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ORIGINAL ARTICLE

Comparative study of total shoulder arthroplasty versus total shoulder surface replacement for glenohumeral osteoarthritis with minimum 2-year follow-up

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Background: Compared with total shoulder arthroplasty (TSA), total shoulder surface replacement (TSSR) may offer the advantage of preservation of bone stock and shorter surgical time, possibly at the expense of glenoid component positioning and increasing lateral glenohumeral offset. We hypothesized that in patients treated for osteoarthritis with a sufficient rotator cuff, TSA and TSSR patients have comparable functional outcome, glenoid component version, and lateral glenohumeral offset.
Methods: We conducted a retrospective cohort study with a minimum of 2 years of follow-up. Patients in the TSA and TSSR groups received a cemented, curved, keeled, all-poly glenoid component. A cemented anatomical humeral stem was used in TSA. TSSR involved a humeral surface replacement (all components from Tornier Inc., St Ismier, France). Patients were assessed for functional outcome. Radiographs were assessed for radiolucent lines. Glenoid component position and lateral glenohumeral offset were assessed using computed tomography images.
Results: After 29 and 34 months of mean follow-up, respectively, TSA (n = 29) and TSSR (n = 20) groups showed similar median adjusted Constant Scores (84% vs. 88%), Oxford Shoulder Scores (44 vs. 44), Disabilities of the Arm, Shoulder and Hand scores (22 vs. 15), and Dutch Simple Shoulder Test scores (10 vs. 11). Glenoid components showed similar radiolucent line counts (median, 0 vs. 0), similar anteversion angles (mean, 0° vs. 2°), and similar preoperative to postoperative increases in lateral glenohumeral offset (mean, 4 vs. 5 mm). One intraoperative glenoid fracture occurred in the TSSR group.
Conclusion: Short-term functional and radiographic outcomes were comparable for TSA and TSSR.
Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: total shoulder surface replacement; total shoulder arthroplasty; functional outcome; glenoid loosening; lateral glenohumeral offset; complications

Glenohumeral osteoarthritis has traditionally been treated by stemmed hemiarthroplasty.[37] Humeral surface replacement was developed as a less invasive alternative. Proponents of this implant additionally underline that humeral head

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version, inclination, and offset can be restored without the need for complicated instrumentation.[9,19,21] In recent years, total shoulder arthroplasty (TSA) has become the standard of treatment of glenohumeral osteoarthritis because of lower reoperation rates and better functional outcome when compared with hemiarthroplasty.[3,11,34]

However, humeral and glenoid component revisions can prove challenging in patients previously treated with TSA. This, combined with possible suboptimal functional outcomes in hemiarthroplasty with humeral surface replacement,[5] has incited the use of a humeral surface replacement with a standard glenoid component: the total shoulder surface replacement (TSSR).[20] Although humeral revision is easier in TSSR, primary glenoid component placement is relatively demanding, and it has been stated that this may result in glenoid component failure, glenohumeral overstuffing, and decreased function.[1] However, the latter has not been investigated, and whether functional and radiologic outcomes differ between TSA and TSSR is currently unknown.

A recent matched pair-analysis of 22 patients found slightly inferior functional outcomes in humeral surface replacement patients compared with TSA at 1 year postoperatively.[5] Yet follow-up may have been too short, and no glenoid component was used in the surface replacement group.

We conducted a retrospective comparative study between TSA and TSSR patients, using the same glenoid component in both groups, assessing patient function, component positioning, and complications with a minimum follow-up of 2 years. We hypothesized that TSA and TSSR patients have comparable functional outcome, a comparable position of the glenoid component, and comparable signs of glenohumeral overstuffing as measured by lateral glenohumeral offset.

Materials and methods

Study design

This retrospective cohort study included patients who underwent TSA or TSSR from 2006 to 2011 in a single regional teaching hospital with a minimum follow-up of 2 years. We included only patients with glenohumeral osteoarthritis, an intact rotator cuff, and an intact glenoid (Walch types A1, A2, and B1).[36] We confirmed preoperative cuff integrity using a combination of preoperative outpatient clinical examination (W.J.W. and D.F.P.D.) for all patients and ultrasonography (n = 3), computed tomography (CT; n = 37), or magnetic resonance imaging (MRI) scans (n = 10). We defined an intact cuff as absence of a full-thickness tear on imaging and absence of a full-thickness tear during intraoperative inspection. We excluded patients with type B2 and C glenoids because bone grafting, augmented glenoid components, or reversed total shoulder replacement may be indicated for these patients.[29] Humeral head bone loss exceeding 40% was considered a contraindication for TSSR.[16] In our patient population, there were no specific criteria to use either TSSR or TSA other than those we have detailed. From 2006 to 2008, patients underwent TSA, whereas from 2009 to 2012, patients underwent TSSR.

Total shoulder arthroplasty

For the purpose of implanting a TSA, the Aequalis prosthesis (Tornier Inc., St. Ismier, France) was implanted by 1 surgeon (W.J.W.) using the deltopectoral approach with a lesser tuberosity osteotomy. Biceps tenodesis was performed in all patients. The humeral head osteotomy was performed according to the anatomical landmarks. After this, the humeral shaft was prepared, a trial humeral component was left in place, and the glenoid was prepared. In cases of posterior erosion or increased retroversion, the surgeon performed asymmetric anterior reaming to reorient the articular surface perpendicular to the axis of the scapula. A cemented, all-polyethylene curved and keeled glenoid component was used with glenoid bone impaction before implantation. Lastly, the definitive humeral component was introduced and cemented into the humeral shaft, and the lesser tuberosity was reattached using transosseous nonabsorbable sutures.

Total shoulder surface replacement

TSSR was performed by 2 surgeons (W.J.W. and D.F.P.D.) using the deltopectoral approach with a lesser tuberosity osteotomy. Biceps tenodesis was performed in all patients. For the humeral side, the Tornier cementless humeral head surface replacement was used. The direction of the anatomical neck was determined. Through a hemispherical instrument, which was used to determine the head version and size, a central pin was placed in the center of the humeral head. After this, the humeral head was reamed until all remaining cartilage was removed and a trial surface replacement could be positioned to assess adequate replacement of the humeral head.[9] Glenoid preparation and implant was identical to that used in the TSA patients. Extensive releases of the posterior and inferior capsule had to be performed to gain exposure of the glenoid.

Rehabilitation

Rehabilitation was standardized and similar for TSA and TSSR. During the first 6 postoperative weeks, range of motion was restricted to 90° of passive forward elevation and abduction and 30° of passive external rotation. Active exercises were commenced thereafter.

Outcome assessment

Functional outcome measures assessed 2 years postoperatively included age- and gender-adjusted Constant scores (minimal clinically important difference [MCID], 12 points),[8,17] Dutch Simple Shoulder Test (DSST; MCID, 2.3 points) scores,[35] Disabilities of the Arm, Shoulder and Hand (DASH; MCID, 13 points) scores, and the Oxford Shoulder Score (OSS; MCID, 11 points).[30,33] We recorded the preoperative Constant score in all patients.

Two observers (B.W.K. and D.P.F.D.) assessed glenoid component loosening using anteroposterior (AP) and axial radiographs 2 years postoperatively by using the radiolucent lines (RLL) score (Fig. 1), as proposed by Molé et al.[23] Three observers (B.W.K., M.P.J.B., and D.F.P.D.) measured glenoid component version on postoperative CT scans using 2-dimensional multiplanar reconstructions,