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Midterm results of stemless shoulder arthroplasty: a prospective study

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Background: This study evaluated the functional and radiologic results of shoulder arthroplasty using a single type of stemless humeral head implant with a minimum follow-up of 5 years.
Methods: Stemless shoulder arthroplasties in 78 patients at a mean age of 58 years were prospectively evaluated at a mean clinical and radiologic follow-up of 72 months. Functional results were documented using the age- and sex-adjusted Constant score with standardized radiographic examination.
Results: The Constant score improved significantly from 38.1% to 75.3% ($P < .0001$). Active range of motion improved significantly for flexion (from 114° to 141°), abduction (from 74° to 130°), and external rotation (from 25° to 44°; $P < .0001$). Bone mineral density was reduced in 34.9% of the older population, without an influence on shoulder function (Constant score without lowering of bone density; 73%; Constant score with lowering of bone density 80%; $P = .404$). The overall complication rate was 12.8%, with an overall revision rate of 9%. None of the stemless implants were revised for loosening.
Conclusion: The functional and radiologic results of the stemless shoulder arthroplasty are comparable to the third and fourth generation of standard stem arthroplasty.
Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Stemless shoulder arthroplasty; primary osteoarthritis; post-traumatic osteoarthritis; complications; total shoulder arthroplasty; hemiarthroplasty

Humeral head replacement using a stemmed implant for chronic proximal humeral fractures can be technically demanding due to malalignment and altered center of rotation. The functional outcome of shoulder arthroplasty for fracture sequelae is inferior to the results of shoulder arthroplasty for primary osteoarthritis, especially when a greater tuberosity osteotomy is indicated to reconstruct the center of rotation of the glenohumeral joint.[4]

Stemless shoulder arthroplasty was introduced in 2004 by Biomet Inc (Warsaw, IN, USA) with the Total Evolutive Shoulder System (TESS) to replicate the advantages of the 3-dimensional reconstruction of the humeral head using a third-generation stemmed implant and to avoid stemmed-related periprosthetic humeral fractures.[11]

The Eclipse stemless shoulder prosthesis (Arthrex, Karlsfeld, Germany) was developed by the first author (P.H.) and initially implanted in 2005. The design objective of this novel humeral head prosthesis was to develop a

This study did not require approval from our Institutional Ethical Review Board.

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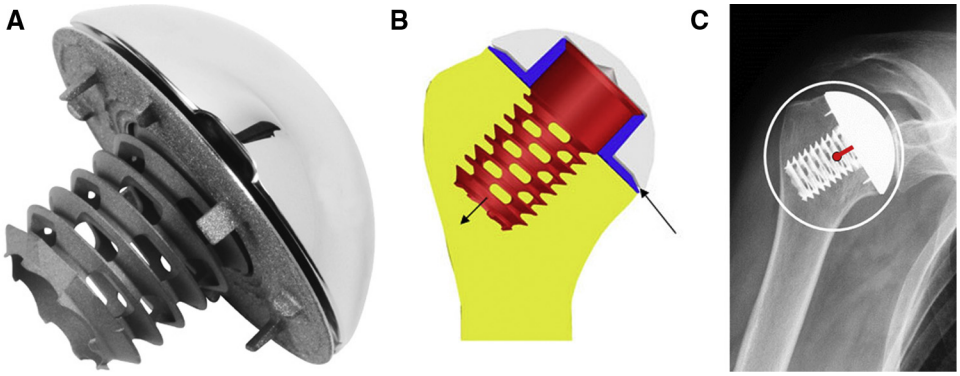

