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Functional internal rotation after shoulder arthroplasty: a comparison of anatomic and reverse shoulder arthroplasty

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Background: Recovery of functional internal rotation after primary shoulder arthroplasty is essential to perform many important activities of daily living. Functional internal rotation is typically reported as it relates to clinical examination findings of motion (posterior reach) and lift-off or belly-press tests. A more detailed evaluation of functional recovery of internal rotation after primary anatomic total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA) is needed.

Methods: A retrospective review of patients treated with primary TSA (n = 132) and RSA (n = 91) with a minimum 2-year follow-up was performed. Subanalysis of revision RSA (n = 24) and primary RSA was performed. Active range of motion, subjective internal rotation motion, manual internal rotation strength, and specific questions related to internal rotation function isolated from the Simple Shoulder Test (SST) and American Shoulder and Elbow Surgeons (ASES) functional questionnaires were reviewed.

Results: Compared with RSA, TSA patients could more likely reach the small of the back (SST) and wash the back/fasten bra (ASES). Active internal rotation motion, SST score, ASES score, and subjective internal rotation were greater after TSA. No significant difference was observed with respect to managing toileting between cohorts. Revision RSA patients were less likely to be able to wash the back/fasten bra (ASES) and easily manage toileting (ASES) compared with primary RSA patients.

Conclusion: Primary anatomic shoulder arthroplasty yields greater functional internal rotation than does primary RSA, with either procedure being effective at managing toileting. Patient education regarding activities of daily living related to internal rotation can be predicted.

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

Keywords: Total shoulder arthroplasty; reverse shoulder arthroplasty; internal rotation; functional recovery; activities of daily living; shoulder arthroplasty expectations

Loss of functional internal rotation is often observed in patients requiring shoulder arthroplasty. Arthritic changes of the shoulder are associated with stiffness, joint contractures, and osteophyte formation, which typically limit internal rotation in patients treated with anatomic total

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shoulder arthroplasty (TSA), whereas subscapularis insufficiency from a massive rotator cuff tear often limits functional internal rotation in patients treated with reverse shoulder arthroplasty (RSA). Restoration of internal rotation is a critical component of functional recovery after shoulder arthroplasty. Important simple activities of daily living (ADLs), such as dressing, bathing, and toileting, rely on the ability to achieve a functional degree of internal rotation.[18] The amount of internal rotation necessary to achieve this level of function was described as 100° of total shoulder internal rotation with the arm at the side.[18] This amount of motion is necessary to achieve 2 internal rotation tasks—to reach the small of one's back to tuck in a shirt and to wash the middle of one's back/unhook a bra—evaluated in commonly used outcome measurement surveys, the Simple Shoulder Test (SST) and American Shoulder and Elbow Surgeons (ASES), respectively.[18] Evaluation of functional internal rotation after shoulder arthroplasty is typically accomplished by examination of motion, internal rotation strength, and ability to perform a belly-press or lift-off maneuver. However, the ultimate patient goal relates to the ability to perform functional internal rotation tasks such as those questioned on the ASES and SST surveys.

Recovery of internal rotation after TSA has been previously characterized and seems to be related to healing of the subscapularis and restoration of shoulder rotational flexibility.[11,16] Typically, this is assessed by internal rotation measurements of the highest midline segment of the back that can be reached (posterior reach)[8] as well as by the lift-off and belly-press tests.[7,16] Deficiencies in subscapularis function and internal rotation function have been reported after TSA in upward of 68% of patients[16] and have been shown to limit functional ADLs, such as the ability to tuck in a shirt.[1,19]

Patients treated with RSA have demonstrated limited improvements in internal rotation.[10,22,23] This limitation has been the primary reason for some authors advocating against performing bilateral RSA because of a fear of complete loss of the ability to perform simple tasks like toileting.[26] Restoration of internal rotation after RSA may be less related to subscapularis function as Clark et al[3] reported no difference in internal rotation motion with and without subscapularis repair. It is more likely that impingement-free arc of motion[2,24] better defines the ability of RSA to restore internal rotation function. To date, however, no study has evaluated the functional recovery of internal rotation after RSA as it relates to essential internal rotation functions typically inquired from functional outcome questionnaires. The purpose of this study was to evaluate the functional recovery of internal rotation after both TSA and RSA. Our hypothesis is that functional internal rotation will be greater for TSA patients than for RSA patients in evaluating for specific functional tasks as well as both subjective and measured range of motion.

Methods

A retrospective query of a prospectively collected shoulder arthroplasty repository (Holy Cross Shoulder Outcomes Repository) was performed. This repository consists of a database of physical examination measurements and patient-reported outcomes scores collected electronically during a patient follow-up encounter. Treating physicians are typically not present while patients are completing outcome questionnaires. No patients were contacted by phone interview. All patients treated with primary TSA and RSA with a minimum 2-year follow-up were selected for primary analysis. In addition, patients treated with revision RSA with a minimum 2-year follow-up were reviewed for subanalysis comparison with primary RSA patients. The most recent follow-up data were used to evaluate several aspects of functional internal rotation. Active range of motion measurement was defined as the highest midline segment of the back that can be reached.[8] As a means of controlling for measurement bias, the measurement was converted into 5 range segments of motion and converted into a 10-point scale (Fig. 1).[10] Subjective internal rotation was assessed by allowing each patient to select the picture best representing the ability to place the hand to the highest midline segment of the back (Fig. 1). Internal rotation strength was assessed by manual testing of internal rotation effort by mimicking the belly-press sign[5] with the 5-point Oxford scale.

Specific questions related to internal rotation function were isolated from the SST[12] and ASES functional questionnaire.[15,20] Responses from the SST question "Can you reach the small of your back to tuck in your shirt with your hand?" and responses to the two ASES function questions—"Wash back/do up bra in back?" and "Managing toileting?"—were noted at most recent follow-up and compared. For analytical purposes of the ASES questions, participants were described as being able to complete tasks easily, being able to complete tasks with difficulty, or unable to complete task.

A total of 223 patients who underwent primary shoulder arthroplasty surgery met the inclusion criterion of minimum 2-year follow-up data. There were 91 patients treated with RSA (median follow-up, 35 months; range, 24-87 months) and 132 patients treated with TSA (median follow-up, 37 months; range, 24-83 months). The median age of patients treated with TSA was 70 years (range, 32-89 years) at the time of surgery; there were 63 men and 69 women. The median age for the RSA patients at the time of surgery was 76 years (range, 52-88 years); there were 33 men and 58 women. Patients treated with RSA were significantly older than patients treated with TSA ($P < .001$). There was no statistical difference with respect to gender between primary TSA and RSA ($P = .089$).

The surgical approach for TSA used a lesser tuberosity osteotomy (105 patients) unless the bone quality was anticipated to be poor (27 patients). In those cases, a subscapularis peel was used. A subgroup analysis comparing TSA patients treated with lesser tuberosity osteotomy and those treated with subscapularis peel was performed to determine differences in internal rotation function and motion between techniques. All patients were treated with either the DJO Turon TSA (DJO Surgical; Austin, TX, USA) or Encore Foundation TSA (DJO Surgical). TSA was performed in patients with end-stage glenohumeral arthritis observed on preoperative radiographs or computed tomography scans, with an intact rotator cuff based on physical examination and intraoperative observations.