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ORIGINAL ARTICLE

# Five-year minimum clinical and radiographic outcomes of total shoulder arthroplasty using a hybrid glenoid component with a central porous titanium post

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**Background:** To determine the effectiveness of hybrid glenoid components in reducing the frequency of glenoid component loosening, we evaluated clinical and radiographic outcomes at a minimum 5-year follow-up in 45 shoulders that underwent total shoulder arthroplasty (TSA) using a system with a central porous titanium post to augment the cemented peripheral pegs.

**Methods:** Function and pain were evaluated with the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment score, visual analog scale, active shoulder range of motion, and strength. Postoperative radiographs were analyzed for radiolucent lines, progressive loosening, and at-risk signs.

**Results:** The mean American Shoulder and Elbow Surgeons score improved from 40.4 to 83.7 ($P < .0001$) and the mean visual analog scale from 5.9 to 0.8 ($P < .0001$). Forward elevation improved from 113° to 151° ($P < .001$), internal rotation from 49° to 60° ($P = .035$), and mean external rotation from 36° to 50° ($P = .0006$). Radiographs showed glenoid component radiolucency in 29 shoulders. Radiolucencies were confined to the area under the glenoid faceplate in 6 and were only around the central post in 13. Nine TSAs (20%) demonstrated 2 or more columns of involvement but were not judged to be at-risk. One implant (2.2%) had glenoid component failure and was revised to a hemiarthroplasty.

**Conclusion:** Anatomic TSA using a hybrid glenoid component with a central porous titanium post demonstrated a low rate of mechanical failure and a rate of radiolucent lines comparable to reports of all polyethylene implants. Further evaluations are needed to demonstrate the long-term durability of these implants and to determine the significance and fate of the radiolucent lines, particularly relative to the central post.

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



**Keywords:** Total shoulder arthroplasty; hybrid glenoid component; central porous titanium post; glenoid component loosening; 5-year follow-up; radiographic outcomes

The University of Tennessee Health Science Center Institutional Review Board approved this study (#15-03748-XP).

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Total shoulder arthroplasty (TSA) has an established track record for pain relief and functional improvement in patients with arthritic shoulder conditions.[8,17,21,25,26] The long-term success of TSA has been dependent primarily on the survivability of the glenoid component. Early glenoid components, designed for cementless fixation using screws and porous coating on a metal backing with a polyethylene shell, had unacceptably high failure rates, and cemented all-polyethylene components are favored today.[8,24,29] Although long-term survival rates of modern TSA are vastly improved from early designs, glenoid component loosening remains an implant survivability issue.[5,13,18] Indeed, glenoid component loosening is still the most common mode of failure in TSA.[3] Early radiolucencies about the glenoid component are concerning for midterm and long-term TSA survival; however, evidence has not shown a clear progression from radiolucency to loosening.[27]

Cemented glenoid components that also use biologic fixation have been investigated. Wirth et al[31] reported promising short-term and midterm results with a minimally cemented all-polyethylene pegged glenoid component designed for biologic fixation. The central polyethylene peg was designed with radial fins that allowed bone ingrowth centrally and a decreased need for cement peripherally. This design also demonstrated favorable radiographic results at short-term follow up.[2]

More recently, hybrid glenoid components that supplement traditional cemented fixation with porous titanium ingrowth technology have been introduced, but a study of one such TSA system demonstrated a high failure rate at 2 years of follow-up.[7] Our study investigated the minimum 5-year clinical and radiographic outcomes of another TSA system that uses a hybrid glenoid component with a central porous titanium post to augment the cemented peripheral pegs. We hypothesized that the glenoid component with an ingrowth porous titanium post would exhibit high rates of implant survival and a rate of periprosthetic radiolucencies similar to traditional implants.

## Materials and methods

The study group consisted of 45 shoulders that underwent TSA for primary glenohumeral osteoarthritis and with a minimum of 5 years of clinical and radiographic follow-up. The study excluded patients with inflammatory arthritis, osteonecrosis, post-traumatic arthritis, arthritis with recurrent instability, capsulorrhaphy arthropathy, irreparable rotator cuff failure, or required glenoid bone grafting.

A standardized preoperative physical examination determined shoulder range of motion and rotator cuff strength. American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment scores and visual analog scale (VAS) scores for each patient were gathered preoperatively. All patients underwent computed tomography (CT) scans for preoperative planning. The modified Walch classification was used to record glenoid types: A1 glenoids were present in 29% of patients, A2 glenoids in 6.7%, B1 glenoids in 6.7%, B2 glenoids in 53%, C glenoids in 0%, and D glenoids in 4.4%.

### Operative procedure

All procedures were performed with patients in the beach chair position under neuromuscular paralysis. Through a deltopectoral approach, a subscapularis tenotomy was performed 1 cm medial to the lesser tuberosity. Any small rotator cuff tears that were determined to be repairable were repaired with suture anchors at the conclusion of the procedure (1 patient).

All TSAs were done with a standard technique using a hybrid glenoid component with a central porous titanium post (Comprehensive Shoulder System, Biomet, Warsaw, IN, USA). The humerus was prepared first with a humeral head osteotomy in 30° of retroversion. After reaming and broaching of the humerus, preoperative CT scans were used to guide reaming of the glenoid to re-establish neutral version in all patients, including those in whom the subchondral bone was penetrated. All glenoids were reamed to full correction so that all components were fully seated on native bone after implantation.

When neutral version was re-established, templating instrumentation was used to drill holes for the 3 peripheral pegs and a central hole for the larger porous titanium post. Components were trialed with special attention to flush seating of the trial in all 4 quadrants of the glenoid, and the glenoid vault was then thoroughly irrigated. A pressurized cementing technique was used to fill the outer holes with vancomycin-impregnated cement, and the glenoid component was inserted so that it sat flush. All excess cement was removed.

After the cement had fully cured, the humeral stem was placed and the humeral head trialed for appropriate head height, version, range of motion, and stability. The subscapularis and rotator interval were repaired with #2 braided nonabsorbable suture, and the wounds were closed and dressed in standard fashion.

Rehabilitation was supervised with a standard protocol of progressive passive and active-assisted range of motion exercises for 10 weeks, and then progressing to isometric strengthening and active motion.

### Follow-up evaluation

At a minimum of 5 years postoperatively, ASES scores, VAS scores, active shoulder range of motion, and strength were evaluated. Postoperative standard radiographs, including anteroposterior, external rotation, and axillary lateral views, were obtained for analysis. Radiographs were evaluated in blinded fashion by a consensus of 2 shoulder and elbow fellowship-trained reviewers (T.J.B. and T.W.T.). In the case of a disagreement between the reviewers, the radiographic findings with greater evidence of loosening were reported in an effort to remain as unbiased as possible. Radiographs were scrutinized for radiolucent lines, signs of progressive loosening or subsidence, and at-risk signs. Radiolucent lines were measured for width in millimeters and graded by zones using a modification of the systems described by Mileti et al[16] and Sperling et al[20] (Fig. 1). Glenoid components were judged to be at-risk if a 1.5-mm circumferential radiolucent line was noted or if there was a shift in component position, or both.

Statistical analyses were performed using paired *t* tests to compare preoperative and postoperative function. Statistical significance was set at $P < .05$.