



ELSEVIER

Bilateral reverse total shoulder arthroplasty—functional outcome and activities of daily living

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Background: Reverse total shoulder arthroplasty (rTSA) has gained popularity in recent years, providing good shoulder elevation, yet less predictable rotations. Good rotations are crucial for performance of activities of daily living (ADLs), including personal hygiene. Concerns remain regarding bilateral rTSA over lack of rotations bilaterally and resultant difficulties with ADLs. This study examined the outcome of patients with bilateral rTSA in restoration of function and ADLs.

Methods: Data were prospectively collected for 19 patients (15 women, 4 men; 38 shoulders), with a mean age of 74.5 years, who underwent staged bilateral rTSA between 2007 and 2013. Mean follow-up was 48.4 months (range, 24–75 months). Patients were evaluated clinically using the Constant score, patient's satisfaction, Subjective Shoulder Value, and the Activities of Daily Living External and Internal Rotations (ADLEIR) score. Video clips were also recorded for documentation at all visits.

Results: Mean duration between staged operations was 18.2 months (range, 3–46 months). The Constant score improved from 18.7 to 65.1 points (age- and sex-adjusted, 100.2). Elevation improved from 57.5° to 143°, internal rotation (IR) from 9° to 81° (30 shoulders could reach above the sacroiliac joint), and external rotation (ER) from 20° to 32° (35 shoulders had >20° ER in adduction, 31 shoulders had full ER in elevation). The Subjective Shoulder Value improved from 2.1 of 10 to 9.2 of 10. Mean ADLEIR score was 33 of 36 ($P < .001$ for all). Most patients resumed their leisure and sport activities (gardening, golf, swimming, bowling).

Conclusion: Bilateral rTSA results in marked and predictable improvement in all movements, pain relief, and functional outcomes, with high patient satisfaction and high ADLEIR score. All patients were able to perform perineal hygiene after their rTSA. Most patients had no limitation in ADLs and their leisure activities.

Level of evidence: Level IV; Case Series; Treatment Study

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Keywords: Shoulder; arthroplasty; stemless; replacement; activities; ADL; rotation; function

The Royal Berkshire Hospital Audit and Review Board approved the study (Study No. N3114).

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Reverse total shoulder arthroplasty (rTSA) has gained in popularity in recent years and has excellent outcomes for a variety of indications^{9,11-13,15,20,30,32,42-45} such as severe rotator cuff tear arthropathy (CTA), rheumatoid arthritis,^{18,49} failed arthroplasty,^{24,34} acute fractures,^{8,23} and fracture sequela.^{19,28,48}

rTSA provides good range of shoulder elevation; however, restoration of active rotational movements is less predictable and has been unreliable in past series.^{1,44}

Good rotational movements are obligatory for performance of activities of daily living (ADLs), internal rotation (IR) for activities regarding perineal and self-hygiene,^{21,31,35} and external rotation (ER) for reaching with the hand to the mouth and head (for eating, drinking, and combing the hair).²¹ The capability of performing these ADLs provides independence for many of these usually elderly patients.⁴⁵

Werner et al.⁴⁵ found that active ER (AER) did not improve but actually decreased by a mean of 5°, particularly in elevation and abduction. The loss of AER was also observed by Baulot et al.⁴ Therefore, concerns remain regarding performing bilateral rTSA because of the lack of rotational movements bilaterally and the resultant difficulties with ADLs. Several authors have recommended caution with bilateral rTSA.^{7,32,45,46} Some even suggested performing rTSA on one side to achieve good elevation and an anatomic prosthesis on the other side to compensate and have good rotational movements but without good elevation.

Bilateral rTSA is indicated in the case of bilateral CTA. Osteoarthritis and inflammatory arthritis often occur bilaterally, requiring arthroplasty treatment of both shoulders.¹⁴ Conversely, bilateral rTSA as a surgical treatment for bilateral, symptomatic CTA has been reported to produce unfavorable outcomes with respect to patient quality of life. Difficulties with IR and ER and the associated infringement on ADLs, specifically the inability to perform perineal care associated with toileting and bathing, have made surgeons reluctant to perform the procedure.^{35,37}

The use of bilateral arthroplasty has proven successful in several other orthopedic procedures. Procedure outcomes in bilateral total hip arthroplasty^{5,26,33} and bilateral total knee arthroplasty^{3,36} have both been extensively reviewed. Although a few studies have examined bilateral shoulder arthroplasty, most reports have focused on bilateral anatomic TSA^{14,17} or a combination of TSA and rTSA.²² The number of reports examining bilateral rTSA is even more limited.^{29,40,41,46} This study examined the clinical and radiographic outcomes of patients with bilateral rTSA in restoration of function and their ability to resume ADLs and more. Our null hypothesis was that bilateral rTSA would cause lack of rotational movements bilaterally and resultant difficulties with ADLs.

