



ELSEVIER

ORIGINAL ARTICLE

Long-term humeral complications after Grammont-style reverse shoulder arthroplasty

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Background: Recent experiences with Grammont reverse shoulder arthroplasty (RSA) have revealed some problems related to the biomechanical changes of the shoulder and humeral stem complications. We analyzed humeral complications in a long-term follow-up of a large series of RSAs, searching for correlations between these and the initial etiology, the follow-up duration, and the clinical outcomes.

Materials and methods: Preoperative and postoperative clinical and radiologic assessments of 1035 RSAs with a minimum 5-year follow-up (implanted in 7 specialized shoulder centers between 1993 and 2010) were retrospectively collected. Postoperative humeral complications, managed conservatively or surgically, were radiographically documented.

Results: Overall, a 3.3% rate of postoperative humeral complications was found in our database. We identified 17 cases (1.6%) with postoperative humeral fractures, 15 cases (1.4%) with aseptic humeral loosening, and 3 cases (0.3%) with humeral stem disassembly. The humeral complications were more frequent in RSAs implanted for tumors, fracture sequelae, and revision for failed arthroplasty.

Discussion: Humeral complications after RSA are not rare, increase with longer follow-up, and have a negative impact on functional outcomes. Postoperative humeral fractures are more frequent in elderly patients, operated on through a superior approach, and after cemented stem implantation. In the absence of associated humeral loosening, conservative treatment should be preferred. Proximal humeral bone loss (due to revisions and tumors) is the most significant risk factor for humeral loosening. Implant unscrewing was initially related to a technological problem, which has been solved, and this complication has disappeared.

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

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Keywords: Reverse shoulder arthroplasty; clinical outcomes; complications; humeral stem; fracture; loosening; subsidence; disassembly

The Institutional Review Board of the Ethical Committee of Hôpital Privé Jean Mermoz and Centre Orthopédique Santy read the study project and deemed that it did not infringe on French ethical rules and the privacy of the patients. This committee allowed Francesco Ascione, MD, to perform this study.

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Reverse shoulder arthroplasty (RSA) was originally designed to treat pseudoparalysis with cuff tear arthropathy in elderly patients,^{4,8,24,28} having the dual advantage of tensioning the deltoid muscle to increase its functional strength and decreasing mechanical torque at the glenoid component, thus avoiding glenoid loosening. Because of its success, the indications have expanded to treat massive rotator cuff tears, failed shoulder arthroplasties, acute fractures, fracture sequelae, rheumatoid arthritis, and tumors.^{22,28}

Although RSA is a clinically successful concept, it implies changes in the biomechanics that might increase the potential for complications with longer follow-up. An overall 20% rate of complications has been reported after RSA, though this is related to the initial etiology and the length of follow-up.^{1,2,8,27,29} Initially, surgeons expected to face glenoid complications and loosening with RSA, but clinical experience has shown that bone adaptation, loosening, and complications (bone lysis, implant failures) were more frequent on the humeral side.^{5,16,20,27} However, information regarding humeral stem complications after RSA (from treatment to final outcome) remains limited to a few small case series.

The aim of this study was to analyze the humeral complications that occur after implantation of a Grammont-type RSA in a long-term follow-up of a large series. Our goal was to look for correlations between humeral complications and the initial etiology, the follow-up duration, and the clinical outcomes.

Materials and methods

Between 1993 and 2010, 1035 RSAs were performed in 7 orthopedic centers, specializing in shoulder surgery, with a minimum of 5 years' follow-up. Of the prostheses, 77% were implanted in female patients, with a mean age of 73 years at the time of intervention and involvement of the right shoulder in 67% of cases.

Experienced orthopedic surgeons (who were blinded to the clinical assessment and surgery) reviewed the radiographs. All radiologic analyses were performed at last follow-up, which occurred at a mean of 8.2 years (range, 5-20.5 years).

The inclusion criteria were RSAs with a minimum 5-year follow-up. Preoperative, intraoperative, and postoperative data were collected. Preoperative characteristics of the patients, including age, sex, preoperative diagnosis, and previous operations, were evaluated. Intraoperative data included surgical approach, implant characteristics, ability to repair the subscapularis, and adjunctive bone graft procedures. Postoperative data included time to complications and their treatment. Postoperative humeral complications (fracture, loosening and/or migration, disassembly), managed conservatively or surgically, were radiographically documented.

The deltopectoral approach was used in 80% of shoulders, and the implant was the Aequalis Reverse (Tornier, Montbonnot Saint Martin, France) in 72% of cases and Delta III (DePuy, Warsaw, IN, USA) in 16%, with a Grammont-style 155° inclination angle in all cases. Cemented stems were implanted in 88% of cases, whereas press-fit stems were used in 12%.

All patients underwent preoperative and postoperative range-of-motion assessment at last follow-up; the Constant-Murley score,¹³

with the adjusted Constant score,¹² and the Subjective Shoulder Value were also recorded. Humeral stem loosening was defined as the presence of complete radiolucent lines in more than 3 zones and/or tilting of the stem, according to previous studies.^{21,25} Scapular notching was graded according to the classification of Sirveaux et al²² into 5 stages.

For statistical analysis, we used the Wilcoxon signed rank test for paired data to compare differences between the last follow-up and the preoperative values, the Kruskal-Wallis test or Mann-Whitney test for between-group comparisons, and the Fisher test or χ^2 test to find relationships between variables. Data were collected and analyzed with the collaborative online software EasyMedStat.com (EasyMedStat, Neuilly-Sur-Seine, France).

Results

The overall postoperative complication rate was 18.7% (with the major complications being infection, 4.1%; instability, 3%; neurologic problems, 2.1%; glenoid complications, 2.3%; and scapular fractures, 1.1%) in 1035 shoulders with at least 5-year follow-up. Overall, a 3.3% rate of postoperative humeral complications was found. We identified 17 cases (1.6%) with postoperative humeral fractures, 15 cases (1.4%) with aseptic humeral loosening, and 3 cases (0.3%) with humeral stem disassembly. Humeral complications were more frequent in RSAs implanted for tumors and revision for failed arthroplasty. Complications according to the etiology are detailed in [Table I](#).

Postoperative humeral fractures

Postoperative humeral fractures ([Fig. 1](#)) occurred more commonly in female patients, at a rate of 94% (vs 77% for non-fracture cases, $P = .14$) and, consequently, a result of low-energy trauma. The mean age at operation was the same as that of the full series (75 years), and the dominant side was involved in 65% of cases.

Of the 17 humeral fractures, 14 were reported in cases with cemented stems (82% vs 88%, $P = .45$). The fractures occurred at an average of 55 months after the index operation. The etiology was not found to be a risk factor ([Table I](#)).

Treatment

Of the patients, 5 (29%) received conservative treatment with a brace for 3 months whereas 12 (71%) were treated surgically. Open reduction-internal fixation with a plate and screws was performed in 10 cases, whereas revision surgery with 1-stage exchange of the humeral stem was performed in 2. No significant difference was found regarding the clinical outcomes according to the treatment ([Table II](#)). At last follow-up, all the fractures united, and the mean Constant score was significantly lower in patients who had a humeral fracture than in those who did not (47 vs 58, $P < .001$).

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