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ORIGINAL ARTICLE

Long-term outcomes of humeral head replacement for the treatment of osteoarthritis; a report of 44 arthroplasties with minimum 10-year follow-up

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Background: Studies have demonstrated mixed results after humeral head replacement (HHR) for osteoarthritis at short- and medium-term follow-up intervals. The purpose of this study was to investigate the long-term outcomes (minimum 10 years) of HHR for the treatment of osteoarthritis.

Methods: This study included 44 shoulders in 42 patients who had been followed up for a minimum of 10 years, at a mean clinical follow-up of 17 years (range, 10-30 years). Of this group, 31 shoulders had radiographic follow-up beyond 5 years, at a mean of 11.1 years (range, 5-21 years).

Results: Patients experienced significant pain relief postoperatively that was maintained during the long-term follow-up ($P < .01$), with a subgroup of 11 patients reporting persistent moderate or severe pain. Patients maintained increases in shoulder abduction (<.01), external rotation (<.01) and modified Neer scores (<.01). Ten of 44 (22.7%) shoulders underwent revision surgery, predominantly for glenoid arthrosis (n = 9). In the 25 shoulders with 5 years of radiographic follow-up, Kaplan-Meier survival analysis demonstrated moderate to severe glenoid erosion in 50% at 5 years, which increased to 59% at 15 years and 88% at 20 years.

Conclusions: HHR remains a successful operation for osteoarthritis at long-term follow-up. However, there is a substantive subgroup with continuing pain and a high rate of glenoid bone erosion after 10 years. Surgeons should carefully consider patients' needs and desires when judging the indications for HHR.

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

Keywords: Humeral head replacement; shoulder hemiarthroplasty; long-term follow-up; glenohumeral arthritis; total shoulder arthroplasty; glenoid erosion

In the mid-1970s, Neer reported on a cohort of 46 hemiarthroplasties at an average of 6 years of follow-up, showing that nearly all had excellent or satisfactory results and pain relief.[15,17] Since that time, several studies have looked at the short-term and midterm results of humeral head replacement (HHR) for glenohumeral arthritis, demonstrating statistically significant increases in Simple Shoulder Test scores and shoulder range of motion, with American Shoulder and Elbow Surgeons pain scores improving an average of 60%

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across all populations, including those with glenoid wear and rotator cuff insufficiency.[9,12,16,26]

With advancing surgical techniques, the outcomes of total shoulder arthroplasty have been found to be more reliable for pain relief and patient satisfaction compared with the shoulder hemiarthroplasty.[4,24] In electing HHR over a total shoulder arthroplasty, it is important to consider the potentially increased risk of revision surgery and variable outcomes in the revision setting of a failed HHR.[2] Several studies have collectively performed a longitudinal analysis during the past 4 decades of HHR, beginning in 1986, when it was observed that 8 of 39 (21%) shoulders with HHR required revision surgery because of painful glenoid arthrosis. Then, in 1998, with use of a similar cohort, 67 HHRs (35 for osteoarthritis and 32 for rheumatoid arthritis) were followed up for an average of 9.3 years. There was a 78% rate of clinical improvement, with 12 shoulders (18%) requiring revision for pain.[3] A decade later in 2006, 51 of these HHRs were evaluated at 11.3 years of follow-up, with 30 shoulders demonstrating an excellent or satisfactory outcome, whereas 10 (20%) shoulders required revision surgery.[21] At this point, there is a paucity of studies looking at long-term follow-up outcomes of HHR. The purpose of this study was to examine the long-term clinical and radiographic outcomes of HHR for the treatment of osteoarthritis in our population.

Methods

We used a combination of our institution's total joint registry and electronic medical record review to identify patients who underwent hemiarthroplasty during an 18-year period.[1]

Population of patients

We identified 60 patients who underwent HHR for osteoarthritis from November 8, 1978, through January 15, 1997. After exclusion of those who died before 10 years of follow-up (n = 14) and those who were lost to follow-up (n = 2), this report examined 44 shoulders at a mean follow-up of 17 years (range, 10-30 years). The average radiographic follow-up of those patients who did not undergo revision surgery was 14 years (range, 5-30 years). No patient died of complications or sequelae related to the HHR.

