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Risk of insufficient internal rotation after bilateral reverse shoulder arthroplasty: clinical and patient-reported outcome in 57 patients

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Background: Bilateral reverse shoulder arthroplasty (RSA) is controversial because of potential rotational deficits impairing daily living activities. We assessed achievement of insufficient internal rotation (IR) and associated factors in bilateral RSA patients.

Methods: Fifty-seven staged bilateral RSA patients with a minimum of 1 year of follow-up after the second intervention were identified from our local monocentric register. Shoulder range of motion (including IR using the Apley scratch test), strength, and Constant and Shoulder Pain and Disability Index scores were assessed preoperatively and 6, 12, and 24 months postoperatively.

Results: Before surgery, both shoulders were similar regarding imaging parameters, but first operated shoulders tended to have poorer function. One year after the first RSA, 21% of patients had insufficient IR (not reaching the lumbosacral junction) compared with 33% after the second intervention ($P = .180$). At 2 years, 5% of patients had insufficient IR on both sides. Patients with insufficient IR on the second side at baseline (relative risk [RR], 1.8 [1.0-3.2]) and patients with insufficient IR 1 year after the first RSA (RR, 3.0 [1.6-5.6]) were more likely to have insufficient IR 1 year after the second RSA. Constant and Shoulder Pain and Disability Index scores and abduction of the second side were significantly worse 1 year after the second RSA ($P \leq .047$); at 2 years, there were no differences in functional outcome between shoulders.

Conclusion: A minority of bilateral RSA patients did not achieve sufficient IR on at least 1 side. Staged surgery is justified, particularly when the outcome of the initial operation is satisfactory.

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

Keywords: Bilateral reverse shoulder arthroplasty; internal rotation; Constant score; patient-reported outcomes; complications; case series

Reverse shoulder arthroplasty (RSA) is a current option to treat cuff tear arthropathy, irreparable rotator cuff tears, fractures or fracture sequelae, rheumatoid arthritis, and degenerative arthritis with glenoid bone loss and static dislocation.[36] With the gain in abduction and flexion, possible loss of rotation can occur after RSA with associated adverse

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effects on activities of daily living. This effect is thought to result from the differing lever arms of the deltoid muscle, in which more fibers are recruited for flexion and abduction.[4] Further reasons for loss of rotation include the positioning of the humeral component, in which more retroversion may theoretically allow more external rotation (ER) at the expense of internal rotation (IR),[5] and the prosthetic design of the glenosphere. A number of studies focused on improving ER in the treatment of cuff tear arthropathy with RSA.[4,9,14,25,31,37] ER is important for positioning the hand in front of the body, especially during eating or undertaking various grooming activities on the face. Less attention has been placed on IR, although it is as important for performing daily activities involved with, for example, toilet hygiene.[26]

Because symptomatic rotator cuff tears are often bilateral,[23,29,39] treatment of both sides may become necessary. If one side has already been successfully treated by RSA, it seems logical to repeat the intervention on the contralateral joint. However, bilateral RSA jeopardizes the bilateral rotational function regardless of any achieved improvements in elevation and pain relief.[4] Losing rotation in both limbs can severely impair a patient's self-dependence. Some authors therefore consider hemiarthroplasty to be the best therapeutic option.[19] Nonetheless, a comparison of functional outcomes achieved after treatment of cuff tear arthropathy with hemiarthroplasty vs. RSA shows better functional results for RSA patients with comparable complication rates.[21,40] Only a few studies with small cohorts report on the outcome of bilateral RSA.[34,38]

We investigated the postoperative clinical and functional outcomes of staged bilateral RSA with special attention paid to the outcome of IR. Specifically to support decision-making, we explored factors associated with a lack of achieving sufficient IR of the second shoulder 12 months after RSA, including IR achievement of the first shoulder.

