



Effects of humeral component retroversion on functional outcomes in reverse total shoulder arthroplasty for cuff tear arthropathy



Yong Girl Rhee, MD*, Nam Su Cho, MD, Seong Cheol Moon, MD

Shoulder & Elbow Clinic, Department of Orthopaedic Surgery, College of Medicine, Kyung Hee University, Seoul, South Korea

Background: The currently recommended 0° to 30° humeral component retroversion angle for reverse total shoulder arthroplasty (RTSA) is based on expert opinion rather than anatomical or clinical evidence.

Methods: Sixty-two patients who underwent RTSA for cuff tear arthropathy were reviewed retrospectively. The humeral component was inserted with 20° retroversion in 30 patients (group A) and with 0° retroversion in 32 (group B). The mean age at the time of operation was 66.2 years and 68.9 years, and the mean follow-up period was 43.3 months and 38.4 months in groups A and B, respectively.

Results: At the last follow-up, external rotation at the side was 47.2° ± 8.4° in group A and 43.9° ± 7.0° in group B, whereas internal rotation to the posterior was L3 and L2, respectively ($P = .102$ and $P = .092$). The ranges of motion between the 2 groups at the last follow-up were not significantly different. Most daily movements related to activities of daily living showed no significant differences between the 2 groups, with the exception of back washing/back doing up bra (1.5 ± 1.2 in group A vs 2.1 ± 0.8 in group B of 3 points, $P = .026$).

Conclusions: Range of motion after RTSA did not significantly differ between 20° and 0° humeral component retroversion angle. Most daily movements did not differ between the 2 groups, but patients in the 0° retroversion angle group scored better on activities related to internal rotation.

Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

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Keywords: Shoulder; rotator cuff tear; cuff tear arthropathy; reverse total shoulder arthroplasty; humeral component; retroversion; range of motion; activities of daily living

Good clinical and radiologic results after reverse total shoulder arthroplasty (RTSA) have been reported recently.^{9,21,25} In particular, RTSA reliably improves the

This study is retrospective in nature and final approval of exemption by the Institutional Review Board was obtained (IRB Approval No.: KMC IRB 1409-06).

*Reprint requests: Yong Girl Rhee, MD, Department of Orthopaedic Surgery, College of Medicine, Kyung Hee University, 1 Hoegi-dong, Dongdaemun-gu, Seoul 130-702, South Korea.

E-mail address: shoulderrhee@hanmail.net (Y.G. Rhee).

pain and dysfunction associated with a rotator cuff-deficient shoulder. Compared with conventional total shoulder arthroplasty, RTSA is known to be effective in cases where active elevation is impossible because of altered biomechanics.^{11,21} Although RTSA can effectively increase the level of elevation a patient can achieve, several studies showed that internal and external rotation are limited after this procedure.^{29,32}

Range of motion after RTSA is influenced by technical or implant-related factors such as the size of the glenoid

component, placement, inclination, and lateralization, as well as the humeral head shaft angle.^{12,17,20,28} In addition to these factors, retroversion of the humeral component can also influence the postoperative range of motion directly related to activities of daily living (ADL) because it can specifically influence internal and external rotation. Because limitations of motions including internal and external rotations can influence the most basic ADL, such as making hand-to-mouth (spoon) motions, combing hair, putting on a coat, and managing hygiene and grooming activities, they are critical to the postoperative prognosis and patient satisfaction.

The RTSA prosthesis is not designed to recreate the normal glenohumeral joint anatomy or mechanics; therefore, the optimal form is not yet known.²⁶ Although the humeral component retroversion angle in RTSA is recommended to be between 0° and 30°,^{8,11,25,26} this recommendation is derived from expert opinion rather than from anatomic or clinical evidence, and a clinical standard is currently lacking. To date, several studies have investigated the correlation between the postoperative internal and external rotation and the degree of humeral component retroversion.^{12,14,20} However, because most previous studies were biomechanical studies that used cadaveric specimens, no study has comparatively analyzed clinical results based on actual postoperative retroversion of the humeral component. In particular, no reports of thorough ADL evaluations have been published.

