

Total versus hemiarthroplasty for glenohumeral arthritis according to preoperative glenoid erosion

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Abstract

Clinical studies on primary osteoarthritis have shown better results of total shoulder arthroplasty (TSA) compared to hemiarthroplasty (HA) regarding the function, revision rate and postoperative pain relief. However, a clear recommendation for implantation of TSA or HA, depending on the glenoid type of erosion, does not exist. The aim of the study was to compare the results of TSA and HA with respect to the preoperative glenoid type. In this study, 41 patients were examined retrospectively; among them, 25 patients were treated with stemmed anatomic TSA and 16 with stemmed anatomic HA. The degree of osteoarthritis was determined according to Samilson and the glenoid erosion was classified according to Walch. The clinical outcome of the patients was determined by using the Constant Score (CS) and the Simple Shoulder Test at final follow-up. Patients after TSA demonstrated a significantly improved internal rotation compared to HA patients. Patients with preoperative B1 glenoid showed better pain relief after TSA compared to HA. For patients with preoperative type A2 glenoid a significantly higher CS was found after TSA compared to HA. We were able to show good short-term results after TSA and HA. Our findings suggest a better internal rotation for TSA compared to HA, superior clinical outcome for patients with preoperative A2 glenoid and lower pain level for patients with a preoperative B1 glenoid. However, these results need to be confirmed by further studies.

Introduction

Hemiarthroplasty (HA) was introduced by Neer in the early 1950s. Since then, many changes and innovations have evolved in shoulder arthroplasty.¹⁻⁵ Because of persistent pain after HA in some patients, Neer performed glenoid resurfacing with satisfactory results.¹ The indication for implantation an anatomical shoulder arthroplasty for primary

osteoarthritis is given, if conservative treatment fails and painful restriction of motion and radiological signs of osteoarthritis of the shoulder joint are present.²

A controversy exists regarding the indication for glenoid replacement in shoulder arthroplasty for osteoarthritis. The indications for glenoid resurfacing remain unclear with contributing factors such as bone quality, estimated risk of loosening and quality of surgical exposure.³ Accepted contraindications for implantation of a glenoid component are for example inadequate bone stock, intact glenoid cartilage and irreparable massive rotator cuff tears.^{2,3} However, several studies have demonstrated superiority of TSA compared to HA regarding postoperative shoulder function and pain relief.^{3,4} Edwards *et al.* showed that TSA had better score results for pain, activity and mobility compared to HA.³ In contrast, other groups have shown that HA provided good results regarding pain relief and improved functional activity in the majority of the patients.¹ Lo *et al.* found no significant outcome difference between TSA and HA after a follow-up period of 2 years.⁵ On the one hand glenoid erosion after HA can result in persistent pain of the operated shoulder.^{3,4} On the other hand radiolucencies develop in 40-60% around the glenoid component after TSA and can precede glenoid loosening.^{6,7} Since specific guidelines for the indication of glenoid replacement are desirable, the aim of our study was to determine the influence of the preoperative glenoid type according to Walch on the outcome after TSA and HA.

Materials and Methods

The study protocol was reviewed and approved by the institutional ethical committee of the Medical School Hannover and all enrolled patients provided informed consent for the follow-up examinations. We conducted a retrospective study of patients who had undergone anatomic TSA (Global AP stem and Anchor peg glenoid, Depuy Synthes, Warsaw, USA) and HA (Global advantage stem, Depuy Synthes) at our institution. Between 2004 and 2010, 16 consecutive HA and 25 TSA were performed for primary osteoarthritis. No patients were lost to follow up by the time of the review, 21 were female and 20 were male. In the total population the mean follow-up was 25.4 months (12 to 61 months). In the TSA group, the mean follow up was 22.4 months (12 to 57 months) and 30.1 months (12 to 61 months) in the HA group. The mean age in the entire population was 70.7 years (range 56 to 83 years). In the TSA group the mean age was 68.4 years (56 to 78 years), in the HA group 74.4 years (63 to 83 years). The average body

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mass index of the TSA group was 29.88 kg/m² (± 3.75) and of the HP 29.16 kg/m² (± 3.19). The severity of the co-morbidities of the patients was measured using the classification of American Society of Anesthesiologists (ASA). The group of patients with an implantation of a TSA had an average ASA value of 2.12 (± 0.33) and the HA group had an average ASA value of 2.19 (± 0.4). All patients were evaluated postoperatively using the Constant score adjusted for age and gender. Range of motion was measured using a goniometer, while strength was measured with the Iso Force Control unit (MDS AG, Oberburg, Switzerland). The Simple Shoulder Test (SST) was also performed. Routine anteroposterior and axillary radiographs were made preoperatively, at the first postoperative visit and at the last follow up examination. The evaluation of the radiographs was performed by two independent observers. The degree of osteoarthritis was determined according to Samilson and Prieto,⁸ preoperative glenoid wear patterns were classified on the basis of the criteria described by Walch *et al.*⁹

The indication for anatomic shoulder arthroplasty included pain and decreased function for primary osteoarthritis after failed conservative treatment. Patients with posttrau-

matic arthritis, cuff tear arthropathy, rheumatoid arthritis and avascular necrosis were excluded. In this consecutive series different surgeons performed the operations. The decision either to implant a TSA or HA was made individually by the operating surgeon based on personal preference and experience.

