Copeland surface replacement of the shoulder

RESULTS OF AN HYDROXYAPATITE-COATED CEMENTLESS IMPLANT IN PATIENTS OVER 80 YEARS OF AGE

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We describe the results of Copeland surface replacement shoulder arthroplasty using the mark III prosthesis in patients over 80 years of age. End-stage arthritis of the shoulder is a source of significant pain and debilitating functional loss in the elderly. An arthroplasty offers good relief of pain and may allow the patient to maintain independence. The risk-benefit ratio of shoulder replacement may be felt to be too high in an elderly age group, but there is no published evidence to support this theory. We have assessed whether the procedure was as reliable and safe as previously seen in a younger cohort of patients.

Between 1993 and 2003, 213 Copeland surface replacement arthroplasty procedures were performed in our unit, of which 29 (13.6%) were undertaken in patients over the age of 80. This group of patients was followed up for a mean of 4.5 years (2.1 to 9.3). Their mean age was 84.3 years (81 to 93), the mean operating time was 40 minutes (30 to 45) and the mean in-patient stay was five days (2 to 21). There were no peri-operative deaths or significant complications. The mean Constant score adjusted for age and gender, improved from 15.1% to 77%. Copeland surface replacement shoulder arthroplasty may be performed with minimal morbidity and rapid rehabilitation in the elderly.

Shoulder arthroplasty is a reliable procedure for relief of pain and improved function in well-selected patients. Although the population of the developed world is becoming increasingly elderly there is a paucity of information about the results of shoulder arthroplasty in this age group. The longevity of the implant is less of a concern, but there are issues of specific relevance to the elderly. Medical comorbidities, the effect of ageing on the properties of the tissues, and potential complications in a vulnerable population all need consideration.

The Copeland surface replacement shoulder arthroplasty was developed by the senior author (SAC). The current prosthesis is hydroxyapatite (HA)-coated and was introduced in 1993. The potential advantages of surface replacement include a shorter operating time, reduced blood loss and fewer complications. Resection of bone is minimal and bone cement is not used. We have assessed the results of the mark III HA-coated Copeland cementless surface replacement arthroplasty in patients over 80 years of age.

Patients and Methods
Between 1993 and 2003, 213 cementless surface replacement arthroplasties procedures were performed using the mark III prosthesis (Biomet Merck, Swindon, United Kingdom). Both humeral and glenoid components have an HA coating and a fluted taper-fit peg. The glenoid component has a metal backing. We prospectively collected data on all the patients and identified 29 who were 80 years of age or more at the time of surgery. Their mean age was 84.3 years (81 to 93). The mean length of follow-up was 53.6 months (25 to 111). Patient demographics are summarised in Table I. The major indication for arthroplasty was debilitating pain and declining ability to function independently.

The specific diagnoses were primary osteoarthritis (OA) in 17 shoulders (58.6%), rotator cuff arthropathy in nine (31%), rheumatoid arthritis (RA) in two (6.9%) and avascular necrosis (AVN) in one (3.5%). Of 29 prostheses, 22 (75.9%) were humeral surface arthroplasties and seven (24.1%) were total shoulder replacements (TSRs).

In the early part of the series, TSR was attempted in all patients. As experience with the prosthesis grew, the results of TSR and humeral
surface arthroplasty were similar, with fewer late complications in the latter group and, therefore, selective resurfacing of the glenoid was carried out. The indications for glenoid replacement were significant posterior erosion and a biconcave glenoid in the presence of a functional rotator cuff. More recently, our practice has been to perform a humeral surface arthroplasty routinely. We ensure that the glenoid is congruent by burring away any prominences and performing a microfracture of the eroded articular surface without replacing the glenoid.

The hospital course, clinical comorbidity, surgical complications and clinical and radiological outcomes were reviewed. Constant scores were recorded before operation and at follow-up. Clinical and radiological reviews were undertaken at three months, six months, one year, and annually thereafter. Before operation, patients were evaluated by a physician and an anaesthetist (who were not authors). According to the classification of the American Society of Anaesthesiologists (ASA), 15 patients were class 2 and 14 class 3. The operation was performed using a minimally-invasive technique through the anterosuperior approach described by Neviaser and Neviaser and MacKenzie (Fig. 1). This has the advantages of a smaller wound and easier access to the glenoid through the rotator interval, and to the posterior and superior cuff for reconstruction. An acromioplasty and excision arthroplasty of the acromioclavicular joint are carried out if indicated and to further improve the exposure. The details of the exposure and operating technique have been described previously.

To expose the glenoid, the humeral trial component is left in situ to protect the head of humerus from damage by subsequent retraction. An extensive capsulotomy is made around the glenoid. Adequate exposure is provided by retraction of the humeral head posteroinferiorly using a Bankart skid (Biomet) or Fukuda (Biomet) retractor. The rotator cuff was intact in 13 shoulders, 12 with OA and one with AVN and deficient and torn in the remainder. A rotator cuff repair was carried out on seven patients. In a further six patients from the rotator cuff arthropathy group, a repair was attempted.

The mean operating time was 40 minutes (30 to 45). After operation the arm was placed into a sling. Passive movement only was allowed for the first 48 hours, and then passive assisted-movement for five days. Active assisted-movements began at one week as determined by comfort, and the sling was discarded by three weeks. This was followed by a graduated programme of active movement and strengthening.

