Anatomic shoulder replacement for primary osteoarthritis in patients over 80 years

Outcome is as good as in younger patients

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Background and purpose — Anatomic total shoulder arthroplasty (TSA) gives good outcome in the treatment of primary osteoarthritis, but it is not known whether this also applies to patients over 80 years old.

Patients and methods — We retrospectively assessed outcome in patients over the age of 80 after anatomic TSA, performed for primary osteoarthritis with a preoperative intact rotator cuff (group O, n = 32). We compared it with outcome in a group of patients under the age of 70 (group Y, n = 32). Subjective outcome, Constant score, and radiological findings were analyzed.

Results — At a mean follow-up time of 7 years, there were no statistically significant differences between the groups. In group O, 24 patients were very satisfied and in group Y, 23 patients were very satisfied; the subjective shoulder value was 81% in both groups. Mean Constant score was 65 in group O and 67 in group Y. Moderate or severe radiological upper migration of the humeral head was detected in 1 patient in group O and in 3 patients in group Y. One patient in group Y was revised for glenoid loosening.

Interpretation — Good to excellent results can be expected after anatomic TSA in patients over the age of 80. Our findings suggest that they have similar results to those in patients around 70 years of age.

Arthroplasty of the shoulder continues to show increasingly reliable results over time. However, there is a limited amount of literature on outcome of anatomic total shoulder arthroplasty (TSA) in older patients (Mullett et al. 2007, Churchill 2008, Foruria et al. 2010). In particular, to our knowledge there are no published data on patients over 80 years of age, and when TSA is performed with an intact rotator cuff preoperatively.

Tearing of the rotator cuff is a recognized complication after TSA (Chin et al. 2006). Recently, a secondary rotator cuff dysfunction rate of 17% following TSA was reported and significantly poorer clinical outcomes were found in these patients compared to those without rotator cuff dysfunction (Young et al. 2012). In addition, rotator cuff quality has been shown to deteriorate with advancing age (Tempelhof et al. 1999). It would therefore appear reasonable to expect worse long-term outcomes in patients over the age of 80.

We report the results of anatomic TSA in a cohort of patients over 80 years old with an intact rotator cuff preoperatively. In addition, we compared the clinical and radiological results to those in a second group of patients aged 70 years or less.

Patients and methods

Between September 1991 and October 2004, 612 consecutive anatomic TSAs were performed and included in the database for a multicenter study. From this register, a first group of consecutive patients over the age of 80 and operated on because of primary osteoarthritis, was identified (group O). We excluded patients with a compromised rotator cuff, follow-up of less than 3 years, fatty infiltration of the rotator cuff muscles higher than stage 2 following the criteria of Goutallier et al. (1994), a history of ipsilateral shoulder surgery, bone-grafting of the glenoid, or use of a metal-backed glenoid component.

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Table 1. Demographic data. Summarized data are mean and range

	Group O	Group Y
Patients	32	32
Age	83 (80–90)	69 (67–70)
Follow-up, months	78 (36–134)	84 (57–139)
Sex: F/M	29/3	29/3
Dominant side	17	21

For calculation of sample size, the postoperative Constant scores of all patients available in the participating centers were collected, for both age groups. The standard deviation was 18. We assumed that a difference of 15 points in the Constant score would be clinically relevant. For a power of 80% and a p-value of 0.05, a sample size of 22 patients was calculated for each group (Stata/SE 11), in order to be able to analyze data with a t-test. As the test selected was non-parametric (Mann-Whitney test) because of the sample distribution, an increase in the sample size of 15% has been recommended (Lehmann 1994), giving at least 26 patients in each group. 32 patients could be retrieved from our dataset for inclusion in group O.

A control cohort was then selected for the comparative study, consisting of 32 shoulders in 32 patients who were aged 70 years or less (group Y). The groups were matched based on sex, duration of postoperative follow-up, and type of glenoid component implanted (flat vs. convex) (Table 1). The underlying diagnosis was primary osteoarthritis in all cases. The 2 senior authors (GW and PB) performed 51 of the 64 procedures.