Surgical procedure

The procedures were performed in the beach-chair position with general anesthesia in combination with an interscalene catheter. A deltopectoral approach 4-5 inch in length was used. The subscapularis was incised vertically close to the lesser tuberosity and the tendon of the long head of the biceps was tenodesed in the bicipital groove with sutures. An anterior and inferior humeral sided capsular release was performed in order to deliver the humeral head out of the wound. The osteophytes were removed and the head was resected with an oscillation saw in anatomic retroversion and 135° of inclination. In case of HA the glenoid surface was only inspected and the labrum was left intact. Then the humeral canal was reamed and broached until cortical contact was achieved. In the case of TSA the labrum was resected and the size of the glenoid surface was measured. After placement of a guide pin the surface was reamed carefully in order to preserve the cortex and afterwards the four fixation peg holes were drilled. After cleaning and rinsing the pegged polyethylene glenoid component was implanted with bone cement (Anchor peg glenoid, Depuy Synthes). After hardening of the cement the humeral trial stem was inserted and the suitable trial head was chosen. After joint reduction the soft tissue tension and range of motion were tested and the trial components were removed. The final implants were assembled and the stem was inserted in a cementless technique. In the case of HA the Global advantage stem (DePuy Synthes) was used, in the case of TSA the Global AP stem (DePuy Synthes) was utilized. The manufactured geometry of the humeral heads was identical for both implant systems. After joint reduction the subscapularis was reattached to the lesser tuberosity with transosseous non-absorbable sutures and the wound was closed in a standard technique.

After the operation the patients underwent a standard rehabilitation program. The arm was placed in a splint in 15° of abduction for 4 weeks. Active assisted exercises with limitation of abduction and forward flexion to 90° were allowed and the subscapularis was protected during the first six weeks after surgery. This involved restriction of active internal rotation and limitation of external rotation within 20° of the maximal external rotation obtained during the operative procedure after subscapularis tendon repair. Strengthening exercises of the rotator cuff, deltoid and scapu-

lar muscles were commenced six weeks after surgery. This program was progressed as tolerated during the following three to six months.

Statistical methods

The statistical analysis was performed using the program SPSS 14.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The significance level for the first error type was set at 5% ($\alpha=0.05$). Univariate group comparisons were performed by the nonparametric analogue of the t-test, the Mann-Whitney test of independence. The descriptive analyzes include the representation of the arithmetic mean values and the standard deviation.

Results

The comparison of the two studied groups showed that the patients after HA were significantly older than after TSA (HA 74.4±4.79 years, TSA 68.2±5.64 years, $P=0.001$). Further, there were no significant differences of BMI and ASA classification comparing the TSA group to HA group.

Preoperative radiographic assessment

According to the Samilson and Prieto classification in the TSA group 2 patients (8.3%) were graded as moderate cases (S2, osteo-

