Short-term Results of the Global C.A.P. Uncemented Resurfacing Shoulder Prosthesis

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Abstract: The authors report the 2-year results of an uncemented resurfacing shoulder prosthesis in 47 patients with primary glenohumeral osteoarthritis who underwent a cementless humeral resurfacing arthroplasty between 2007 and 2009. Constant scores (corrected for sex and age), shoulder function, visual analog pain scales, Dutch Simple Shoulder Tests, and physical SF-12 scores improved significantly (P<.05) from preoperatively to 2 years postoperatively. Mental SF-12 scores remained the same. Complications included 1 traumatic lesser tuberosity avulsion fracture, 1 intra-articular loose body due to a fractured osteophyte, and 1 subcapularis tendon rupture. No patient required revision surgery for any reason. Cementless humeral resurfacing arthroplasty is a viable treatment option for primary glenohumeral arthritis.

sessed with magnetic resonance imaging (MRI). Rotator cuff tears larger than 1 cm were excluded.

**Intervention**

All surgeries were performed by the senior authors (C.V., A.v.N.) in 2 separate clinics, Rijnland Hospital, Leiderdorp, and Spaarne Hospital, Hoofddorp, the Netherlands. All patients received a cementless humeral resurfacing prosthesis (Global C.A.P.) implant. A first-generation cephalosporin was administered intravenously 30 minutes prior to incision. General anesthesia in conjunction with a preoperative interscalene block was used. Patients were placed in the beach-chair position with the arm draped free.

A deltopectoral approach was used, with preservation of the pectoralis major tendon and the circumflex humeral vessels. The subscapularis tendon was divided approximately 1 cm medial to its insertion, in line with the anatomic neck. Aggressive soft tissue release of the subscapularis tendon and the anterior and inferior aspects of the capsule was performed when necessary to improve tendon excursion. This included a 360° release of the subscapularis tendon. The anterior aspect of the capsule was left attached to the subscapularis to enhance suture fixation of the tendon back to its original fixation on the lesser tuberosity. Tenodesis or tenotomy of the long head of the biceps was only performed when tendinopathy was diagnosed intraoperatively. Patients with a symptomatic acromioclavicular joint arthritis had a lateral clavicle resection.

The appropriate-sized implant was placed with respect for anatomic retroversion and inclination. The implant is available in 5 head sizes, and each size has 2 heights to match the anatomy of the shoulder. The glenoid was treated with a Chondro Pick (Smith & Nephew, Inc, Memphis, Tennessee) to enhance microfracturing of the eroded articular surface. No glenoid implants were used, but microfracturing of the eroded glenoid was performed to stimulate the growth of fibrous cartilage.

A standard sling was used for up to 6 weeks. Patients were stimulated to perform front-to-back pendulum exercises and were allowed to start with forward elevation and abduction (passively and actively assisted) immediately postoperatively. External rotation was allowed within the maximum degree of that obtained intraoperatively after subscapularis tendon repair to minimize tension in the reattached tendon.

**Clinical and Radiological Assessment**

Baseline assessment, including demographic details, diagnosis (primary arthritis), radiographs, and MRI, was performed in the outpatient clinic by one of the senior authors (C.V., A.v.N.). Two physician’s assistants (P.S., M.C.), who did not participate in the perioperative care and did not view the postoperative radiographs, assessed each patient’s visual analog pain scale (VAS), activities of daily living (Short Form [SF]-12), Dutch version of the Simple Shoulder Test (DSST), and range of motion and strength to derive a Constant score.

The VAS was assessed by asking patients to rate their pain on a scale of 1 to 10, with 1 being no pain and 10 being the most pain ever experienced. The Constant score is a scoring system consisting of 4 variables used to assess shoulder function. The subject variables are pain and activities of daily living (sleep, work, recreation/sports), which yield a total of 35 points. The objective variables are range of motion and strength, which yield a total of 65 points. The maximum Constant score is 100 points.

Anteroposterior and axillary radiographs were obtained at 3 months postoperatively and then annually. An assessment of radiolucent lines and their evolution over time was performed. Definite loosening was defined as a change in position of a component over time. Probable loosening was defined as an unchanged position but progressive radiolucent lines greater than 2 mm wide. Glenoid changes were assessed by measuring the distance of the implant in relation to the coracoid. The distance between the lateral border of the coracoid and the medial side of the implant was measured on the first postoperative radiograph and compared with the distance on the radiographs 2 years postoperatively. This space may decrease due to degeneration and may increase due to the formation of fibrosis because of the microfracturing. Assessments were performed for dislocation of the prosthesis and migration.

Figure: Illustrations showing A1 (A), A2 (B), B1 (C), B2 (D), and C (E) Walch classification.
of the prosthesis outside the center of the glenoid.