Operative technique

A standard deltopectoral approach was used in all cases. The upper 2 cm of the pectoralis major tendon was released and a subscapularis tenotomy was performed. Instrumentation was performed with the Tornier Aequalis (Tornier, Edina, MN) in all procedures. The keeled glenoid and the humeral stem were both cemented. The subscapularis was re-attached with transosseous sutures. Tenodesis of the long head of the biceps to the pectoralis major tendon was performed. External passive rotation was evaluated under anesthesia to determine the appropriate rehabilitation protocol.

Postoperatively, the arm was placed in a simple sling. Rehabilitation was started immediately after surgery, using a self-assisted protocol divided into 3 phases. Postoperative evaluations were at 6 weeks, 3 months, 6 months, and annually.

Subjective outcome

Personal subjective satisfaction ratings were classified as: very satisfied, satisfied, disappointed, and unsatisfied. Furthermore, the patients were asked to rate their shoulder in a range between 0 and 100 as a percentage of a normal shoulder, and this was recorded as the subjective shoulder value (SSV) (Gilbart and Gerber 2007).

Follow-up time

The mean follow-up period in group O was 78 (36–134) months, whereas in group Y it was 84 (57–139) months.

Clinical analysis

All patients were evaluated preoperatively with Constant score, which was subsequently adjusted for age and sex to obtain the adjusted Constant score (Constant et al. 2008). Scores were graded as poor when < 50, fair when 51–65, good when 66–80, and excellent when 81–100 (Lam et al. 2004). The sections for pain and mobility in the Constant score were also analyzed separately as independent variables. In addition, active and passive ranges of motion were measured and recorded for forward elevation in the plane of the scapula and external rotation with the arm at the side. Identical testing was repeated during the postoperative evaluation and the data from the last follow-up were recorded. Postoperative complications and any revision surgery were also registered.

Radiological analysis

Radiographic evaluation consisted of preoperative, immediate postoperative, and latest follow-up images including anteroposterior views (neutral, internal, and external rotation), and axillary view. Assessment of all images involved consensus between 3 experienced shoulder surgeons.

Superior migration of the humeral head was evaluated with the anteroposterior view in neutral rotation (Torchia et al. 1997). Determination of upper migration was considered mild if the center of the prosthetic humeral head translated less than one-quarter of its diameter relative to the center of the glenoid component, moderate if it translated between one-quarter and one-half, and severe with translation of more than half the diameter of the prosthetic humeral head. Subluxation in the posterior direction of the humeral head was assessed in the axillary view and was considered to be a sign of recurrent posterior instability (Walch et al. 1999). The presence of periprosthetic radiolucent lines around the glenoid component was scored according to Molé et al. (1999). Radiolucencies of the humeral component were graded using an 8-zone system (Sperling et al. 2000). If radiolucencies were present at final follow-up, previous films were evaluated for evidence of progression.

The preoperative CT arthrogram or MRI, which was available in all cases, showed an intact rotator cuff. Glenoid morphology was classified according to Walch et al. (1999) and it is summarized in Table 2. A postoperative CT arthrogram was only indicated when there were unsatisfactory clinical results or complaints by the patient at follow-up. Thus, 5 CT arthrograms were performed in group O and 9 in group Y.

The degree of muscle fatty infiltration was classified in 5 stages (0–4) (Goutallier et al. 1994). The incidence of fatty infiltration of all individual rotator cuff muscles was similar between groups preoperatively. Group O had 21 patients with any degree of fatty degeneration in any rotator cuff muscles and group Y had 17.

Table 2. Distribution of patients in both groups depending of glenoid morphology, according to the Walch classification

	Group O	Group Y
A1	6	8
A2	14	9
B1	4	9
B2	7	4
C	1	2

Table 3. Evolution of Constant score (CS), pain score, and mobility score in both groups (expressed as mean and range) and significance of differences

	Group O	Group Y	p-value
Preoperative CS	27 (5 to 87)	34 (17 to 64)	0.06
Preoperative adjusted CS	48 (35 to 57)	42 (25 to 51)	0.2
Postoperative CS	65 (8 to 83)	67 (35 to 85)	1.0
Postoperative adjusted CS [a]	110 (13 to 148)	97 (51 to 131)	0.005
Progression	38 (–22 to 74)	33 (–10 to 67)	0.1
Progression adjusted CS [a]	68 (–34 to 116)	49 (–13 to 97)	0.007
Preoperative pain score	2.8 (0 to 7)	3.7 (0 to 7)	0.2
Postoperative pain score	12.7 (5 to 15)	12.3 (3 to 15)	0.3
Preoperative mobility score	14 (0 to 30)	17 (6 to 36)	0.2
Postoperative mobility score	30 (0 to 40)	32 (0 to 40)	1.0
CS graded as excellent/good/fair/poor, n	4/18/3/7	4/16/7/5	

[a] Statistically significant.

