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ORIGINAL ARTICLE

Total shoulder arthroplasty in patients with a B2 glenoid addressed with corrective reaming

Nathan D. Orvets, MD[a], Aaron M. Chamberlain, MD, MS[a], Brendan M. Patterson, MD[a], Peter N. Chalmers, MD[b], Michelle Gosselin, MD[a], Dane Salazar, MD[c], Alexander W. Aleem, MD[a], Jay D. Keener, MD[a,*]

[a]*Department of Orthopaedic Surgery, Washington University in St. Louis Medical Center, St. Louis, MO, USA*
[b]*Department of Orthopaedic Surgery, University of Utah, Salt Lake City, UT, USA*
[c]*Department of Orthopaedic Surgery, Loyola University, Chicago, IL, USA*

Background: This study describes the short-term functional and radiographic outcomes after total shoulder arthroplasty (TSA) in shoulders with a B2 glenoid deformity addressed with corrective reaming.
Methods: We conducted a retrospective series of consecutive patients who underwent TSA with a Walch B2 glenoid quantified by computed tomography scan. All glenoid deformities were addressed using partially corrective glenoid reaming. Radiographic and functional outcome measures, including scores on the visual analog scale for pain, American Shoulder and Elbow Standardized Shoulder Assessment, and Simple Shoulder Test were collected.
Results: Functional outcome scores were available for 59 of 92 eligible subjects (64%) at a mean of 50 months. The mean preoperative retroversion measured 18° (range, –1° to 36°), superior inclination was 8° (range, –11° to 27°), and posterior subluxation was 67% (range, 39%-91%). Mean visual analog scale improved from 7.4 to 1.4, the American Shoulder and Elbow Shoulder Standardized Assessment improved from 35.4 to 84.3, and the SST improved from 4.5 to 9.1. Radiographs were evaluated at a mean of 31 months: 38 had no glenoid radiolucent lines, 13 glenoids had grade 1, 2 had grade 2, and 5 had grade 3 lucencies. There was no difference in the rate of progression of glenoid radiolucencies between shoulders with a preoperative glenoid version of ≤20° (27.8%) compared with glenoids with >20° of retroversion (22.7%, $P = .670$). No shoulders were revised due to glenoid loosening or instability.
Conclusion: TSA with partial corrective glenoid reaming in selected shoulders with a B2 glenoid deformity resulted in excellent functional and radiographic outcomes at short-term follow-up, with a low risk of revision surgery.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: total shoulder arthroplasty; B2 glenoid; biconcave glenoid; corrective reaming; glenoid retroversion; radiolucency

The Washington University in St. Louis Institutional Review Board approved this study (IRB approval #201409158).

*Reprint requests: Jay D. Keener, MD, Washington University Orthopedics, 660 S Euclid Ave, Campus Box 8233, St. Louis, MO 63110, USA.

E-mail address: keenerj@wudosis.wustl.edu (J.D. Keener).

Total shoulder arthroplasty (TSA) is a reliable treatment option for patients with glenohumeral arthritis, with excellent documented improvements in pain and function.[1,3,21,22] However, the results in patients with a biconcave glenoid (B2) wear pattern have historically been less predictable.[14,29] The

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B2 glenoid, originally described by Walch et al,[28] presents unique challenges during shoulder arthroplasty due to asymmetric posterior glenoid wear and posterior humeral head subluxation. Numerous studies have reported poorer clinical outcomes, increased complications, and increased rates of glenoid loosening after TSA in patients with a B2 glenoid.[3,29] Surgical techniques to address B2 glenoid deformities include corrective reaming of the glenoid, augmented glenoid components, bone grafting of the glenoid defect, and in some cases, reverse shoulder arthroplasty.[5,7,17,23,25,29]

Corrective reaming of the glenoid can help to normalize version in the setting of a B2 glenoid; however, excessive anterior reaming can lead to loss of bony support for the glenoid component.[4,9,13,20] Posterior glenoid bone grafting and augmented glenoid components have been suggested as a means to correct glenoid version while minimizing the amount of corrective anterior reaming.[7,19,23,25] The use of posteriorly augmented glenoid components allows for correction of acquired posterior retroversion without the need for anterior corrective reaming; however, instrumentation of these components requires variable amounts of bone removal, which may also decrease glenoid bone support.[15] Early and midterm results of posterior glenoid bone grafting have been variable, with some reporting high rates of graft incorporation and others recommending against the use of this technique due to high rates of failure.[19,23,29] Although partial corrective reaming of the glenoid is an accepted technique to correct acquired retroversion in patients with B2 glenoids, clinical and radiographic results of this technique are lacking in the literature.[3,8,29]

This study describes the short-term functional and radiographic outcomes after TSA in a series of shoulders with a B2 glenoid deformity addressed with partial corrective reaming. We hypothesized that shoulders with more severe preoperative glenoid retroversion deformities (>20°) would have a greater rate of early postoperative glenoid radiolucencies than less severe deformities (≤20°).