Statistical Analysis

Pre- and postoperative Constant scores, shoulder function (internal rotation, external rotation, and strength), VAS scores, SF-12 scores, and DSST scores were analyzed using the Wilcoxon signed rank test. The authors used this test because the sample data are not normally distributed, and they cannot be transformed to a normal distribution by means of a logarithmic transformation. The pre- and postoperative elevation and abduction results were analyzed using a paired t test. A P value less than .05 was considered significant. SPSS version 20.0 statistical software (SPSS Inc, Chicago, Illinois) was used to analyze the data.

RESULTS

Forty-nine Global C.A.P. resurfacing prosthesis humeral head surface replacement arthroplasties were performed in 47 patients (2 bilateral) (35 women and 12 men; mean age, 69 years [range, 56-86 years]). One patient was lost to follow-up because she was unable to keep follow-up appointments. The length of follow-up was 2 years for all patients.

Six patients had a lateral clavicle resection. Thirty-seven patients had a tenodesis of the biceps tendon. Mean Constant score (corrected for sex and age) improved from 49±18 points (range, 19-100) preoperatively to 79±23 points (range, 17-100) at follow-up (P<.000000).

Mean DSST improved from 22±23 points (range, 0-92 points) preoperatively to 66±29 points (range, 29-100 points) at follow-up (P<.000000).

All components of range of motion (elevation, abdication, external and internal rotation, and strength) improved significantly following resurfacing shoulder arthroplasty (Tables 1-2). Pain score according to the VAS decreased from 65±18 points (range, 4-100) preoperatively to 35±27 points (range, 0-90) at follow-up (P=.000006). The SF-12 was divided into mental score and physical score. Mean SF-12 mental score did not improve (P=.773). Mean SF-12 physical score improved from 35±8 points (range, 22-50) preoperatively to 42±10 points (range, 21-59) at follow-up (P=.000076). The authors found no correlation of glenoid centric type, according to Walch classification, with the clinical outcome in this short-term follow-up.20

Radiology

Radiographs were available for 48 shoulders in 46 patients. None of these patients showed loosening around the prosthesis 2 years postoperatively. The distance between the lateral border of the coracoid and the medial side of the implant did not change during this short-term follow-up.

Complications

For this study, the authors only reported implant and operation complications. Complications such as bladder infections and hospital-acquired pneumonia were not reported. There were no major perioperative complications, such as neurovascular injury, infection, humeral fracture, or gross malposition of the implant. One patient had a subscapularis tendon rupture shortly after surgery. Two months after the index surgery, the tendon was reattached during a second surgery. One patient experienced a loose body caused by a fractured osteophyte from the posterior rim of the glenoid 8 months after the index surgery. The posterior rim of the glenoid was trimmed via a posterior joint approach and the loose body removed during a second surgery. One patient had a lesser tuberosity avulsion fracture after intensive fitness exercise. The lesser tuberosity avulsion fracture was reattached 15 months after the index surgery.

Table 1

<table>
<thead>
<tr>
<th>Function</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>99°±34°</td>
<td>120°±36°</td>
<td>&lt;.000042</td>
</tr>
<tr>
<td>Abduction</td>
<td>82°±28°</td>
<td>113°±38°</td>
<td>&lt;.000000</td>
</tr>
<tr>
<td>External rotation</td>
<td>3°±1°</td>
<td>4°±2°</td>
<td>&lt;.000001</td>
</tr>
<tr>
<td>Internal rotation</td>
<td>3°±1°</td>
<td>4°±1°</td>
<td>&lt;.000050</td>
</tr>
<tr>
<td>Strength, kg</td>
<td>8±3</td>
<td>10±3</td>
<td>&lt;.016026</td>
</tr>
</tbody>
</table>

Table 2

Evaluation of Pre- and Postoperative External and Internal Rotation According to a 6-point Scale

External Rotation
1. Impossible
2. Hand behind head with elbow forward
3. Hand behind head with elbow behind
4. Hand on head with elbow forward
5. Hand on head with elbow behind
6. Full elevation hand from head

Internal Rotation
1. Dorsum hand—lateral thigh
2. Dorsum hand—pelvis
3. Dorsum hand—lumbar-sacral
4. Dorsum hand—middle (lumbar 3)
5. Dorsum hand—thoracal 12
6. Dorsum hand—between the scapulae

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Revision Surgery

No revision surgery was necessary in 2 years of follow-up.