Statistics

Data are expressed as mean and range. The Kolmogorov-Smirnov test was performed to determine whether the distribution of data corresponded to normal distribution. Normally distributed quantitative variables were analyzed with Student's t-test, and those that were not consistent with normal distribution were tested with a non-parametric test (Mann-Whitney). Any p-value < 0.05 was considered significant. Statistical analysis was performed using SPSS version 18.

Ethics

This study was performed at the Centre Orthopédique Santy-Hôpital Privé Jean Mermoz, Lyon, and was approved in September 2013 by the Institutional Review Board and Ethics Committee of the Centre Orthopédique Santy-Hôpital Privé Jean Mermoz (reference study 2013-06).

Results

Subjective outcome

In group O, 24 of the 32 patients were very satisfied, 4 were satisfied, 2 were disappointed, and 2 were dissatisfied. In group Y, 23 of the 32 patients were very satisfied, 8 were satisfied, and 1 was disappointed. The SSV was 81% (20–100) in group O and 81% (40–98) in group Y.

Clinical results

In both groups, an increase in Constant score (CS) was observed between the preoperative and postoperative assessments ($p < 0.001$). After adjustment for age and sex, it remained statistically significant ($p < 0.001$). Results of CS in the older group (O) were good or excellent in 22 of the 32 patients, and in 20 of 32 in the younger group (Y). Mean values for preoperative and postoperative CS and its progression in both groups are given in Table 3. Adjusted CS postoperatively was statistically significantly higher in group O, as was the progression of adjusted CS. Overall, the mean pain and mobility scores improved in both groups ($p < 0.001$), but the end results were similar.

Preoperative range of motion was similar in both groups, except for the preoperative passive anterior elevation, which was higher in group Y ($p = 0.005$). At the last follow-up, neither final range of motion nor progression postoperatively were found to be significantly different for any of the movements assessed (Table 4, see Supplementary data).

Radiological findings postoperatively

The incidence of radiological upper migration of the humeral head (14% in total) was similar in the 2 groups. In group O, 3 patients with upper subluxation were detected (2 mild and 1 moderate), and 6 were observed in group Y (3 mild, 1 moderate, and 2 severe). The Constant score of patients with moderate or severe upper migration was 50 (36–84), which was lower than that obtained for the rest of the patients (67 (8–85); $p = 0.2$). Pain score was significantly better in patients with mild or no upper migration (13 (5–15) points) than in patients with moderate and severe upper migration (8 (3–12) points) ($p < 0.001$). Global mobility score was similar, but a better active anterior elevation was found in patients with mild or no upper migration (150º (30–180)) than in patients with moderate or severe upper migration (108º (80–170) ($p = 0.07$).

A full-thickness rotator cuff tear not present in preoperative images was detected by postoperative CT arthrogram in 1 patient in group O and in 2 patients in group Y. The 2 patients in group Y had an upper migration of the humeral head. In group O, the rotator cuff tear was not related to upper migration.

Posterior subluxation was present in 1 case and anterior subluxation in another, both in group O. Interestingly, the Constant score in these 2 patients was 71 and 77, which was higher than the mean value for the patients without posterior or anterior subluxation (66 points).

The score for radiolucent lines around the glenoid was < 6 (no loosening) in 20 patients in group O and in 21 patients in group Y. The glenoid component was radiographically "at risk" of clinically important loosening (7–12 points) in 4 patients in group O and in 5 patients in group Y. Radiological loosening of the glenoid component (13–18 points) was found in 6 patients in group O and 6 in group Y. None of these differences were statistically significant. Radiolucent lines around the humeral stem were observed in 2 patients in group O and in 3 patients in group Y. The clinical results of these 5 patients were similar.

