

Original Research Article

Study on glenoid component in anatomical total shoulder arthroplasty in Nagapattinam district

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ABSTRACT

Background: Depending upon the mechanism of dysfunction or injury a shoulder arthroplasty can either be a partial or total replacement. Shoulder arthroplasty surgery has shown remarkable progress during the last few decades. The objective was to study the effect of prosthesis positioning in reverse shoulder arthroplasty on radiological and clinical outcomes.

Methods: This was a prospective comparative non-randomized study of 37 patients who underwent reverse shoulder arthroplasty (RSA) in Government District Head Quarters Hospital Nagapattinam with a follow-up ranging from March 2018 to January 2019 (11 months).

Results: Grade 1 indicated a notch limited to the scapular pillar, grade 2 reached the inferior screw of the baseplate, grade 3 extended beyond the inferior screw and grade 4 reached the central peg of the baseplate. Glenoid loosening was defined as radiolucencies under the baseplate or around the peg or screws, screw breakage, or glenoid migration.

Conclusions: Outcome measures were improved regardless of the LHO. At 3 months follow-up increased LHO harmed shoulder function and gave more shoulder pain at rest and exertion but did not affect the quality of life, health status, or ROM. At 12 months follow-up, LHO had no relation with the outcome measures. Further studies are warranted to investigate the influence of LHO on long-term prosthetic survival.

Keywords: Arm lengthening, Comprehensive shoulder prosthesis, Lateral humeral offset, Quick DASH, Scapular notching, TESS shoulder prosthesis, Total shoulder arthroplasty

INTRODUCTION

Shoulder replacement is a surgical procedure in which all or part of the glenohumeral joint is replaced by a prosthetic implant. Such joint replacement surgery generally is conducted to relieve arthritis pain or fix severe physical joint damage.¹ Shoulder replacement surgery is an option for the treatment of severe arthritis of the shoulder joint.² Arthritis is a condition that affects the cartilage of the joints. As the cartilage lining wears away, the protective lining between the bones is lost.³ When this happens, painful bone-on-bone arthritis develops. Severe shoulder arthritis is quite painful and can cause restriction of motion. While this may be tolerated with some medications and lifestyle adjustments, there may come a time when surgical treatment is necessary.⁴ There are a few

major approaches to access the shoulder joint. The first is the deltopectoral approach, which saves the deltoid, but requires the sub scapularis to be cut the second is the transdeltoid approach, which provides a straight-on approach at the glenoid. However, during this approach, the deltoid is put at risk for potential damage.⁵ Gluck designed several shoulder replacements, including a simple prosthesis consisting of an ivory humeral component, which was articulated by hooking on to an ivory eye screwed into the glenoid. He also developed more complex hinge and ball and socket joints using ivory and cadaveric bone (Gluck 1891).⁶ However, he did not describe the results of these operations or state definitively that they were performed in living human beings.⁷ Neer designed his humeral prosthesis in 1951 for the treatment of four-part fracture-dislocation of the proximal humerus. The

prosthesis was mono block with one press-fit stem and head size. The stem had additional holes in the upper lateral flange to stabilize the tuberosities.⁸ The prosthesis constituted of a mono block humeral component, with 2 different humeral head sizes, and a keeled polyethylene glenoid component. Glenoid fixation remain the weakest link in TSA. There vision rate for the glenoid component is 3.2% compared with 1.8% for the humeral component.⁹ A cemented glenoid component is an effective treatment for glenohumeral arthritis.¹⁰ Radiolucent lines and the potential for glenoid loosening remain a major concern. Most cemented glenoid components with lucent lines are present from the immediate postoperative period and do not progress.¹¹ These concerns resulted in the development of metal-backed, bone-in growth prostheses which potentially could offer a more stable fixation. Another potential benefit is the ability to convert an anatomical TSA to an RSA, in cases of revision due to rotator cuff failure, without compromising the fixation of the glenoid baseplate component.¹²

METHODS

This was a prospective comparative non-randomized study of 37 patients who underwent reverse shoulder arthroplasty (RSA) in Government District Head Quarters Hospital Nagapattinam with a follow-up ranging from March 2018 to January 2019 (11 months), after obtaining the ethical committee clearance from the institution The inclusion criteria were: 1) All patients with CTA, primary OA with rotator cuff dysfunction, RA, and proximal humeral fracture sequelae who had undergone TESS RSA (Zimmer Biomet), both stemmed and stemless at Government District Head Quarters Hospital, Nagapattinam during the study period. 2) Intact cognitive function (no diagnosis of dementia, with the patient being lucid and fully oriented). 3) No previous neurological disorder that affects the operated side. There were no age limits for inclusion. Functional impairment was evaluated by the Quick DASH index, the EQ-score was used for the estimation of the quality of life, and global VAS for evaluation of overall health status. Pre-and post-operative active ROM was measured by visual estimation in degrees of abduction and flexion, while internal rotation was measured as the ability to reach behind the back. VAS was used for assessing pain. The VAS pain is a continuous scale comprised of a 100 mm line, anchored by 2 verbal descriptors, one for each symptom extreme. Grade 1 indicated a notch limited to the scapular pillar, grade 2 reached the inferior screw of the baseplate, grade 3 extended beyond the inferior screw and grade 4 reached the central peg of the baseplate. Glenoid loosening was defined as radiolucencies under the baseplate or around the peg or screws, screw breakage, or glenoid migration. The peg-glenoid rim distance was measured as the distance from the uppermost border of the central peg to the inferior glenoid margin on post-operative AP radiographs of glenoid component craniocaudal positioning two horizontal lines were drawn, one from the inferior margin of the glenoid spheres parallel to another line which was