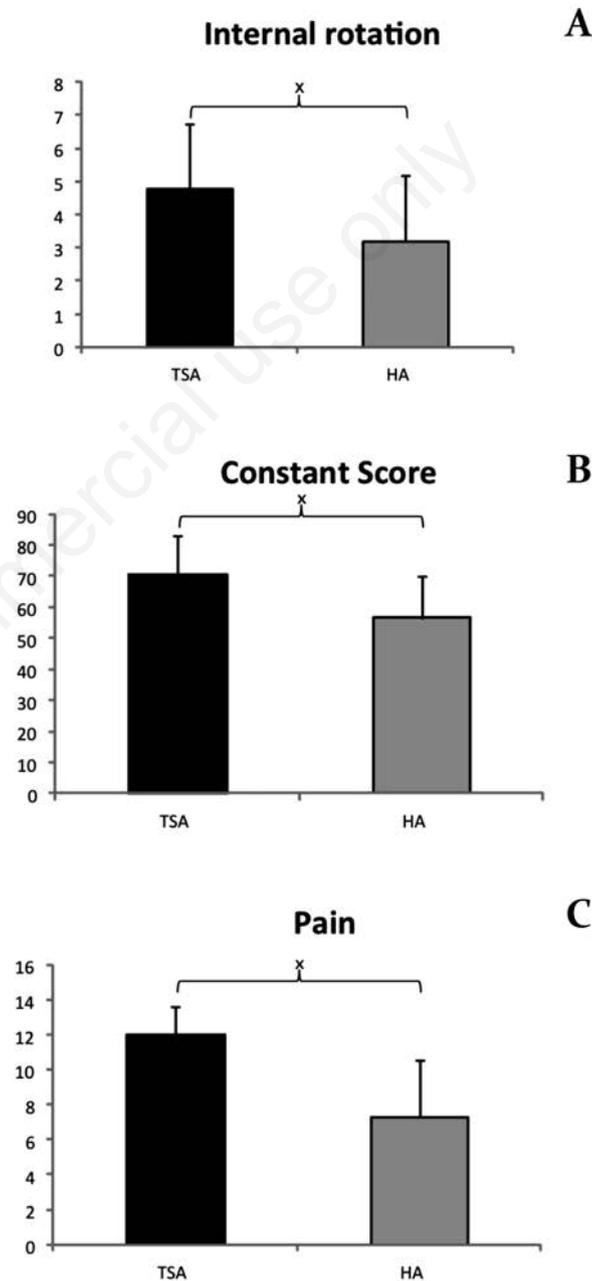


Figure 1. Comparisons between TSA and HA: A) Internal rotation; B) Constant Score of preoperative glenoid type A2 patients; C) Pain score of preoperative glenoid type B1 patients.

phyte 3-7 mm) and 22 patients (91.7%) as severe cases of osteoarthritis (S3, osteophyte >7 mm). In the HA group 1 patient (6.3%) was graded as a mild case (S1, osteophyte <3 mm) and 15 patients (93.7%) as severe cases of osteoarthritis (S3, osteophyte >7 mm).

According to the Walch classification in the TSA group 4 shoulders (16%) demonstrated a concentric glenohumeral relationship type A1 with mild erosion and 8 cases (32%) were type A2 with severe erosion of the glenoid. In 7 cases (28%) the glenohumeral relationship demonstrated a posterior subluxation of the humeral head type B1 with mild posterior erosion and 4 (16%) were type B2 with advanced biconcave posterior erosion of the glenoid surface. A type C glenoid according to Walch was detected in one case (4%).

According to the Walch classification in the HA group 4 shoulders (25%) demonstrated a concentric glenohumeral relationship type A1 with mild erosion and 9 cases (56.2%) were type A2 with severe erosion of the glenoid. In 3 cases (18.8%) the glenohumeral relationship demonstrated a posterior subluxation of the humeral head type B1 with mild posterior erosion, type B2 and type C glenoids according to Walch were not detected.

Functional outcome

The average age and gender adjusted Constant score was 85% for the TSA group compared to 81% for the shoulder HA patients, but the difference was not significant. The analysis of the subgroups of the CS demonstrated significantly better internal rotation ($P=0.03$) after TSA (4.8 ± 1.9 points) than after HA (3.2 ± 2.0 points) (Figure 1A).

Regarding the stage of osteoarthritis according to Samilson and Prieto, no significant differences were observed in the func-

tional outcome. The results according to the Walch classification of the glenoid morphology are shown in Table 1. The average Constant scores of patients with type A2 glenoid were significantly lower after HA (56.3 ± 13.6 points) than after TSA (70.1 ± 12.7 points, $P=0.046$, Figure 1B). The patients with preoperative type B1 glenoid demonstrated significantly better pain relief after TSA than after HA in the related subgroup of the CS (TSA 12.1 ± 1.6 points, HA 7.3 ± 3.2 points, $P=0.033$, Figure 1C). For other glenoid types, the average age and gender adjusted Constant score values and results of the subcategories showed no statistically significant differences after TSA and HA.

Complications and reoperations

Intraoperatively no complications were observed. After TSA one patient underwent arthroscopic capsular release and resection of the lateral clavicle for postoperative stiffness and symptomatic osteoarthritis of acromioclavicular joint 14 months after the implantation. Two patients (19 and 24 months after implantation) developed glenoid erosion and stiffness after HA and required conversion to TSA with secondary implantation of a glenoid component. No infections occurred in our series and no revisions were performed for symptomatic aseptic loosening of the implants.

Postoperative radiographic results

The immediate postoperative radiographs of 3 patients (7.3%) showed radiolucent lines around the humeral stem. At the time of the final follow up radiolucent lines around the stem were detected in 56.1% of the all cases. It was divided in 12 patients (75%) of the HA group and 11 patients (52.4%) of the TSA group. Glenoid sided radiolucencies were

found in 7 cases (17.1%) at the final follow up. Despite of the high incidence of radiolucent lines, no clinical symptoms of loosening were observed.