Complications

One case of glenoid component loosening was clinically relevant in group Y, and this was the only patient requiring revision surgery with glenoid component and humeral head revision (performed 3 years after the index surgery).

Discussion

There have been few reports with results of anatomic TSA in patients over 80 years of age. Foruria et al. (2010) reported outcomes of anatomic TSA for primary osteoarthritis in 50 shoulders over the age of 80, with a mean follow-up of 5.5 years. Four shoulders, however, had a preoperative full-thickness rotator cuff tear. They found a radiological upper migration of the humeral head in 5 shoulders and suggested that the high frequency may have been related to deficiency of the rotator cuff. Mullett et al. (2007) reported outcomes for 29 patients over the age of 80 with a Copeland surface replacement arthroplasty and a mean follow-up of 4.5 years. The diagnosis was rotator cuff arthropathy in 9 of the patients, and 1 of them was the only case requiring revision surgery (to a reverse TSA) because of increasing pain with poor function. Churchill (2008) described outcomes for 7 cases of TSA performed in patients over the age of 90. Again, surgical indications included different diagnoses and the rotator cuff tendons were reported to be compromised in 2 patients. These 2 patients were treated with a hemiarthroplasty for rotator cuff arthropathy. Thus, these 3 studies analyzed heterogeneous groups of patients, including patients with documented rotator cuff tendon tears and with different surgical indications.

We found that excellent results can be expected when anatomic TSA is performed in patients over the age of 80 with a preoperative intact rotator cuff. To our knowledge, this is the first study to compare outcomes of anatomic TSA in 2 distinct age groups, with one of the groups being patients over the age of 80. Due to degeneration of the rotator cuff with age (Tempelhof et al. 1999), we hypothesized that anatomic TSA might be a successful treatment for patients over 80 years of age, but that the results would be inferior to those obtained in a younger cohort. Our hypothesis was not confirmed, as no statistically significant differences were found between the 2 groups. In fact, we found better postoperative adjusted Constant score in the older patient group. The gain in Constant score achieved by this group, when adjusted by age, was also higher. This finding could be attributed to the lower demands on shoulder activity in older patients. Outcomes in younger patients may be worse as a result of the higher functional requirements, as has been reported in the literature after hip and knee replacements (Wainwright et al. 2011).

In patients with upper migration because of cuff insufficiency, the conversion of an anatomic prosthesis to a reverse prosthesis can improve the results (Flury et al. 2011). There is strong evidence for the effectiveness of reverse TSA for rotator cuff tear arthropathy (Frankle et al. 2006). However, indications for other shoulder pathologies such as primary osteoarthritis with an intact rotator cuff are currently not supported. Increasing age is considered by many surgeons to be an indication for the reverse TSA, as age is known to be a risk factor for rotator cuff degeneration (Tempelhof et al. 1999) and secondary upper migration of the humeral head after anatomic TSA (Foruria et al. 2010). In order to avoid the need for a conversion, a reverse prosthesis could be suggested in patients at higher risk, such as the elderly, where the incidence of cuff tears is higher. Even so, our findings suggest that age itself should not be considered a reason to implant a reverse instead of an anatomic TSA. Finally, although it has been suggested that recovery from reverse TSA may be faster than from an anatomic arthroplasty, this idea is not supported by current studies (Levy et al. 2014).

One strength of our study was the homogeneity of the groups, as only patients with an intact preoperative rotator cuff were included and all of them had the same indication for surgery—primary osteoarthritis. Furthermore, considering the limited cohort of patients over 80 years of age undergoing shoulder replacement, our sample size can be considered to be high.

Limitations of the present study include the retrospective design and therefore the inherent risk of selection bias, although the patients were collected consecutively and they were selectively matched. In addition, the operations were performed in different centers by several surgeons, although the majority of them were actually performed by 2 experienced shoulder surgeons.

In summary, good to excellent results can be expected after anatomic TSA in patients over the age of 80 with an intact preoperative rotator cuff.

Supplementary data

Table 4 is available at Acta's website (www.actaorthop.org), identification number 7797.

II: design of the study, data collection and database creation, statistical analysis, and writing of the article. CC: design of the study, bibliographical research, and writing of the article. MTF: writing of the article. PR: supervision of the article during writing. PB and GW: surgeons for patients included in the study, and supervision of the article during writing.

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