of 24 months or until time of revision. Exclusion criteria included patients with type A and type C glenoid morphologies; patients with secondary causes of arthritis, including inflammatory disease, osteonecrosis, cuff tear arthropathy, and fracture; and shoulders without a preoperative computed tomography (CT) scan. Between 2004 and 2011, the senior author (H.R.H.) performed TSA for primary glenohumeral osteoarthritis on 170 shoulders (146 patients). This included 53 shoulders with type A glenoids (36, A1; 17, A2), 112 shoulders (104 patients) with type B glenoids, and 5 shoulders with type C glenoids. We identified 64 B1 glenoids and 48 B2 glenoids. Of these, 87 shoulders (81 patients) had at least 2 years of follow-up with complete records and were included for analysis (50 B1 glenoids and 37 B2 glenoids). Eighteen shoulders (18 patients) were lost to follow-up, and 7 shoulders (6 patients) were deceased with unknown revision status at 2 years postoperatively. The mean clinical follow-up was 60 months (range, 23-120 months). Our series included 37 women (45.7%) and 44 men (54.3%) with an average age at surgery of 69 years (range, 48-85 years). Preoperative clinical data collection included the shortened Disabilities of the Arm, Shoulder, and Hand questionnaire (QuickDASH) and range of motion testing. According to standard preoperative protocols, all patients had preoperative radiographic images including anteroposterior, Grashey, axillary, and scapular Y views as well as a CT scan of the affected extremity.

Measurements of version and subluxation were determined from the CT scan axial plane image corresponding to the center of glenoid on the sagittal and coronal plane images. Humeral head subluxation was determined relative to the scapular axis as described by Walch and colleagues.[12] Subluxation ratios between 0.45 and 0.55 are considered normal (centered), whereas shoulders with subluxation ratios >0.55 are considered to be posteriorly subluxated. Shoulders with posterior subluxation ratios >0.55 were classified as B1 glenoids, and shoulders with posterior subluxation ratios >0.55 and with a posterior cupula or biconcavity were considered B2 glenoids.[21] For B2 glenoids, the intermediate glenoid and the neoglenoid version angles were measured according to previous published reports[4,12,19]; however, the intermediate glenoid represents the most reliable and clinically useful angle.[19]

All patients underwent anatomic TSA by a deltopectoral approach. Three implant systems were used during the study period: the PROMOS shoulder system (Smith & Nephew, Cordova, TN, USA) with either a cemented all-polyethylene pegged or keeled glenoid component; the Aequalis shoulder system (Tornier Inc., Edina, MN, USA) with either a cemented all-polyethylene pegged or keeled glenoid component; and the Aequalis Ascend shoulder system (Tornier) with a cemented all-polyethylene anchor pegged glenoid component. The PROMOS and Aequalis systems have standard humeral and glenoid components; the Aequalis Ascend system has a short humeral stem design and anchor pegged glenoid. We looked at the difference in results between the 3 implants.

To address either severe retroversion or a biconcave glenoid, the anterior glenoid was asymmetrically reamed to try and achieve retroversion between 0° and 10° with the limitation of removing less than 5 mm of bone. No glenoids in this cohort required structural posterior bone grafting procedures or an augmented glenoid component. Patients were routinely given a postoperative sling with an abduction pillow to wear for 4 weeks and participated in postoperative rehabilitation.

Postoperative evaluations included clinical and telephone follow-up. For clinical follow-up, range of motion testing, QuickDASH score, and a subjective satisfaction question were obtained. A telephone interview of all available patients included QuickDASH score, a question about any reoperations, and a subjective satisfaction question. No data on range of motion were obtained in the telephone interview. In addition, routine