Materials and methods

Since March 2006, patients who received a shoulder arthroplasty were consecutively documented in a monocentric local shoulder prostheses register at our clinic.[20,30] Patients receiving bilateral RSA as the primary operation for various indications were identified. Patients receiving RSA as a revision intervention or because of an acute proximal humerus fracture sustained in 1 shoulder or both shoulders were excluded, as were those who did not complete at least a 12-month follow-up examination for each side. All patients and their data were handled according to routine practice. Ethical approval was obtained to use the clinical data for research purposes.

All RSA procedures were performed according to the manufacturer's instructions with 1 of the following prostheses: Promos Reverse (Smith & Nephew Orthopaedics AG, Rotkreuz, Switzerland); SMR Reverse (Lima Corporate S.p.a., Udine, Italy); Aequalis Reversed (Tornier AG, Cham, Switzerland); and Univers Revers (Arthrex Inc, Naples, FL, USA). All surgeries were performed in a standardized manner through the deltopectoral approach, including tenotomy and repair of the subscapularis (SSC) tendon whenever possible and irrespective of the degree of muscle degeneration. All prostheses were positioned according to the recommended amount of retroversion. After surgery, the treated arm was initially immobilized in a sling for 3 days and at night for a period of 4 weeks. All patients followed a standardized postoperative rehabilitation program involving passive motion on the first day after surgery with only limited ER to protect the reinserted SSC tendon.

Follow-up examinations and radiographic assessment

All patients included in our registry underwent clinical and radiographic evaluation preoperatively (ie, baseline) as well as at 6, 12, 24, and 60 months after surgery. For this analysis, 12- and 24-month follow-up examinations after primary implantation were considered. In the event that a complication was documented and required a revision operation, the follow-up schedule was reset on the basis of the date of the prosthesis revision.

Clinical assessment of insufficient shoulder IR was defined as not reaching the lumbosacral junction in the Apley scratch test. Active shoulder anteversion, abduction, and ER in 0° abduction were clinically measured with a goniometer. Abduction strength in 90° abduction was also determined for both shoulders using a spring scale (Pesola AG, Baar, Switzerland). Functional outcome instruments included the Constant-Murley[8] and Shoulder Pain and Disability Index (SPADI)[1] questionnaires. In addition, patients were asked if they would opt to undergo the same operative procedure again, given their shoulder condition at the time. Intraoperative and postoperative complications were documented according to Audigé et al.[2]

Standard radiographs in anteroposterior (with IR and ER) and axial views were obtained at each examination. Preoperative radiographs were assessed to determine the grade of glenohumeral arthritis as defined by Samilson and Prieto,[27] osteoarthritic changes of the glenoid according to Walch et al,[35] and arthropathy according to Hamada et al.[17] In addition, the status of the supraspinatus (SSP), infraspinatus (ISP), and SSC tendons (ie, intact, partial or complete rupture) was evaluated before and during surgery by ultrasound or magnetic resonance imaging (MRI). For a small proportion of patients with available MRI scans, the degree of fatty infiltration in the rotator cuff muscles was also determined.[13] All postoperative radiographs were assessed for signs of implant loosening, polyethylene erosion, migration of the components, and scapular notching.[32]

Data management and statistical analysis

Register data were managed using the REDCap electronic data capture system[18] and exported for statistical analysis using Intercooled Stata version 13 (StataCorp LP, College Station, TX, USA). All analyses were explorative. Baseline characteristics as well as the 12- and 24-month outcome parameters for each shoulder were compared. Paired tests including the paired *t* test as well as the signed rank and McNemar tests were used, depending on the nature of the variables, with a significance level set at .05.

Insufficient IR at baseline and the 12- and 24-month follow-up examinations was compared using a generalized mixed regression model considering both paired sides and repeated outcome measures. Potential prognostic factors for insufficient IR on the second side 12 months after RSA were also explored using univariable and multivariable binomial regression analyses including the following factors: age (≤70/>70 years); gender; operation on a dominant side;