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Original article

Results and limitations of humeral head resurfacing: 105 cases at a mean follow-up of 5 years

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ABSTRACT

Background: The objective of this study was to assess clinical and computed-tomography (CT) outcomes at least 2 years after humeral head resurfacing to treat concentric gleno-humeral osteoarthritis.
Hypothesis: Humeral head resurfacing provides similar outcomes to those achieved with stemmed humeral head implants.
Materials and methods: This single-centre retrospective study included 40 Copeland™ and 65 Aequalis™ humeral resurfacing heads implanted between 2004 and 2012. Mean patient age at diagnosis was 64 years. The diagnoses were osteoarthritis with an intact (68%) or torn (21%) rotator cuff, avascular necrosis (5%), osteoarthritis complicating chronic instability (3%), post-traumatic osteoarthritis (2%), and chronic inflammatory joint disease (1%). Validated clinical scores, radiographs, and CT before surgery and at last follow-up were compared.
Results: During the mean follow-up of 56 months, complications occurred in 24 implants. Revision surgery with reverse shoulder replacement was required in 18 cases, after a mean of 43.6 months, to treat glenoid wear or a rotator cuff tear. At last follow-up, for the implants that did not require revision surgery, the mean Constant score was 64/100. The implants had a mean varus of 5° and mean retroversion of −13.3°. The mean increase in glenoid cavity depth was 2.4 mm. Mean increases in medial and lateral humeral offset were 1.9 mm and 2.7 mm, respectively. Pre-operative factors significantly associated with failure were rotator cuff tear ($P = 0.017$) and glenoid erosion ($P = 0.001$).
Discussion: We found a high failure rate related to glenoid wear or progressive rotator-cuff impairment, although CT showed no evidence of implant malposition or overstuffing. Previous studies of stemmed humeral head implants showed better outcomes. Given the low medium-term prosthesis survival rate, we now reserve humeral head resurfacing for concentric osteoarthritis without glenoid erosions or rotator cuff damage.
Level of evidence: IV, retrospective study.

1. Introduction

Concentric osteoarthritis is classically managed by total shoulder arthroplasty or humeral head replacement. The risk of glenoid component loosening [1,2] and technical difficulties raised by removing a stemmed humeral implant have led us to prefer humeral head resurfacing, a method developed by S Copeland in the 1980s [3,4]. Advantages of humeral head resurfacing include replication of native geometry, preservation of bone stock, and greater ease of revision surgery [5].

The objective of this study was to evaluate the clinical and radiological outcomes of humeral head resurfacing. In addition, factors predicting failure were sought. The working hypothesis was that humeral head resurfacing implants produced similar outcomes to cemented or uncemented stemmed humeral head implants.

2. Materials and methods

2.1. Patients

A single-centre multi-surgeon retrospective study was conducted in 100 patients who underwent humeral head resurfacing to treat concentric gleno-humeral osteoarthritis between 2004 and 2012. There were 70 females and 30 males with a mean age of 64

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Table 1
Distribution of the diagnoses.

	Number	Samilson and Prieto classification [11]	Arlet and Ficat classification [12]
Gleno-humeral osteoarthritis with an intact rotator cuff	71	15 grade 2 26 grade3 30 grade4	
Gleno-humeral osteoarthritis with a torn rotator cuff	22	3 grade2 6 grade3 13 grade4	
Avascular necrosis	6		6 grade 3
Gleno-humeral osteoarthritis due to shoulder instability	3	2 grade3 1 grade4	
Post-traumatic glenohumeral osteoarthritis	2	1 grade3 1 grade4	
Inflammatory joint disease	1		
Total	105		

years (range, 39–83 years) at surgery. The procedure was bilateral in 5 patients; of the 105 implants, 57 were on the right and 48 on the left. Table 1 reports the diagnoses.

Exclusion criteria were follow-up less than 2 years after humeral head resurfacing, eccentric gleno-humeral osteoarthritis, glenoid resurfacing, absence of CT at last follow-up, and last evaluation performed over the telephone instead of during a physician visit.

A pre-operative CT scan was available for 96 (90.5%) of the 105 shoulders. Magnetic resonance imaging (MRI) was performed to assess avascular necrosis in 6 patients and unenhanced CT combined with ultrasonography in 3 patients who were allergic to iodinated contrast agents.

