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ORIGINAL ARTICLE

Risk factors for glenoid erosion in patients with shoulder hemiarthroplasty: an analysis of 118 cases

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Background: Glenoid erosion is one of the main concerns in shoulder hemiarthroplasty. The goal of this study was to quantify glenoid erosion and to identify risk factors in patients with humeral hemiarthroplasty.
Methods: There were 118 shoulders in 113 patients available for a standardized retrospective review. Erosion was graded as follows: grade 1, none; grade 2, mild (erosion into subchondral bone); grade 3, moderate (medialization of subchondral bone with hemispheric deformation); or grade 4, severe. The findings were then analyzed for confounding factors using a multivariate analysis.
Results: Mean follow-up was 31 months (range, 5-86 months). Negative predisposing factors for erosion were glenoid cysts (odds ratio, 5.4; $P < .001$, approximately 3 times more frequent in women), fatty infiltration of the rotator cuff musculature (R, 0.43; $P < .001$), and rheumatoid arthritis (odds ratio, 3.6; $P = .049$). A valgus position of the prosthetic head relative to the glenoid (angle >50°) appeared to lead to local destruction of the cartilage. The degree of erosion did not correlate with age and glenoid or humeral head size. Only 1 patient (of 30) with a fracture-type prosthesis developed progressive glenoid erosion.
Conclusion: In this series, favorable conditions for resistance to erosion after hemiarthroplasty were lack of glenoid cysts, intact glenoid cartilage, intact rotator cuff musculature, and a fracture situation. Age, the version of the glenoid, and the size of the prosthetic head showed no importance. The use of hemiarthroplasty seems to be associated with glenoid destruction in female patients with impending osteoarthritis, with rheumatoid arthritis, and if the head is implanted in a valgus position.
Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Shoulder; hemiarthroplasty; glenoid erosion; failure; fracture; osteoarthritis; rheumatoid arthritis

Replacement of the humeral head can lead to good and excellent results in patients with isolated humeral head arthritis or humeral head fractures if the rotator cuff is intact.[4,9,11] However, the potential development of glenoid erosion is an important but in development poorly predictable risk and one of the main triggers for early revision.[1,3,19] The purpose of this study was to analyze the development of glenoid erosion after hemiarthroplasty of the shoulder for joint disease or complex

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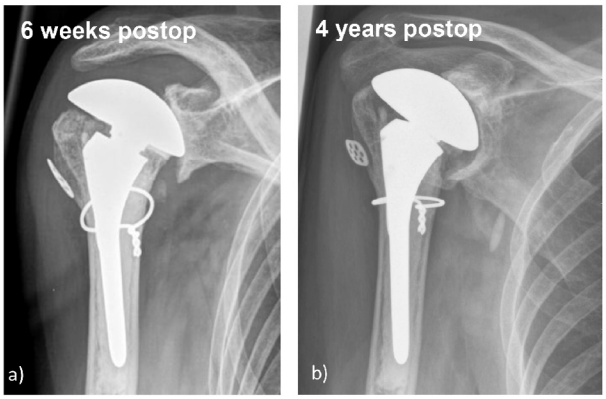

Figure 1 (**A**) Horizontally placed prosthetic head. (**B**) Erosion after 4 years.

humeral head fractures and to investigate possibly predisposing factors for glenoid erosion. Specifically, we hypothesized that an overly horizontal positioning of the prosthetic head may result in a gouging mechanism against the glenoid and therefore promote excessive glenoid erosion (Fig. 1).

Materials and methods

Patients

Between April 2002 and August 2011, 142 hemiarthroplasties were performed at our institution for primary or secondary osteoarthritis or fractures not amenable to operative reduction and internal fixation. Of these, 118 shoulders in 113 patients were available for review, whereas 24 had to be excluded from the study because they met one of the following exclusion criteria: periprosthetic infection, severe Parkinson disease, or follow-up <1 year (except if severe erosion occurred already in the first months postoperatively).