Discussion

This study generally demonstrates good clinical outcome after anatomic stemmed TSA and HA. These results confirm previous reports after stemmed HA for primary osteoarthritis.^{1,10-15} Our general CS differences after TSA and HA were not significant, but in the subcategory internal rotation the TSA results were statistically superior compared to HA. This finding is confirmed by the multicenter study of Edwards *et al.*,³ who investigated 601 patients after TSA and 89 patients after HA and showed superior mobility and activity after TSA. In a prospective randomized study Gartsman *et al.*¹ compared 27 TSA with 24 HA for glenohumeral arthritis and demonstrated better internal rotation and pain relief after TSA. In contrast, Sperling *et al.*¹⁶ examined 79 HA and 36 TSA and could not show a significant difference for internal rotation. In concordance Haines *et al.*⁴ compared 42 HA and 82 TSA and did not find a difference in range of motion.

However, the analysis of our data related to the preoperative glenoid type according to Walch showed superior CS results for patients with type A2 glenoids after TSA compared to HA. For type A1 and B1 glenoids the CS differences were not significant and for type B2 and C glenoids a comparison was not possible, because these types were not represented in the HA group. However, in our study the CS results in the subgroup pain were superior after TSA compared to HA for preoperative type

Table 1. Results of the constant score according to the glenoid type (Walch classification).

Glenoid type, arthroplasty	Constant score	Pain	Activity	Anteversion	Abduction	External rotation	Internal rotation	Power
A1								
TSA	57.1	11.8	15.8	6.5	5.0	8.5	3.5	6.1
HA	65.2	12.5	19.3	8.0	6.7	9.3	4.0	5.3
A2								
TSA	70.1	13.4	18.1	9.0	7.8	9.3	4.9	7.9
HA	56.3	11.8	14.4	7.6	5.8	8.2	2.7	5.8
B1								
TSA	66.4	12.1	17.8	8.0	6.3	9.4	5.1	7.4
HA	52.8	7.3	12.3	7.3	6.0	8.0	4.0	7.8
B2								
TSA	58.4	12.0	14.8	6.5	6.5	7.0	5.0	6.6
HA	0	0	0	0	0	0	0	0
C								
TSA	59.5	12.5	12.0	6.0	4.0	10.0	6.0	9.0
HA	0	0	0	0	0	0	0	0

TSA, total shoulder arthroplasty; HA, hemiarthroplasty.

B1 glenoids. This finding has been shown in many previous studies, that did not differentiate the patients according to their glenoid type.^{1,3,6,10,17,18}

Haines *et al.*⁴ classified the preoperative glenoid type according to Walch, but did not investigate the correlation to the functional outcome.

Favard *et al.*¹⁹ conducted a multicenter-study including 399 shoulders after HA with a minimum follow-up of five years and 49 patients were treated for primary osteoarthritis. Their results showed that patients with preoperative glenoid type A1 and B1 had significantly inferior postoperative CS results compared to patients with a glenoid type A2 or B2. Favard *et al.* concluded that HA particularly should be offered to younger, cuff intact osteoarthritis patients with type B2 glenoids, which are difficult to manage with TSA. This finding could not be confirmed by our study, since type B2 glenoids were not present in the group treated with HA. But the BMI and the co-morbidities did not seem to affect the functional outcome, because no significant differences were observed between the TSA and HA group.

Levine *et al.* correlated their functional results after HA with the degree of glenoid wear and found good outcome in 15 patients with concentric compared to 16 patients with non concentric glenoid configuration.¹¹ Our results could not support the hypothesis, because we found no significant difference between A and B glenoids in patients with TSA or HA. Furthermore, patients with A2 glenoids had a significant better function of the shoulder after TSA in our series.

Regarding the radiolucent lines at the stem and the glenoid our findings were comparable to other studies in the literature and showed no impact on the functional outcome.^{6,7,20-24}

Our study has limitations. Since a consecutive series of patients was investigated, the patient groups were not randomized for HA and TSA and the choice of treatment was determined by the operating surgeon. We had no control group after nonoperative treatment, and the duration of follow-up was limited. Despite that 41 patients were examined, the subgroups investigated according to the Walch and the Samilson and Prieto classification were small. Larger prospective randomized studies are needed to investigate the influence of glenoid wear on the clinical outcome after HA and TSA. Although the significant age difference between the groups was balanced by the adaption of the CS to age and gender, the analysis of the CS subgroups could be biased since the results were not modified accordingly and age possibly could have been a significant factor for the range of internal rotation.

Conclusions

In conclusion, we were able to show good short-term results after HA and TSA. For the treatment of osteoarthritis TSA provided superior internal rotation compared to HA. For patients with pre-operative type A2 glenoid superior general clinical outcome and for patients with preoperative type B 1 glenoid less pain was observed after TSA compared to HA.

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