Figure 1 Implant design: (**A**) The Eclipse implant consists of a titanium rough-blasted trunnion coated with BONIT (an electrochemical coating technique developed by DOT GmbH, Rostock, Germany) and plasma spray, with fins on its back surface preventing rotation of the implant on the bony surface. (**B**) The trunnion is fixed in the metaphysis close to the center of rotation by a self-tapping cage screw compressing the trunnion onto the resection surface of the proximal humerus. The trunnion is additionally supported by the cortical bone. The humeral head is fixed by a cone mechanism on the trunnion and is supported by the cortical bone of the resection surface of the proximal humerus. (**C**) Primary stability is reached by shifting the fixation of the trunnion close to the center of rotation (*red point*), resulting in a short lever arm generating only low shear forces on the trunnion and the cage screw.

stemless system enabling the anatomic reconstruction of the center of rotation of the humeral head independent from the shaft axis and to avoid an additional osteotomy of the greater tuberosity. Additional benefits of a stemless humeral head replacement represent a standard approach to the glenoid for glenoid resurfacing (compared with surface replacement of the humeral head), avoidance of stress shielding at the lateral humeral cortex, preservation of an intact humeral shaft for revision arthroplasty, and theoretic risk reduction of periprosthetic humeral shaft fractures.

The midterm results of stemless shoulder arthroplasty were encouraging.[5,25] Longer-term results were not available until recently for stemless shoulder arthroplasty.[5] This study evaluated the functional and radiologic results of shoulder arthroplasty using a single type of stemless humeral head implant with a minimum follow-up of 5 years.

Materials and methods

Since 2005, stemless shoulder arthroplasty using the Eclipse implant was prospectively evaluated at our institution. The design objective of Eclipse (Fig. 1) was to develop a stemless humeral head replacement enabling the anatomic reconstruction of the center of rotation of the humeral head independent from the shaft axis, especially in post-traumatic conditions. Contraindications specific to this analysis involved rheumatoid arthritis, osteoporosis, and large subchondral cysts precluding stable anchorage of the implant.

Ninety-six stemless humeral head replacements were performed between May 2005 and September 2008. Seventy-eight patients (81% of the study group), comprising 39 women and 39 men, with a mean age of 57.8 years (range, 36-84 years) presented for clinical and radiologic follow-up at a minimum of 60 months (mean, 72.9 months; range, 60-100 months). There were no revisions.

The clinical results were documented using the absolute and the age- and sex-normalized Constant-Murley score.[8,9] Abduction strength was measured using the ISOBEX dynamometer (MDS Medical Device Solutions AG, Oberburg, Switzerland) according to the recommendation of Constant et al.[8] Standardized digital X-ray images were examined in 3 planes (true anteroposterior [AP], axillary, and scapular Y views) to assess radiolucent lines around the humeral and glenoid components, to monitor secondary glenoid wear after hemiarthroplasty, to monitor stress shielding, and to assess the humeral head center of rotation in the coronal (gothic arc) and the transversal planes. Migration of the humeral head was defined by a progressive discontinuation of the gothic arc compared with the postoperative AP radiograph at 6 weeks. Rotator cuff deficiency at follow-up was defined by humeral head migration and progressive loss of active range of motion.

The assessment of the radiolucent lines around the humeral component was performed in the AP and the axillary views by dividing the implant–bone interface in 3 different zones (Fig. 2). In a similar fashion, radiolucent lines around the glenoid component were assessed in 3 different zones with the AP and axillary views. Study indications for shoulder arthroplasty are provided in Table I.

One-third of the patients had undergone previous surgical intervention (range, 1-9). The types of intervention are summarized in Table II. Thirty-nine patients were treated with a hemiarthroplasty, and 39 underwent total shoulder arthroplasty. Twenty-four of the 39 patients underwent a total shoulder arthroplasty using a cementless metal-backed glenoid component, and the remaining 15 received a cemented all-polyethylene-keeled glenoid component.

At surgery, the rotator cuff was intact in 71 patients (91%). Partial lesions of the supraspinatus tendon were observed in 4 patients (5.1%), which were reconstructed during shoulder arthroplasty. Three patients had a large rotator cuff tear, indicative of cuff tear arthropathy.[19]

All data for the study were collected on the basis of a normal standardized clinical investigation. All patients provided written consent for the use of their anonymous data.