drawn from the inferior margin of the glenoid. The distance between the two lines was calculated and values more than 0 mm were regarded as an overhang. Glenoid component inclination was described as the angle between the baseplate and a horizontal line drawn from the upper margin of the glenoid. An inferior tilt was defined as an angle measuring more than 90°; a superior tilt was under 90°, while 90° was considered neutral.

Statistical analysis

Statistics were obtained using SPSS for Windows statistical program release 21 (SPSS Inc., Chicago, IL, USA). Pearson Correlation was used to find out the relationship between variables. The Wilcoxon signed-rank test was used to compare pre-and post-operative values of Quick DASH, EQ-5D, VAS pain, and ROM. The Mann-Whitney test was used to compare inclination and overhang between categories of glenoid notching. The Spearman correlation was used to evaluate relations between arm lengthening and outcome. Kruskal-Wallis analysis of variance (ANOVA) was used to evaluate relations between notching and glenoid loosening. Values for continuous data are presented as median (minimum, maximum). The statistical significance level was designated at $p < 0.05$.

RESULTS

The study group comprised 37 patients (23 women and 14 men mean age at surgery 72.0 years; age range 60-88 years). In total 40 shoulders were operated on. The mean duration of follow-up was 39 months (range 15-66 months). Indications were CTA (n=14), primary OA with rotator cuff dysfunction (n=10), RA (n=7) and proximal humeral fractures sequelae (n=9).

Table 1 shows three patients died during the study from causes unrelated to the surgery at 20, 35, and 40 months post-operatively. For these patients, results were obtained from their last follow-up. There were 37 patients (40 shoulders) who underwent TESS RSA. There were 16 stemless and 24 stemmed. The shoulder disorders that were operated on using stemmed RSA (n=24) were as follows: 1) CTA (n= 7). 2) OA with cuff dys function (n=5). 3) RA (n= 3). 4) Proximal humeral fracture sequelae (n= 9). Cemented stemmed RSA prostheses were used only in fracture patients. The shoulder disorders that were operated on using stemless RSA (n=16) were as follows: 1) CTA (n=7). 2) OA (n=5). 3) RA (n=5). When we looked at the stemmed and stemless RSA in arthritis patients (i.e. no fracture patients included), we found the two groups to be comparable except that more women received stemmed implants (< 0.05). At radiological follow-up, we found no signs of humeral implant loosening except for one stemmed shoulder where thin zones of resorption of the proximal humerus were detected. Glenoid component positioning; The inclination of the glenoid base plate was 93° (range 80-105°). No correlation was observed between inclination and SN. The mean glenoid over hang was 1.3

mm (range 5-6 mm). With no overhang, there was a higher incidence of SN (10 of 12 shoulders; $p < 0.001$). The peg-glenoid rim distance was 20 mm (range 15-28 mm). The peg-glenoid distance correlated with SN. When the distance was more than 20 mm, SN was evident in 9/12 shoulders, while 3/12 occurred when the distance was less than 20 mm ($p < 0.01$). Arm lengthening: the lengthening of the upper extremity was 16 mm (range 0-32 mm). We compared those with arm lengthening 15 mm or less (15

shoulders) to those with lengthening over 15 mm (12 shoulders). Those with arm lengthening more than 15 mm showed greater improvement in EQ-5D (pre-operative mean = 0.41 versus 0.80 post-operatively) as compared with the others (pre-operative mean = 0.51 versus 0.66 post operatively; $p < 0.05$). However, lengthening did not correlate with the degree of post-operative pain, ROM, Quick DASH, or SN.

Table 1: Preoperative and postoperative values of eq-5d, quick dash score, pain, and rom for all patients.

Parameter	Preoperative	Post-operative	P value
Quick DASH			
All	68 (4.5-93.2)	30 (2.5-86.4)	<0.01
Stemless	67 (38.6-88.6)	29 (4.5-86.4)	<0.01
Stemmed	56 (4.5-55)	35 (5-80)	<0.01
EQ-5D			
All	0.60 (0.11-1.00)	0.81 (0.18-1)	<0.01
Stemless	0.49 (0.18-0.77)	0.74 (0.3-1)	<0.01
Stemmed	0.43 (0.17-0.80)	0.73 (0.4-1)	<0.01
VAS pain at rest			
All	35 (0-80)	0 (0-20)	<0.01
Stemless	30 (10-80)	10 (0-20)	<0.01
Stemmed	35 (15-60)	0 (0-15)	<0.01
VAS pain at the activity			
All	60 (30-90)	10 (0-30)	<0.01
Stemless	65 (40-80)	10 (0-20)	<0.01
Stemmed	70 (50-75)	15 (0-20)	<0.01
Abduction			
All	30 (10-80)	100 (50-170)	<0.05
Stemless	30 (10-60)	110 (60-170)	<0.05
Stemmed	40 (20-80)	90 (70-160)	<0.05
Forward elevation			
All	50 (10-80)	100 (40-170)	<0.05
Stemless	50 (10-80)	110 (80-170)	<0.05
Stemmed	45 (20-80)	90 (60-160)	<0.05
Internal rotation			
All	Sacrum (trochanter L5)	L3 (trochanter L1)	<0.05
Stemless	Sacrum (trochanter L5)	L3 (trochanter L2)	<0.05
Stemmed	Sacrum (trochanter L5)	L4 (sacrum L1)	<0.05