The purpose of our study was to evaluate the effects of humeral component retroversion on the clinical and functional outcomes of RTSA for cuff tear arthropathy. On the basis of previously reported biomechanical studies, we hypothesized that the postoperative external rotation would increase with a large humeral component retroversion during RTSA and that the postoperative internal rotation would increase with a small retroversion. We also hypothesized that the difference in the postoperative range of motion would influence ADL and postoperative patient satisfaction.

Methods

Patient selection

From January 2008 to November 2012, 110 consecutive shoulders underwent RTSA for irreparable massive rotator cuff tear or cuff tear arthropathy. For a precise comparative study under homogeneous conditions, those that were associated with primary osteoarthritis, rheumatoid arthritis, infection sequelae, or trauma were excluded. Patients lost to follow-up within 2 years after the operation were also excluded.

The study enrolled 62 shoulders with at least 24 months of available postoperative follow-up data. The patients included 24 men and 38 women, of whom 45 were right-handed and 17 were left-handed.

Patients were divided into 2 groups according to the retroversion angle of the humeral component used during the operation: the 20° or 0° group. From January 2008 to August 2010, the humeral component was inserted at a 20° retroversion angle in 30 patients (group A), and from August 2010 to November 2012, the humeral component was inserted at 0° retroversion angle in 32 (group B). The mean age at the time of operation was 66.2 years (range, 58-78 years) in group A and 68.9 years (range, 56-81 years) in group B. The mean follow-up was 43.3 months (range, 27-66 months) and 38.4 months (range, 24-71 months) in groups A and B, respectively.

Preoperative fatty infiltration was evaluated for each muscle with the 5-stage grading system developed by Goutallier et al.¹⁰ Preoperative muscle atrophy was evaluated on the oblique sagittal plane image medial to the level of the coracoid process with the 4-stage grading system (normal, mild, moderate, or severe) developed by Warner et al.³¹ The Hamada classification¹⁵ was used for the preoperative radiologic assessment of the degree of cuff tear arthropathy.

Preoperative and postoperative clinical evaluations

All patients underwent a physical examination 1 day before the operation. Patients underwent regular postoperative evaluations regularly as outpatients at 3 weeks, 6 weeks, 3 months, 6 months, 9 months, 12 months, and at the last follow-up. The results of the last follow-up were analyzed. Preoperative and postoperative subjective pain scores at rest and during motion were measured using a visual analog scale (VAS). The VAS was used to measure pain of the patients, with 0 indicating no pain and 10 indicating extremely severe pain. Shoulder range of motion (ROM), forward flexion, external rotation of the side, internal rotation of the back, and abduction were assessed before and after the operation. Quantitative rotator cuff muscle strength measurements were made using a portable, handheld Mecmesin Myometer (Mecmesin Co, Nottingham, UK). Elevation strength was tested with the patient seated with the arm flexed to 90° in the scapular plane. External and internal rotation was tested with the shoulder in a neutral position and the elbow in 90° of flexion. Clinical assessments included the Constant score⁴ and the University of California at Los Angeles (UCLA) Shoulder Rating Scale.⁷

Activities of daily living

Nine ADL were selected for the patients to perform (Table I). These 9 tasks were taken directly from the functional assessment sections of the American Shoulder and Elbow Surgeon (ASES) score,²² the Pennsylvania Shoulder Score (PSS),¹⁸ and the Simple Shoulder Test (SST).³³ Although these functional assessments included 20 tasks, we selected and studied only 9 tasks critical to daily living, which were objectively scored as 0 = unable, 1 = very difficult, 2 = somewhat difficult, and 3 = not difficult on the basis of interview diagnoses and physical examinations.

Radiologic evaluations

We investigated the status of inferior scapular notching and implant loosening on the final follow-up radiologic images. The

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