J Shoulder Elbow Surg (2018) 27, S43–S49

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Good functional outcomes expected after shoulder arthroplasty irrespective of body mass index

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Background: This study evaluated how body mass index (BMI) factors into functional outcomes and complications after shoulder arthroplasty.
Methods: A retrospective analysis was performed of age-matched patients with a minimum 2-year follow-up after total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RTSA), or hemiarthroplasty (HA). Patient-reported outcome (PRO) scores, range of motion (ROM), and complications were assessed. Forty-nine patients were classified into the following groups: normal (BMI <24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2), class I obese (BMI 30-34.9 kg/m2), class II obese (BMI 35-39.9 kg/m^2), and class III morbid obese (BMI ≥40 kg/m^2).
Results: A total of 245 patients (134 women, 111 men; average age, 64 ± 8 years) were evaluated at an average follow-up of 48 ± 18 months. TSA was performed in 122 patients (50%), RTSA was performed in 103 (42%), and HA was performed in 20 (8%). No significant difference was found among the 5 BMI groups in arthroplasty type ($P = .108$) or in complications, including reoperations ($P = .27$). All groups had significant postoperative improvements in PROs and ROM ($P < .001$ for both). There were no significant differences among the BMI groups in postoperative ROM or PROs.
Discussion: This study demonstrates that patients undergoing TSA, RTSA, and HA can expect good functional outcomes, with improvements in pain, function and outcome scores, irrespective of BMI.
Levels of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Shoulder arthroplasty; obesity; outcomes; complications; BMI; body mass index

The management of glenohumeral arthritis in patients with an intact rotator cuff with total shoulder arthroplasty (TSA) results in excellent pain relief and significantly improved functional outcomes.[5,7,31] Patients with cuff tear arthropathy, fracture sequelae, inflammatory arthropathy, and failed prior anatomic shoulder arthroplasty have achieved significant improvements in pain and functional outcomes with the reverse TSA (RTSA).[3,9,11,26] As indications for shoulder arthroplasty continue to expand, its use in the United States continues to increase.[20,29] Furthermore, as the aging population continues to grow, the burden of patients needing a shoulder arthroplasty is expected to increase.

Obesity presents a significant health issue throughout the world. The World Health Organization reported the

The Rush University Office of Research Affairs approved this study (#12062802).

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1058-2746/$ - see front matter
https://doi.org/10.1016/j.jse.2018.03.022

rate of obesity with a body mass index (BMI) >30 kg/m^2 in 2009 to 2010 was 36% for men and women.[6] Minorities and the elderly are especially prone to being overweight or obese, with rates up to 70%.[18,27] In the hip and knee arthroplasty literature, increased complication and revision rates are strongly correlated with obesity.[1,4,15,16] Despite this, functional outcomes are still expected to significantly improve after knee arthroplasty in the obese patient population.[23]

Most studies to date that have evaluated the effects of obesity on shoulder arthroplasty are insurance and health care database studies. Werner et al[28] found that a BMI >50 kg/m^2 was associated with a significant increased rate of surgical and postoperative complications for patients after shoulder arthroplasty. Gupta et al[10] found increased complication rates in patients undergoing RTSA with a BMI >35 kg/m^2. In contrast, Anakwenze et al[2] found no significant increase in the deep infection rate, aseptic revision rate, or 1-year mortality after shoulder arthroplasty with higher BMI groups. Similar to Anakwenze et al, Jiang et al[12] reported increased surgical times with increasing BMI levels but found no increase in short-term complications between the different obesity classes. Most recently, Wagner et al[25] reported significantly increased rates of revision surgery, superficial wound infection, and postoperative complications in the higher BMI groups. Regarding patient satisfaction and functional outcomes, TSA and RTSA both demonstrated good pain relief and functional outcome scores in obese patients.[13,14,17,19,21,24]

Thus, the effect of patient BMI status on outcomes after shoulder arthroplasty is unclear due to differing study designs and differing databases. The purpose of this study was to stratify clinical outcomes and complication rates among differing BMI groups in patients who undergo TSA, RTSA, or hemiarthroplasty (HA) from a single-institution with high-volume fellowship-trained surgeons, with a minimum 2-year follow-up. We hypothesized that patients in all BMI groups would have a significant improvement in clinical outcome scores and similar complication rates.

Materials and methods

Consecutive patients undergoing shoulder arthroplasty by 2 high-volume fellowship-trained surgeons (G.P.N. and A.A.R.) were retrospectively reviewed from a prospectively maintained shoulder arthroplasty database. All patients who underwent a nonrevision arthroplasty, including TSA, RTSA, or HA, and had minimum 2-year clinical follow-up were identified. The study excluded patients with incomplete medical records, including preoperative patient-reported outcomes (PROs), those undergoing revision arthroplasty surgery, and those with less than 2 years of follow-up.

Patient BMI grouping

Patients were classified according to the World Health Organization BMI classification[30] as normal (BMI <24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2), class I obese (BMI 30-34.9 kg/m^2), class II obese (BMI 35-39.9 kg/m^2), and class III morbid obese (BMI ≥40 kg/m^2). Patients who met the inclusion criterion were age matched with 49 patients in each BMI group. Patient demographics and type of surgery are reported in Table I.

Outcomes measures

All patients included in this study completed the following PRO scores preoperatively and postoperatively: Single Assessment Numeric Evaluation, American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form, Western Ontario Osteoarthritis of the Shoulder index, visual analog scale (VAS), and Simple Shoulder Test (SST). Range of motion (ROM), including forward elevation, external rotation at the side, and abduction internal rotation, was measured by the treating physician during the patient's preoperative visit and at the final follow-up. Complications, including persistent pain, poor range of motion, superficial and deep infections, fractures, and all reoperations were recorded.

Statistical analyses

The statistical tests were computed with SPSS 22.0 software (IBM, Armonk, NY, USA). Statistical analysis was performed using 1-way univariate and multivariate analysis of covariates adjusting for BMI

Table I Demographic data of study population by body mass index group

Variable	Body mass index group (kg/m^2)				
	<25 (n = 49)	25-29.9 (n = 49)	30-34.9 (n = 49)	35-39.9 (n = 49)	>40 (n = 49)
Sex					
Female	33	19	24	29	29
Male	16	30	25	20	20
Diabetes	5	7	6	12	17
TSA	19	27	30	19	27
RTSA	24	19	16	28	16
Hemiarthroplasty	6	3	3	2	6

TSA, total shoulder arthroplasty; *RTSA*, reverse total shoulder arthroplasty.
Data are presented as number of patients.