DISCUSSION

Stemless prostheses with total elimination of the humeral stem and total reliance on meta physeal fixation were developed to decrease shaft-related complications, e.g. periprosthetic fracture and bone loss.¹³ The great individual variation in shoulder anatomy makes it a challenge to design implants that fit most anatomical variations.¹⁴ The factors that affect the pain range of motion, stability, and wear rate after shoulder reconstruction are multifactorial.¹⁵ For instance, the length of the lever arm of the deltoid and rotator cuff muscles and tension of the soft tissue are both important and can be adjusted by proper component position and size

selection.¹⁶ Stemless implants should provide other potential benefits, including the ability to restore shoulder anatomy regardless of the posterior offset of the proximal humerus. Grammont et al evaluated the implication of the type of implant fixation and positioning of prosthesis on the both clinical and radiological outcome. We reported clinical and radiological results using the TSA and RSA (TESS, Zimmer Biomet) shoulder system, both stemless and stemmed, for various shoulder disorders.¹⁷ Both stemmed and unstemmed implants showed improvement in clinical outcomes with no sign of radiological loosening after stemless implantation. In contrast, there were zones around one stemmed implant.¹⁸ We did not find a specific diagnosis where the use of stemless implants was mandatory. Instead,

the decision to use stemmed or stemless humeral implants depends on bone quality and judgment of the stability achieved during the initial preparation of the proximal humerus.¹⁹ In fracture surgery, we recommend that only stemmed implants should be used since implant-bone stability is not expected in osteoporotic bone. We chose to cement the stems in the fracture group to secure the fixation of the prosthesis and to maintain the proximal humeral length.²⁰ We used the anterosuperior surgical approach in all cases. We experienced no technical difficulty with this approach and had no axillary nerve injury. We had two patients in the stemless group with early instability secondary to a malpositioned or displaced corolla component. This can be the effect of limited surgical technical experience, limited operative exposure, or poor bone quality.²¹ Malpositioning of the prosthetic components, in adequate tensioning of the periprosthetics of tissues, bony effects, and rupture of the subscapularis tendon are some of the underlying factors.²² The above-mentioned complications took place early in the study period and the authors think that this is most probably due to the learning curve of the procedure.²³ Hugué et al reported that 30-40 cases are needed as a learning curve to improve the rate of early complications associated with reverse shoulder replacement. The complications encountered in our studies are comparable to those reported by other authors using other shoulder prosthesis systems.²⁴ This study showed the possibility of safely implanting a stemless humeral cup for reverse shoulder arthroplasty. Other possible explanations cannot be excluded, e.g. the forward scapular rotation in the early post-operative period or a prominent anatomical notch of the circumflex scapular vessels. In the same study, we reported the effect of arm lengthening on radiological and clinical outcomes.²⁵ We found that arm lengthening improved the quality of life, but we were unable to note effects on function, ROM, or pain. This is by previous reports that found that arm lengthening could influence the outcome.

The limitations of this study include the relatively small sample size and short duration of follow-up. Although there are many possible additional clinical and radiographic variables that could have been considered in our study, we elected to focus on those that are readily accessible to shoulder surgeons: patient demographic characteristics, patient-reported outcomes using the SST, and straightforward measurements made on standardized radiographs.

CONCLUSION

The results of stemless shoulder prostheses are promising with a complication rate that is comparable with other shoulder prosthetic systems with the advantage of bone stock preservation and avoidance of stem-related complications. Long-term follow-up is required to confirm the results of this innovative system in the long run. The antero superior approach can adequately be used for the implantation of different versions of shoulder prostheses.

RSA can successfully treat different shoulder problems. The glenoid overhang can reduce SN and arm lengthening has positive effects on the outcome. Our method of arm lengthening measurement needs further studies to ensure validity. LHO measurement on AP radiographs is less reliable and underestimates the distance when compared with CT. Also, CT is a reliable tool to measure LHO supporting its use in preoperative planning. Outcome measures were improved regardless of the LHO. At 3 months follow-up increased LHO harmed shoulder function and gave more shoulder pain at rest and exertion but did not affect the quality of life, health status, or ROM. At 12 months follow-up, LHO had no relation with the outcome measures. Further studies are warranted to investigate the influence of LHO on long-term prosthetic survival.

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Ethical approval: The study was approved by the institutional ethics committee

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