Discussion

The most important finding of this study is that the outcome of the Global C.A.P. shoulder resurfacing arthroplasty was good after short-term follow-up. The authors report the results of cementless humeral resurfacing arthroplasty performed in 48 shoulders between 2007 and 2009 and followed prospectively for 2 years. The authors found substantial increase in patient satisfaction, a perceived return of function, and decreased pain with neither loosening nor radiolucent lines around the prosthesis. These results are similar to results with the Mark 3 prosthesis.\(^9,32,33\) The current authors’ early results are slightly better compared with other results reported with stemmed implants.\(^34-38\)

The authors tried to minimize selection bias in this study by only including patients with an intact cuff (less than 1-cm rotator cuff tear) and glenohumeral osteoarthritis. Measurement bias was minimized by having assessors who were not involved with the original surgery. To the authors’ knowledge, this is the first article to report the outcome with the Global C.A.P. resurfacing shoulder prosthesis.

Although the authors realize that total shoulder arthroplasty is the current gold standard for the treatment of osteoarthritis of the shoulder, they believe there is a place for resurfacing because of the unknown survival of the glenoid in total shoulder arthroplasty after long-term follow-up. Glenoid loosening after unconstrained total shoulder arthroplasty has been reported to be between 0% and 20% at mid-term follow-up and 39% at mid- to long-term follow-up,\(^5,12-17,39,40\) with more than a 5% rate of revision surgery at long-term follow-up. Several factors, such as rotator cuff tears, component malposition, and glenoid instability, can contribute to glenoid failure.\(^17,40,41\)

Advantages of hydroxyapatite-coated surface replacement of the shoulder compared with stemmed implants include less bone resection, primary press-fit cementless fixation with bone ingrowth into a hydroxyapatite coating, easier replication of the native anatomy, reduced risk of intraoperative humeral shaft fracture and stem perforation, preservation of humeral bone stock, and easier revision surgery.\(^9,42,43\)

Although there were some complications in the current series, all have been reported in association with the standard surgical technique for any shoulder replacement and were not specific to this humeral resurfacing shoulder implant design. Although a short follow-up is reported, the complication rate with this implant in this series was equal to that with stemmed implants.\(^9,12\) No revision surgery was performed or required, similar to the low revision rates for stemmed prostheses after short-term follow-up.\(^9,44,45\) The authors agree with Cofield\(^46\) that revision rate alone is not sensitive to a failed procedure due to subjective assessment by the surgeon. He suggests that it be used in combination with pain and satisfaction as assessed by patients, with those reporting pain equal to or worse than that preoperatively considered a failure.\(^9\)

Glenoid changes after resurfacing prosthesis were assessed by measuring the joint space and determination of possible bone loss of the glenoid. This space may increase by the formation of fibrosis because of microfracturing. Glenoid erosion in hemiarthroplasty is one of the major reasons for revision to total shoulder arthroplasty.\(^47-49\) In the current series, the authors observed no glenoid erosion, likely because of the short-term follow-up. Nevertheless, radiological glenoid deterioration is not correlated with pain or deterioration of clinical results.\(^34\)

Periprosthetic fractures were not seen in this series, possibly because of the absence of stress shielding with resurfacing implants.\(^50,52\) Stemmed prostheses create a stress riser effect at the tip of the stem in the midshaft of the humerus.\(^9\) The absence of a stem means that there is no stress riser in the midshaft in the humerus. This is especially important with elderly patients, who have a greater tendency to fall. This situation can cause difficulties in the event of a humeral shaft fracture.\(^33,53-55\) Periprosthetic fractures, which have a reported prevalence of 3%, account for approximately 20% of all complications associated with total shoulder arthroplasty intra- and postoperatively. This can be avoided using this prosthesis.\(^33,53-57\)

This study has some limitations. Although the patients were enrolled prospectively in a computerized database, there was no control group treated with a stemmed implant. Also, the population reported is small, yet comparable with other published studies of shoulder resurfacing.\(^9,33,35\) Nevertheless, small case numbers suggest caution in interpreting the incidence of uncommon complications. Performing a new type of surgery on a large scale would not be considered wise because of recent lessons learned from, for example, the metal-on-metal issue in hip surgery. Long-term follow-up is critical to determine whether treating patients who have end-stage osteoarthritis of the shoulder with this cementless resurfacing implant is viable. Despite the promising 2-year follow-up with good pain relief and functional outcomes, the authors have concerns about the longevity of this cementless resurfacing implant and the progressive glenoid erosion and loosening of the component.

Conclusion

The authors report the clinical and radiologic outcome for the uncemented Global C.A.P. resurfacing prosthesis for the treatment of primary osteoarthritis in patients with an intact rotator cuff at 2-year follow-up. The authors conclude that short-term follow-up of the uncemented Global C.A.P. resur-
Reference is encouraging and comparable with modular stemmed hemiarthroplasty and the Mark 3 resurfacing prosthesis. No patients required revision surgery and there were no cases of aseptic loosening, periprosthetic fracture, or glenoid erosion at short-term follow-up. Long-term follow-up is necessary to evaluate whether these results will endure.

**References**


