



# Five- to ten-year follow-up with a partially cemented all-polyethylene bone-ingrowth glenoid component



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**Background:** Although total shoulder arthroplasty has demonstrated better clinical outcomes than hemiarthroplasty, glenoid component loosening is a common complication. Recently, a novel partially cemented all-polyethylene fluted central peg bone-ingrowth component was introduced.

**Methods:** Forty-two consecutive total shoulder arthroplasties from 2003 to 2007 performed by a single surgeon were evaluated radiographically and clinically with American Shoulder and Elbow Surgeons (ASES) scores and range of motion.

**Results:** The average follow-up was 80 months (63-114); the average forward elevation improved from 107° to 137°, and external rotation improved from 30° to 37° at the latest follow-up. The average ASES score improved from 50 to 84. There was a strong correlation with the mean peripheral peg lucent line score (Lazarus score), which was 0.81, with the mean anchor peg lucent line score, which was 0.50 ( $P < .001$ ). An analysis of polyethylene before and after cross-linking revealed a strong correlation between components with cross-linking and the Lazarus scores and the central fluted peg scores. Overall, there was 97% survivorship at 80 months. On radiographs, 81% of the central fluted pegs had complete incorporation with no lucent lines. These lucent lines correlated with lower ASES scores, suggesting that loosening of the glenoid decreases functional outcome.

**Conclusion:** Care should be taken in preparing the central fluted peg as perforation of the vault can lead to central flute peg lucent line formation, whereas perforation of the peripheral pegs does not seem to negatively affect the outcome.

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

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**Keywords:** Shoulder; glenoid; total shoulder arthroplasty; polyethylene; cement; peg; bone ingrowth

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Total shoulder arthroplasty has demonstrated better clinical outcomes compared with hemiarthroplasty.<sup>8,19</sup> Glenoid component loosening continues to be the most common complication in total shoulder arthroplasty.<sup>2,3,16,21,22</sup> In an effort to mitigate glenoid component loosening, glenoid component design has evolved, with most studies demonstrating that curved-back all-

polyethylene components perform better clinically compared with flat-back or metal-backed designs.<sup>2,20</sup> Curved-back designs usually incorporate either a pegged or keeled fixation method. Prospective randomized studies by both Gartsman et al<sup>10</sup> and Edwards et al<sup>9</sup> found that radiolucent lines were significantly reduced in pegged components compared with keeled components on initial and 2-year postoperative radiographs. Wirth et al<sup>24</sup> further reported on the curved-back all-polyethylene pegged glenoid component by adding a central fluted bone-ingrowth peg. In their canine model, the fluted peg demonstrated bone ingrowth and had better mechanical strength compared with a cemented keeled component. A similar component has been used clinically, and several studies have demonstrated favorable radiographic and clinical outcomes.<sup>1,11,25</sup> Arnold et al<sup>1</sup> demonstrated by fine-cut computed tomography (CT) scans that bone fully integrated into the fluted fins of the central peg in 23 of 35 patients and in 4.5 of the 6 compartments in all of the 35 patients. Midterm clinical follow-up demonstrated 85% to 88% bone incorporation of the central fluted peg on plain films.<sup>6,7</sup>

The purpose of this study was to determine the 5- to 10-year follow-up of a curved-back partially cemented bone-ingrowth all-polyethylene glenoid component. The hypothesis was that bone incorporation of the fluted central peg would be associated with fewer lucent lines around the peripheral pegs and correlate with validated outcomes measures.

## Materials and methods

This Level IV case series evaluated the results of 76 consecutive total shoulder arthroplasties performed from 2003 through 2007 by a single surgeon (E.E.S.) with the DePuy Global Advantage (DePuy, Warsaw, IN, USA) arthroplasty with a partially cemented bone-ingrowth glenoid component. The study group included 27 men and 15 women with a mean age of 64 years (range, 51-80) at the time of the index procedure. We did not include 34 patients in the analysis because they were either deceased ( $n = 15$  [19.7%]) or could not be contacted for final follow-up ( $n = 19$  [25%]). This allowed 42 patients with a mean of 80 months of follow-up to be analyzed.