Materials and methods

We performed a retrospective case series to identify patients who underwent anatomic TSA between 2007 and 2014 using a departmental billing database with a Current Procedural Terminology (American Medical Association, Chicago, IL, USA) code 23472. We reviewed all preoperative imaging and included only those patients with radiographs and a computed tomography (CT) scan demonstrating a B2 glenoid deformity (Fig. 1), which was confirmed independently by 2 observers (N.D.O., B.M.P.). We excluded patients who did not have preoperative clinical scores, including visual analog scale (VAS) for pain, the American Shoulder and Elbow Standardized Shoulder Assessment (ASES), and Simple Shoulder Test (SST). We included only anatomic TSA without placement of bone grafts or augmented glenoids in this series. There were no exclusion criteria based on radiographic severity of glenoid deformity. Patients were then contacted and invited to participate in the study. Final postoperative radiographs and clinical outcome scores (VAS pain, ASES, SST) were analyzed.

All preoperative CT scans were reformatted in the plane of the scapula using OsiriX software (Geneva, Switzerland) to calculate the intermediate glenoid retroversion angle, superior tilt, and percentage of humeral head subluxation using a previously described technique (Fig. 2).[2] These measurements were made independently by 2 authors (N.D.O., B.M.P.) who were blinded to each other's results; the average measurements were reported.

All patients underwent primary TSA within the study period by 1 of 4 shoulder and elbow fellowship-trained surgeons at a single institution. A deltopectoral approach was used, and the subscapularis was managed with a lesser tuberosity osteotomy in all cases. An all-polyethylene, in-line pegged glenoid prosthesis was cemented in all cases along with a cemented or noncemented humeral stem (Zimmer, Warsaw, IN, USA). Glenoid deformities were addressed using a high side, corrective ream with the goal of achieving an estimated minimum of 80% glenoid support and a final retroversion angle within 10° to 15° of neutral. Preoperative CT scans defined the severity and, therefore, the desired magnitude of correction; however, the reaming angle was estimated intraoperatively. The reaming angle was estimated initially by sounding the glenoid vault depth with a small-caliber drill at the anticipated correction angle, which we defined as the angle that removed the bone ridge between the paleoglenoid and neoglenoid surface and was roughly perpendicular to the junction of the anterior glenoid vault and scapular body, which was localized with palpation. Reaming proceeded until the implant face was at least 80% supported. In more severe deformities, the implant was placed slightly more retroverted in favor of excessive reaming, which would compromise glenoid fixation.

The cement was manually pressurized before implant placement, and no cement was placed on the backside of the glenoid

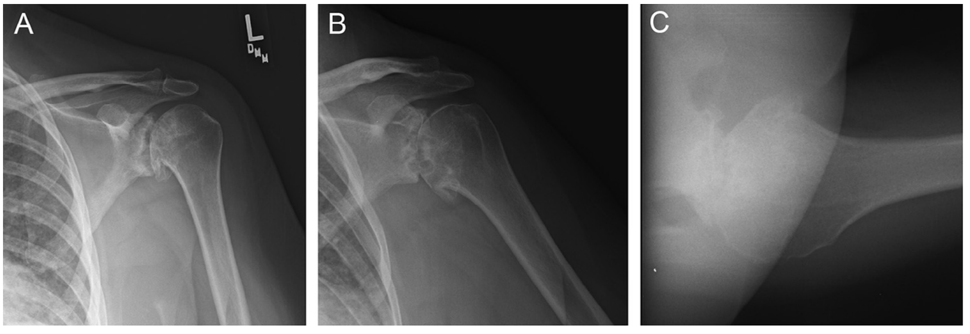

Figure 1 Preoperative (**A**) anteroposterior view (**B**) true anteroposterior view, and (**C**) axillary view radiographs demonstrate primary glenohumeral osteoarthritis with a biconcave (B2) glenoid.