There were 67 shoulders in women and 51 in men. The average age of the patients was 62 years (range, 17-90 years). The average follow-up was 31 months (range, 5-86 months). Only 2 patients with a follow-up <1 year (5 and 10 months, respectively) were included because of severe erosion within that time.

Eleven patients (9.3%) presented with inflammatory arthritis, and 1 patient suffered from chondrocalcinosis.

Operative technique

In all patients, surgery was performed using a deltopectoral approach, with osteotomy of the lesser tuberosity. The Zimmer Anatomical Shoulder System (Zimmer Inc, Warsaw, IN, USA) was used in 88 cases, whereas the Zimmer Anatomical Shoulder Fracture System was used in 30 cases for fracture or fracture-dislocation of the humeral head. Fixation of the tuberosities was performed using high-strength polyethylene sutures. No kind of biologic resurfacing and no reaming were performed in this cohort of patients. Postoperatively, a standard rehabilitation program was followed with passive mobilization for the first 6 weeks in fractures and active assisted mobilization in osteoarthritis. Patients were seen for follow-up after 6 weeks, 3 months, and 1 year and then at yearly intervals. At each visit, a series of standardized radiographs were taken: anteroposterior centered on the glenoid, anteroposterior centered on the humerus in neutral rotation, lateral (Neer view), and axillary view.

Parameters measured

All patients' charts were reviewed for coexisting factors that could potentially have had an impact on glenoid erosion. Hereby inflammatory arthritis (11 patients) and chondrocalcinosis (1 patient) could be identified.

The full radiologic data set of the included patients, including preoperative computed tomography (CT) scans (available in all but 7 cases) and, if available, magnetic resonance imaging (MRI) scans (in 1 patient), was reviewed for the following criteria:

- Glenoid erosion was graded independently by 2 observers (R.H. and K.W.) using the method proposed by Sperling et al.[19] It was labeled as none (grade 1), mild (grade 2; erosion into subchondral bone), moderate (grade 3; medialization of subchondral bone with hemispheric deformation), or severe (grade 4; complete deformation/destruction of the glenoid or hemispheric deformation until/beyond the base of the coracoid). In further analysis, the difference between preoperative and postoperative erosion was calculated. The mean value was used for statistical analysis (eg, if grade 2 and grade 3 erosion was observed, we used grade 2.5 for statistical analysis). Severe erosion was defined as erosion of grade ≥2.5.
- Preoperatively existing cysts in the glenoid were graded as present or not present (CT scans).
- Preoperatively existing osteophytes were graded as present or not present (CT scans).
- The preoperative condition of the rotator cuff musculature was evaluated according to Goutallier[8] (CT scans) or Fuchs[7] (MRI scans).
- The preoperative glenoid size and version as well as degree of version were also recorded from preoperative CT scans.

Patients without preoperative CT scan (7 patients) were excluded from the analysis of these criteria.

The following criteria were evaluated on the first and the last available postoperative radiographs, and differences of the obtained values were calculated:

- Beta angle[15] and critical shoulder angle[17] (Figs. 2 and 3). Theoretically, a change in these angles could be used as an indicator for eccentric erosion of the glenoid.
- Another attempt to quantify glenoid erosion was to draw a vertical tangent to the lateral edge of the acromion and measure the distance from that line to the most medial point of the prosthetic head (Fig. 4). However, these measurements proved to be unreliable and were excluded from further analysis.
- To test the hypothesis that horizontal positioning of the prosthetic head would lead to more severe erosion of the glenoid than vertical positioning, the inclination of the prosthetic head in relation to the humeral shaft axis (Fig. 5) and the inclination of the prosthetic head in relation to the glenoid (Fig. 6) were measured on first and last postoperative radiographs.

The size of the prosthetic head was determined on postoperative radiographs and correlated to degree of glenoid erosion. As well,