The rotator cuff was torn in 25 (23.8%) shoulders, including 3 with avascular necrosis. The tear involved a single tendon was torn in 19 cases and two or more tendons in 6 cases (Table 2). The amount of tendon retraction was classified according to Patte [6].

The mean index of fatty degeneration according to Goutallier [7] was 0.47/4 (range, 0–2.6).

The humeral head resurfacing procedures were performed by 11 senior surgeons, according to the technique described by Deladerrière et al. [8]. The implant was a Copeland Mark III™ (Biomet Merck, Swindon, UK) in 40 cases and an Aequalis Resurfacing Head™ (Tornier, Edina, MN, USA) in 65 cases. Central peg length and implant thickness and diameter varied with implant size.

2.2. Assessment methods

The pre-operative assessment included determination of Constant's score [9]. In addition, two radiographs were obtained, an antero-posterior view in neural rotation and a scapular Y view. The following radiographic parameters were measured (Fig. 1): coronal neck inclination, acromio-humeral interval, and glenoid wear according to Rispoli's criteria [10]. Severity was graded according to Samilson and Prieto for osteoarthritis [11] and to Arlet and Ficat for avascular necrosis [12] (Table 1). Pre-operative CT images were used to determine the following: medial humeral offset (MHO) (Fig. 2), lateral gleno-humeral offset (LGHO) (Fig. 3), humeral head size (Fig. 4), antero-posterior humeral head centring according to Badet [13] (Fig. 5), and glenoid cavity depth (Fig. 6). The reproducibility of these CT parameters has been reported previously by Deladerrière et al. [8] ($R > 0.9$ according to the Fleiss method).

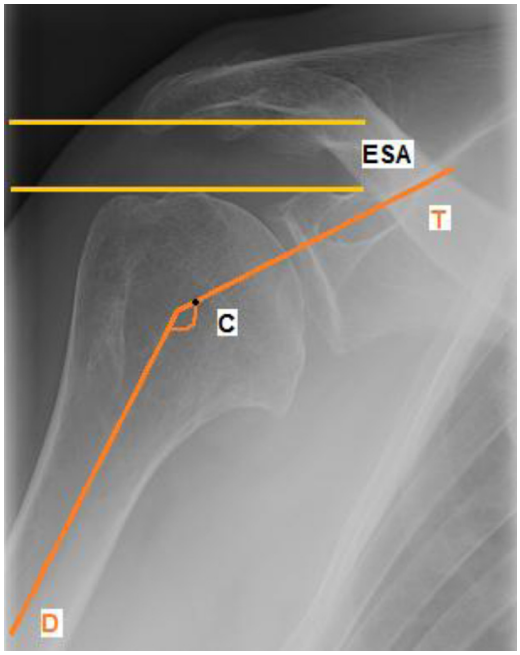

Fig. 1. Coronal inclination is defined as the angle formed by the axis of the humeral diaphysis (D) and the axis of the humeral head (T) through the centre of the head (C). The acromio-humeral interval (AHI) is the distance between the apex of the humeral head and the underside of the acromion.

Patients were re-evaluated by an independent observer, who determined Constant's score, the Simple Shoulder Test (SST) score [14], and the DASH score [15]. Patients were asked whether they were very satisfied, satisfied, or dissatisfied with the procedure. In all the included patients, the radiographic and CT evaluation performed pre-operatively was repeated at last follow-up. The images were examined for a radiolucent line around the implant or secondary implant displacement. Cup version (Fig. 7) was assessed only at last follow-up.

In patients who required revision surgery, a comprehensive clinical and radiographic evaluation was conducted before the repeat procedure. This allowed us to include their outcomes at the time of revision surgery into the study analysis.

2.3. Statistical analysis

Quantitative variables were analysed by applying Student's t test for paired data and the chi-square test when sample size was greater than 30. Fisher's test was used for qualitative variables. Continuous variables were compared using Wilcoxon's test. Between-group comparisons were with the Mann–Whitney test. Values of $P < 0.05$ were considered statistically significant.

Implant survival was assessed using the Kaplan–Meier method, with revision by reverse shoulder arthroplasty as the endpoint.

Table 2
Pre-operative rotator cuff tears.

	Supra-spinatus (SS) only	Infra-spinatus (IS) only	Sub-scapularis (SbS) only	SE + IS	SE + SS
Partial thickness	8	0	1	0	2
Full-thickness without retraction, type 1 according to Patte [6]	8	1	0	3	0
Full-thickness with retraction, type 2 according to Patte [6]	1	0	0	1	0

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