Exclusion criteria included those with any prior surgery, concomitant rotator cuff repairs, or bone grafting procedures. All patients were between 5 years and 10 years post surgery and had completed American Shoulder and Elbow Surgeons (ASES) forms, had postoperative radiographs, and had range of motion measurements performed by an independent physical therapist.

All patients had a total shoulder arthroplasty performed with a subscapularis tenotomy that was anatomically repaired with a minimum of 4 buried figure-of-8 sutures with No. 2 FiberWire (Arthrex, Naples, FL, USA). Cortical bone reamings from the glenoid were packed around the central fluted peg component, and the 3 peripheral holes were dried and pressurized with cement. The glenoid component was held in place until the cement had cured. Before cementing, humeral and glenoid component position was confirmed with intraoperative biplanar fluoroscopy. Intraoperative fluoroscopy ensured that head height and radius recapitulated the normal anatomy.

All patients completed ASES forms and were evaluated by an independent physical therapist for range of motion measurements preoperatively and at final follow-up.

The preoperative and postoperative radiographs included true anterior-posterior (AP) (Grashey) views and axillary views. The postoperative views were initially performed fluoroscopically to ensure that the beam trajectory was tangential to the glenoid, but the images obtained in this manner did not represent the quality that was required to determine subtle lucent lines around the pegs. Regular plain films (true AP and axillary) were used to determine if there were lucent lines around the peripheral pegs or the central fluted pegs. If the radiographs were not tangential, they were repeated until a good representation of the glenoid component was obtained. Although this process was a little more arduous, we believe that it represented the true lucent lines. These radiographs were interpreted by 2 fellowship-trained musculoskeletal radiologists blinded to the patients' clinical results. If the independent readings were discordant, the higher grade was recorded. The peripheral pegs were evaluated according to the accepted Lazarus method,<sup>13</sup> and the central fluted peg was evaluated according to the modified Lazarus method described by Churchill.<sup>6</sup>

The true AP (Grashey) view was used to determine the amount of calcar osteolysis. Calcar osteolysis was determined as the linear measurement from the inferior aspect of the humeral head to the point at which calcar bone was present.

Statistical analysis was performed to analyze the relationships between the recorded variables. Nonparametric tests (Spearman rank and Mann-Whitney *U*) for the significance of correlation were used. The following relationships were tested: Lazarus score with the central fluted peg score, central fluted peg score with the ASES score, central fluted peg vault perforation with the central peg score, peripheral vault perforation with the Lazarus score, calcar osteolysis and the central fluted peg score, cross-linked polyethylene with the Lazarus score, and cross-linked polyethylene with the central fluted peg score. Significance was set at  $P < .05$ .

## Results

### Cohort descriptive statistics

The average forward elevation was 107° preoperatively (standard deviation [SD], 29°; range, 30°-160°), 155° postoperatively (SD, 24°; range, 16°-170°), and 137° (SD, 15°; range, 90°-160°) at the final follow-up. Preoperatively, the mean external rotation was 30° (SD, 13°; range 0°-50°). The mean increased to 52° postoperatively (SD, 8°; range, 30°-60°). At the final follow-up, the mean external rotation was 37° (SD, 13°; range, 15°-75°).

The preoperative ASES scores had a mean of 50 (SD, 10; range, 36-70). This increased to a mean of 84 postoperatively (SD, 19; range, 18-100). Final follow-up ASES score was 82 (SD, 17; range, 18-100). Overall, there was a 97% survivorship, with 81% of implants demonstrating central fluted peg bone ingrowth with no lucency. In addition, 5 subjects had central fluted peg vault perforation, whereas 9 subjects had peripheral peg vault perforation. Six weeks postoperatively, the mean Lazarus score was 0.07,

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