The mean in-patient stay was five days (2 to 21). This length of stay was a relic of the old regimen of hospitalisation after joint replacement for five to seven days. In some cases, the increased length of stay was because of social issues. Now, we discharge our patients one or two days after operation. Radiographs were performed on the day of operation and repeated at follow-up (Fig. 2).

**Results**
A total of 21 patients (72.4%) were fit to return for complete clinical and radiological review; four (13.8%) had died at a mean of five years (2 to 9) after surgery, but had...
a satisfactory outcome at their last follow-up. Another four patients were either too frail to attend or had developed cognitive impairment which made formal assessment impossible, but none had obvious pain or symptoms in the shoulder. The mean age- and gender-adjusted Constant score of those reviewed with diagnosis of OA was 82.1% (52.3% to 100%). The mean forward flexion increased from 48° (SD 13.3) to 88° (SD 31.1). The mean age- and gender-adjusted Constant score changed from 9.8% (4% to 13%) to 42.6% (25% to 56%). The clinical details and results are outlined in Table II.

Complications. There were no peri-operative deaths or serious morbidities. A revision was required in one shoulder. This patient had a hemiarthroplasty for rotator cuff arthropathy. She had three years of adequate pain relief but then developed increasing pain with poor function. A reverse-geometry prosthesis (Delta III, DePuy, New York) was inserted 44 months after the index procedure. The mean age of the patients who had died was 82.75 years (81 to 92) at the time of surgery. All the deaths were from causes unrelated to the operation.

Discussion
The most rapidly growing segment of the population in the USA is those over 80 years of age. The percentage of Americans aged over 65 years is expected to increase from 12.6% of the total population today to 20% by 2030. Many reports of hip and knee replacement in the octogenarian patient have shown significant improvement in pain and function. However, there has been no account of the outcome following shoulder replacement.

An increased rate of complications has been reported in elderly patients undergoing elective arthroplasty of the lower limb, but our complication rate was similar to that experienced in younger patients. Surface replacement performed through an anterosuperior approach is a minimally-invasive technique. Reaming of the medullary canal and the use of bone cement is not necessary. These factors may reduce anaesthetic and medical complications, such as confusion and thromboembolic events. Shoulder replacement should not be undertaken in frail elderly patients if it is felt that the risk-benefit ratio is too great. None of our patients died within three years of the index procedure, which is remarkable given the age group involved. This may be because those considered for shoulder replacement are possibly physiologically younger than their contemporaries.

Surface replacement, unlike the use of stemmed implants, avoids a focal stress riser at the distal tip of the implant. This supports the finding that shoulder replacement is associated with lower dislocation rates compared to total shoulder arthroplasty.

Table II. Analysis of the results

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Type of operation</th>
<th>Number of patients</th>
<th>Follow-up (yrs)</th>
<th>Pre-operative mean Constant score (%)</th>
<th>Post-operative mean Constant score (%)</th>
<th>Patient satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary osteoarthritis</td>
<td>Surface replacement</td>
<td>10</td>
<td>3.7</td>
<td>11.5</td>
<td>18 (9.8 to 30)</td>
<td>62.1</td>
</tr>
<tr>
<td>Rotator cuff arthropathy</td>
<td>Surface replacement</td>
<td>4</td>
<td>6.1</td>
<td>10.3</td>
<td>16 (9.0 to 27)</td>
<td>62</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>21</td>
<td>4.7</td>
<td>9.7</td>
<td>15.1 (4 to 30)</td>
<td>56.4</td>
</tr>
</tbody>
</table>

* TSR, total shoulder replacement
is of particular relevance in patients with generalised osteopa-
nia, who are at a higher risk of peri-prosthetic fracture.7-9,12-22
Infection has been reported to be more frequent in younger patients,16 although none of our patients was affected. Surface
replacement arthroplasty avoids broaching the medul-
lary canal, and so infection can usually be controlled by simple
lavage and treatment with antibiotics, whereas with
cemented stemmed implants management can be challenging.

We were able to perform the procedure in less than one
hour with minimal blood loss. The adverse effects of pro-
longed anaesthesia were thus avoided and post-operative
recovery was rapid. Most of our patients went directly home
or to a basic nursing home at a mean of five days (2 to 7).
The longer in-patient stay of five days was because of the percep-
tion and regimen of hospitalisation for five to seven days after
joint replacement. In some cases, the increased length of stay
was because of social problems. If there were no medical
issues and adequate ‘step-down’ facilities were available, the
in-patient stay could be reduced to 24 hours. Compared with
more invasive techniques such as stemmed TSR the combina-
tion of reduced operating time, a single-component implant
and complications of the use of bone cement, can be avoided
and the short in-patient stay makes the procedure very
favourable in terms of financial expenditure.

We achieved a satisfaction score of 84% after shoulder
arthroplasty, which matches well with the high patient satis-
faction usually observed in younger patients who have the
same procedure.1

In this elderly group of patients, the mark III cementless
surface replacement arthroplasty provided satisfactory results
in the intermediate term. The risk of peri-prosthetic fracture
and complications of the use of bone cement, can be avoided
with the cementless surface replacement arthroplasty, reduc-
ing the risk of complications in this vulnerable age group.

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