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Results of total shoulder arthroplasty with a monoblock porous tantalum glenoid component: a prospective minimum 2-year follow-up study

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Background: Aseptic loosening of all-polyethylene glenoid components remains a limiting factor in achieving long-term implant survival in total shoulder arthroplasty (TSA). This study prospectively evaluated the functional and radiographic outcomes of patients undergoing TSA with a novel, porous, tantalum-backed glenoid component, with a minimum 2 years of follow-up.

Materials and methods: Porous tantalum-backed glenoid components were used in 19 TSAs in 19 patients. All patients were available for radiographic follow-up at an average of 38 months (range, 24-64 months). Patients were evaluated prospectively using the American Shoulder and Elbow Surgeons (ASES) score and pain on a visual analog scale (VAS). Radiographs were evaluated for component loosening and failure of the porous tantalum backing at a minimum 2 years of follow-up.

Results: The mean VAS decreased from 8.6 to 2.9 ($P < .0001$). The mean ASES score improved from 21 to 70 points ($P < .05$). Mean active forward elevation improved from 75° to 131° ($P < .0001$). At latest follow-up, all glenoid components except 1 had complete in-growth of the porous tantalum keel; however, 4 components (21%) failed by fracture at the keel–glenoid face junction.

Conclusions: There was an unacceptably high rate of glenoid component failure (21%) due to fracture at the keel–glenoid face junction in this series. The manufacturer has subsequently revised this early design to reduce the risk of failure. The results of this study illustrate that caution should be exercised in the use of novel implants with an unproven clinical track record.

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

Keywords: Metal backed glenoid; porous tantalum; trabecular metal; total shoulder arthroplasty; glenoid failure; glenoid loosening

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Modern total shoulder arthroplasty (TSA) using fully cemented all-polyethylene glenoid components has proven to be a successful procedure to treat a variety of end-stage arthritic conditions of the shoulder.[11,23,28,31] These good results, combined with the aging population, have led to a marked increase in the number of TSAs being performed annually in the United States.[12] However, despite this success, there remains significant concern about the presence of radiolucent lines at the glenoid cement–bone interface, as well as clinical loosening of all-polyethylene, fully cemented glenoid components. Recent studies have shown radiolucent lines are present in 0% to 94% of cemented glenoid implants at the initial implantation, with corresponding rates of clinical loosening from 2% to 44% at midterm to long-term follow-up.[2,8,11,14,15,17,18,20,23,32] Radiolucent lines around the humeral component are much more infrequent, making glenoid fixation the weak link in the survivorship of TSA.[10] Given the increasing number of TSAs being performed and the inferior results of revision TSA, attaining stable fixation of the glenoid component is important for achieving good long-term outcomes in TSA.

Previous attempts to decrease the prevalence of radiolucent lines and increase the longevity of glenoid implants used metal-backed glenoid prostheses to promote bony ingrowth and achieve stable, permanent fixation of the glenoid prosthesis to the host bone.[7,9,16,21,29,30,33] Unfortunately, the clinical and radiographic results of metal-backed implants has shown inferior survivorship compared with cemented all-polyethylene glenoids, leading to the eventual abandonment of those designs.[7,15,16,21,29,30,33] A metal-backed glenoid component using novel materials and design was recently introduced for clinical use in an attempt to improve these historically poor results. This prosthesis, the Trabecular Metal Glenoid (Zimmer, Warsaw, IN, USA), incorporates several specific features designed to address the shortcomings of previous metal-backed glenoid implants, including a monoblock design to prevent backside wear, decreased metal stiffness to reduce stress transfer, and a porous tantalum keel to allow for stable bony in-growth (Fig. 1).[22]

We are unaware of any previous studies reporting the clinical results of this specific glenoid component. The purpose of this study was to prospectively evaluate the clinical outcome and radiographic results of a minimally cemented, monoblock, porous, tantalum-backed glenoid component as part of a TSA system at a minimum 2 years of follow-up. Our hypothesis was that the use of a minimally cemented, porous, tantalum glenoid component in TSA would show superior results compared with historical results for TSA with a fully cemented, all-polyethylene glenoid component.

Materials and methods

The study prospectively enrolled consecutive patients undergoing TSA with a porous, tantalum-backed glenoid component between March 2004 and August 2005. Inclusion criteria included a painful shoulder with radiographic evidence of advanced osteoarthritis, post-traumatic arthritis, or inflammatory arthritis refractory to at least 6 months of nonoperative management. Exclusion criteria included rotator cuff insufficiency, insufficient glenoid bone stock for implantation of the prosthesis, active infection, or inability to return for follow-up.

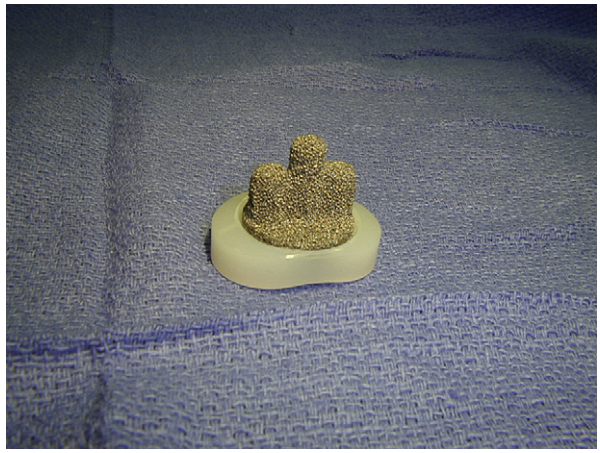

Figure 1 Example of a porous, tantalum-backed glenoid implant.

During the study period, 25 shoulders in 23 patients received a porous tantalum-backed glenoid component as part of a TSA. One patient declined to participate, 1 died before the 2-year period, 1 was lost to follow-up, and 1 had incomplete results, resulting in a final group of 19 TSAs in 19 patients (5 men, 14 women). Of the 2 patients that had bilateral TSAs, only 1 side was used for evaluation in the study.[24]

Preoperative diagnoses included osteoarthritis in 15 shoulders (79%), and juvenile rheumatoid arthritis, rheumatoid arthritis, avascular necrosis, and post-traumatic arthritis in 1 shoulder each (21%). One patient presented with painful glenoid arthrosis after a previous humeral head resurfacing arthroplasty. No other patients had undergone previous shoulder surgery. Procedures were performed on 14 right shoulders and 5 left shoulders. Patients were a mean age of 62.8 $\pm$ 14.6 years. The average clinical follow up was 31 months (range, 24-64 months).

Operative technique

The operation was performed by an experienced shoulder surgeon (J.M.W.). All patients received the same Bigliani-Flatow humeral stem component (Zimmer) and the Trabecular Metal Glenoid component.

A standard deltopectoral approach was used in all shoulders with a subscapularis tenotomy. After osteotomy of the humeral head, the glenoid face was reamed to match the curvature of the back of the glenoid component. Attention was paid to not remove the underlying subchondral bone in order to provide a secure base for implant fixation. Drill bits and an osteotome were used to create a linear slot for the porous tantalum keel. Because the U.S. Food and Drug Administration has approved the prosthesis for cemented use only in the U.S., the components were implanted using a limited cement technique recommended by the manufacturer, placing polymethylmethacrylate cement at the tip of the keel to enhance initial fixation.

The final implant was firmly impacted into the glenoid to achieve secure press-fit fixation. The humeral component was