During the study period, 541 shoulders underwent anatomic total shoulder arthroplasty for osteoarthritis. A comparative analysis revealed that hemiarthroplasty was performed for patients who were younger, with higher activity levels, and who had full-thickness cartilage loss over a portion of or the entire glenoid surface with either minimal glenoid erosion or severe central erosion that would compromise glenoid fixation (n = 10).[21] Regarding the 44 shoulders included in this study, the average age was 58 (37-77) years. Of note, 9 (20%) patients were older than 65 years. There were 16 (39%) female patients (17 shoulders). Regarding occupation of the patients, there were 3 homemakers, 16 office workers, and 12 manual laborers. Only 1 patient underwent a prior procedure, an open distal clavicle resection and acromioplasty.

Intraoperatively, 9 shoulders had small to medium rotator cuff tears (all <3 cm in diameter) confined to the supraspinatus tendon, each having concomitant repair during the operation. All the humeral components were press-fit without cement; 2 were augmented with autologous, corticocancellous bone graft. The implants used were 25 Neer hemiarthroplasty prostheses (3M, St. Paul, MN, USA), 16 Cofield prostheses (Smith & Nephew, Memphis, TN, USA), and 3 Biomodular prostheses (Biomet, Warsaw, IN, USA).

Outcome analysis

Pain was evaluated preoperatively using a 5-point scale graded as follows: 1, no pain; 2, mild pain; 3, moderate pain after vigorous exercise; 4, moderate pain at rest or with normal activities; and 5, severe pain at rest. Shoulder range of motion was assessed using goniometers. Radiographic outcomes included humeral component lucency and glenoid erosion. Glenoid erosion was graded according to the previously described scale,[21] including none when the original subchondral plate was clearly visible, mild if a portion or all of the subchondral plate was eroded but <5 mm in depth, moderate if erosion was to the lateral aspect of the base of the coracoid process (5-10 cm in depth), and severe if the erosion was medial to the lateral aspect of the base of the coracoid (>10 mm in depth). Humeral lucency was scored as 0 (none), 1 (<1 mm wide, incomplete), 2 (1 mm wide, complete), 3 (1.5 mm wide, incomplete), 4 (1.5 mm wide, complete), or 5 (2 mm wide, complete).[5,24] The radiographs were reviewed and findings confirmed by three authors (J.W.S., E.R.W., W.A.R.).

Statistical analysis

The differences between continuous and categorical variables were tested using Student *t*-test; categorical variables were tested using Fisher exact test. Implant survival was assessed using the Kaplan-Meier method and compared groups and comorbidities using the log-rank test and proportional hazards regression. Given the limited number of revision and complication episodes, no multivariable analyses were performed. P value < .05 was statistically significant.

Results

Complications, reoperations, and implant survival

Within the follow-up period, there were 10 (23%) shoulders that developed issues leading to revision surgery. The causes for revision surgery were posterior shoulder dislocation (n = 1) and painful glenoid arthrosis (n = 9) as determined by clinical findings in concert with radiographic evidence of glenoid sclerosis or wear. The dislocated shoulder was treated with revision hemiarthroplasty; the remaining 9 were revised to a total shoulder arthroplasty. The average time from initial hemiarthroplasty to revision surgery was 7 years (0.5-14 years) The 10-, 20-, and 25-year follow-up implant survival rates were 86%, 77%, and 77%, respectively (Fig. 1). Furthermore, the 10-, 20-, and 25-year survival free of revision for glenohumeral arthrosis was 87%, 78%, and 78%, respectively (Fig. 2). Older age at surgery and the presence of a rotator cuff tear requiring concomitant repair were associated with a decreased risk of revision surgery after hemiarthroplasty (Table I).