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Outcomes of Trabecular Metal–backed glenoid components in anatomic total shoulder arthroplasty

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Background: As glenoid failure is one of the primary causes of failure of anatomic total shoulder arthroplasty (TSA), Trabecular Metal–backed glenoid components have become popular. This study reports implant survival and clinical outcomes of patients who received a Trabecular Metal–backed glenoid component during primary anatomic TSA.

Methods: Patients who underwent TSA with a Trabecular Metal–backed glenoid component by a single surgeon were identified and reviewed for clinical, radiographic, and patient-reported outcome measures with a minimum of 2 years' follow-up.

Results: Of 47 patients identified, radiographic and clinical follow-up was available on 36 patients (77%). Average age was 66.36 years (range, 50-85 years), and the average follow-up 41 months (range, 24-66 months). Three patients showed signs of osteolysis, 4 had radiographic evidence of metal debris, and 1 patient had a catastrophic failure after a fall. Of the 47 TSAs, 5 (11%) were revised to a reverse TSA for subscapularis failure and pain. Visual analog scale for pain scores improved by an average of 4.4. At final follow-up, the average Single Assessment Numeric Evaluation score was 72.4; Penn satisfaction score, 7.5; Penn score, 70.35; and American Shoulder and Elbow Surgeons score, 69.23. Outcome scores were similar in the 7 patients with osteolysis or metal debris compared to those without.

Conclusion: Trabecular Metal–backed glenoids had a 25% rate of radiographic metal debris and osteolysis at a minimum 2-year follow-up in this series with one catastrophic failure. This implant should be used with caution, and patients followed closely.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Total shoulder arthroplasty; Trabecular Metal; outcomes; glenoid; loosening; implant survival; osteolysis

Institutional review board approval for this project was received from Greenville Health System (Pro00040469).

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For many years, anatomic total shoulder arthroplasty (TSA) has been used to treat arthrosis of the shoulder. One of the primary causes of failure and reasons for TSA revision is glenoid component failure. Revision rates for symptomatic glenoid loosening and failure range from 0% to 4% per year.[16] There is evidence that metal-backed glenoid components have a higher rate of loosening than all-polyethylene components.[10] A recent systematic review reported a loosening rate of 14% for metal-backed glenoid components and 3.8% for all-polyethylene components.[16] In an effort to improve the results and durability of the glenoid components in TSAs, a number of design changes have been implemented. For example, to increase the long-term fixation and survivability of the glenoid components, a novel implant with a porous Trabecular Metal–backed glenoid (Zimmer, Warsaw, IN, USA) has been introduced. This implant is made of tantalum Trabecular Metal, a highly porous biomaterial excellent for bony ingrowth and designed to have structural and functional properties similar to bone. The initial "scratch fit" supports biological ingrowth and fixation from the high coefficient of friction and porosity. The Trabecular Metal technology[1,2,12] has been successful in securing implants with bony ingrowth and good survival rates in hip and knee arthroplasty.[8,14] Bogle et al[3] showed good results with secure glenoid fixation at short-term follow-up for cementless Trabecular Metal porous-coated implants for reverse total shoulder replacement. The current design of the Trabecular Metal–backed glenoid component (Zimmer) was released in 2009. Although over 10,000 of these glenoid components have been implanted worldwide, evidence on either the intermediate- or long-term survival of Trabecular Metal–backed glenoid components in anatomic TSA is very limited. The purpose of this study was to report the early results, survival, and patient-reported outcomes of this anatomic TSA system using Trabecular Metal–backed glenoid components.

Materials and methods

This retrospective case series with a systematic chart review was performed on all patients undergoing shoulder replacement surgery (Current Procedural Terminology code 23472) by the senior author (S.J.T.) since the use of the Trabecular Metal–backed glenoid TSA system began in 2009. From the chart and operative report review, we determined which patients had undergone primary TSA with the Trabecular Metal–backed glenoid component system. Those patients who met the inclusion criterion of a minimum postsurgery status of 23 months were included in the analysis. The primary outcome was implant survival, defined as no revision surgery during the follow-up period. Secondary outcomes included evidence of loosening of the component on postoperative imaging, visual analog scale (VAS) scores at final follow-up compared with preoperatively, improvement in forward elevation and external rotation range of motion, and patient-reported outcomes. Anteroposterior, oblique, and axillary lateral views were retrospectively reviewed for evidence of loosening by 2 orthopedic surgeons (S.T.W. and G.K.G.). Patient-reported outcome measures were collected at greater than 2 years' follow-up. These outcome measures included the American Shoulder and Elbow Surgeons score, Penn satisfaction shoulder score, and Single Assessment Numeric Evaluation score, as well as a VAS score for pain.

Operative technique

All patients underwent primary anatomic TSA for indications of primary osteoarthritis by a single fellowship-trained shoulder surgeon. In all cases in this series, the implant was a Zimmer Total Shoulder with a Trabecular Metal–backed glenoid component. All but 3 glenoid components were implanted with an uncemented press-fit technique. We acknowledge that this is not approved by the Food and Drug Administration in the United States, but as with many Trabecular Metal technologies, it is acceptable practice to press fit the component. The decision to cement the component was at the discretion of the surgeon based on the glenoid bone quality and ability to obtain adequate fixation on attempted press fitting. Operations were carried out with patients under a combination of general and interscalene anesthesia. The deltopectoral approach and a subscapularis peel technique were used to access the glenohumeral joint and repaired with transosseous sutures. Humeral preparation was carried out in standard fashion with press-fit stem placement in 20° to 30° of retroversion. After capsular release and proper retractor placement, the glenoid was exposed. The central peg hole was centered on the central axis of the glenoid, with correction for version from preferential posterior wear as needed. Reamers were used to prepare the host glenoid down to the subchondral bone. After preparation of the glenoid vault for the peg-keel construct, the implant was impacted to achieve secure press-fit fixation. The wound was closed in standard fashion. The postoperative regimen included wearing a sling for 4 weeks. Physical therapy was initiated at 2 weeks postoperatively with passive and active-assisted range of motion. External rotation was limited to less than neutral until 6 weeks and then progressed to 30° until week 12. Active internal rotation was allowed at 6 weeks.

Statistical analysis

All analyses were performed using SPSS software (version 22.0; IBM, Armonk, NY, USA). Preoperative and postoperative values were assessed for distribution normality; violations of normality were identified for 1 or both repeated groups for each analysis. The Wilcoxon signed rank test was used to analyze the differences between preoperative and postoperative measurements for active external rotation, active forward elevation, and VAS pain scores. The Wilcoxon signed rank test is a nonparametric statistical hypothesis test used to compare 2 related samples, matched samples, or repeated measurements on a single sample. Statistical significance was defined as $P < .05$.

Results

During the defined period, 47 patients received a Trabecular Metal–backed glenoid component that would be eligible for the minimum 2-year follow-up. Radiographic and clinical follow-up at a minimum of 2 years was available in 36 of 47 patients (77%). These 36 patients were included in the study for radiographic and clinical analysis. Patient-reported outcome measures in addition to 2-year follow-up radiographs and clinical examination findings were available in 28