Materials and methods

Review of the prospectively collected data revealed 19 patients (38 shoulders) who underwent staged bilateral rTSA at our institution between 2007 and 2013, with a minimum of 2 years of follow-up after the second operation. There were 15 women and 4 men, the mean age at surgery was 74.5 years (range, 63-90 years), and the mean follow-up was 48.4 months (range, 24-75 months). The indications for surgery were CTA in 13 patients (one side was fracture sequela in 2 patients), after failed rotator cuff repairs of massive

cuff tears in 1, osteoarthritis in 1, and rheumatoid arthritis in 4. In 6 patients the rTSA was performed as revision arthroplasty. In 5 patients, one side was operated on as revision arthroplasty, and 1 patient with rheumatoid arthritis underwent bilateral revision arthroplasties (Table I). All cases were performed at a high-volume shoulder arthroplasty center by a single surgeon (O.L.).

All of the primary procedures and all but 1 of the revisions were performed through the Neviaser-MacKenzie anterosuperior approach.²⁷ Only 1 revision of a well-fixed stemmed TSA (Biomodular; Biomet, Warsaw, IN, USA) to a stemmed Verso rTSA (Innovative Design Orthopaedics, London, UK; formerly Biomet, Swindon, UK) was performed through the deltopectoral approach to allow performing humeral window osteotomy for removal of the stem.

The same Verso implant was used in all procedures. In all the primary cases and in 3 of the revisions, the stemless metaphyseal prosthesis was used. In 4 revision cases of failed stemmed arthroplasty the Stemmed Verso implant was used.

A humeral cut of 155° in 30° retroversion was performed in all shoulders, and the humeral component was inserted in 30° of retroversion. However, this implant has a 10° angled dialable polyethylene liner that changes the angle of the humeral component to 145° and allows for final fine adjustment of the optimal version in each patient to achieve the optimal arc of rotations.^{2,25} The implant has a +3-mm lateralized center of rotation (LCOR) from the glenoid face incorporated in the glenosphere.^{2,25}

The posteroinferior rotator cuff was absent in 36 shoulders; however, the surgeon always attempted to approximate any existing remnant of the teres minor. The teres minor was present in 2 shoulders operated on for osteoarthritis.

A standardized postoperative rehabilitation protocol was followed in all patients. Patients were evaluated clinically and radiographically preoperatively and postoperatively at 3 weeks, 3 months, 6 months, 1 year, and yearly thereafter. Three patients died of unrelated causes more than 2 years after the last operation, so their last follow-up data were considered.

Shoulder function was assessed using the Constant score (CS),¹⁰ patient's satisfaction score, Subjective Shoulder Value (SSV),¹⁶ or Single Assessment Numeric Evaluation (SANE),⁴⁷ and the Activities of Daily Living External and Internal Rotations score (ADLIER) score, which was modified from the ADLER (Activities of Daily Living Requiring External Rotation) score.⁶

The ADLIER score questionnaire assesses 12 different activities that represent ADLs such as to comb the hair, to shave (men) or apply make-up (women), to brush teeth, to dress without help, to fill a glass from a full bottle, to drink with a full glass, to use their hand to eat with a utensil or eat soup with full spoon, to shake hands or open a door, to use a telephone at the ear level, to write/type or play the piano, to use and remove object from their back pocket, to manage toileting, and to wash the armpit and the back of the opposite shoulder. All these activities should be performed without the help of flexing the neck or bending the trunk and without the help of first abducting the elbow (ie, without doing a Hornblower sign). Each activity is scored as 0 = unable to do, 1 = very difficult to do, 2 = somewhat difficult to do, 3 = not difficult at all. The total score is 36 points (Table II).

Patient satisfaction and pain relief were assessed on a 0 to 10 and a 0 to 15 visual analog scale, accordingly.

The patients' function and range of motion were clinically assessed by independent observers. A goniometer was used to measure range of motion in forward elevation, abduction, ER, and IR in a

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