# The effect of body mass index on one-year functional outcome, quality of life and postoperative complications in total shoulder arthroplasty

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## Abstract

The aim of this retrospective cohort study was to investigate the effect of BMI on 1-year functional outcome, quality of life (QoL) and rate of postoperative complications after shoulder arthroplasty. We included 121 patients (59 men and 62 women) with primary osteoarthritis (OA) who underwent anatomical or reverse total shoulder arthroplasty (TSA or rTSA) between 2011 and 2016. Age, sex, preoperative BMI, preoperative medical status using American score of anesthesiologists (ASA) class, type of prosthesis, preoperative and 1-year postoperative functional outcome using the Constant score and quality of life (QoL) using the EQ-5D as well as postoperative complication rate were documented. Patients were divided into three groups based on their BMI, group 1 (normal weight, BMI <25), group 2 (overweight, BMI 25-30) and group 3 (obese, >BMI 30). All three groups were comparable regarding age, sex and ASA class, preoperative Constant score EQ-5D. We found significant improvement of the Constant score and EQ-5D at 1-year postoperative follow-up, regardless of BMI (p<0.05). Comparing the three groups, we found no significant differences among them in 1-year Constant score, EQ-5D or postoperative rate of complications. This study showed that BMI did not affect functional outcome, QoL and postoperative complication rate in TSA. These results can help physicians and patients to make reasonable perioperative expectations and planning.

## Introduction

Total shoulder arthroplasty (TSA) is a cost-effective and successful surgical intervention for patients with shoulder joint osteoarthritis (OA) complaining of persistent pain and disability.[1] The procedure has been around for many decades and provides substantial improvement in both pain relief and function.[2,3] However, more than 10% of TSA patients report persistent pain and suboptimal functional outcome at follow-up.[4] The absolute number of dissatisfied patients is expected to rise given the increase in the annual number of TSA performed. Therefore, every effort should be made to investigate factors that could influence the outcome.

The phenomenon of unhealthy diet and sedentary lifestyle is giving rise to the modern epidemic of obesity. Currently more than two-thirds of US citizens are classified as obese and medical costs associated with obesity exceed $275 billion. This accounts for over 20% of all healthcare expenditure.[4,5] Because of the extensive adipose tissue in obese patients, performing a TSA can be challenging and may give suboptimal surgical technique, longer operative time and bleeding as well as increased rate of postoperative complications, such as wound infection.

The negative effects of body mass index (BMI) on lower limb arthroplasty have been repeatedly shown in several studies.[6,7] However, the effect of BMI on functional outcome, quality of life (QoL) and postoperative complication rate after TSA needs further research as the current available evidence in the literature is still scarce.[8] To this date, a few studies have been done showing disparity on whether obesity is associated with postoperative complications and negative outcome.[9-11]

The aim of this study was to investigate the effect of BMI on post TSA functional outcome and QoL and whether BMI is associated with increased rate of postoperative complications. Our hypothesis was that BMI would negatively influence the examined outcome parameters.

## Materials and methods

This study is a retrospective cohort study. The inclusion criteria for this study were patients that had undergone primary TSA between Jan 2011 and Jan 2016 at Sundsvall Teaching Hospital. Excluded patients were post-traumatic osteoarthritis (OA), inflammatory OA and revisions. In March-April 2018, an observer not involved in patient management conducted a thorough review of related medical records. The following medical data were collected and analyzed: sex, age, BMI (kg/m^{2} where kg is a patient's weight in kilograms and m[2] is thei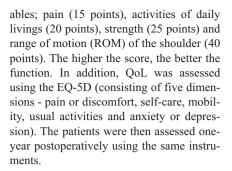r height in meters squared, checked by the physician or the nurse at preoperative admission), indication for surgical intervention, concomitant diseases [evaluated using the American Society of Anesthesiologists (ASA) grade], type of prosthesis (anatomic or reverse) and postoperative complications that required medical or surgical intervention such as infection, instability or periprosthetic fractures.

Three patient groups were categorized based on BMI (kg/m^{2}), following an a-priori decision and according to the World Health Organization (WHO): group 1 consists of normal weight patients (BMI <25); group 2 consists of overweight patients (BMI 25-30), and group 3, obese patients (BMI >30).

Patients were either given stemless TSA or an uncemented stemmed reverse TSA (TESS, Zimmer Biomet) prosthesis depending on the status of their rotator cuff muscle, which was evaluated preoperatively.[12,13]

### Outcome scores

An independent observer conducted data collection. To assess the preoperative functional impairment, the Constant score questionnaire was used. It is a scoring system with a 100-point scale, used to evaluate function of the shoulder based on four vari-

ables; pain (15 points), activities of daily livings (20 points), strength (25 points) and range of motion (ROM) of the shoulder (40 points). The higher the score, the better the function. In addition, QoL was assessed using the EQ-5D (consisting of five dimensions - pain or discomfort, self-care, mobility, usual activities and anxiety or depression). The patients were then assessed one-year postoperatively using the same instruments.

### Statistical analysis

We used the Kruskal-Wallis test to compare continuous variables among the BMI groups such as age, Constant score and EQ-5D. The Chi square test for more than two groups was used to compare the categorical variables (sex, type of prosthesis and rate of complications). A *p*-value <0.05 was considered statistically significant.

### Results

One hundred and twenty-one patients (59 men and 62 women, mean age 69.2 years, SD 8.5, range 28 to 89) were enrolled in the study. The mean BMI was 28.3 (SD 4.1, range 21 to 43). Seventy-six TSA and 45 rTSA were fitted. Group 1 (BMI <25 kg/m²) consists of 26 patients (21%) with a mean BMI of 23.6 (SD 1.0). Group 2 (overweight, BMI 25-30 kg/m²) consists of 59 patients (49%) with a mean BMI of 27.3 (SD 1.2). Group 3 (obese, BMI >30 kg/m²) consists of 36 patients (30%) with a mean BMI of 33.5 (SD 3.0).

The demographics of the three groups are found comparable as shown in Table 1.

Regarding outcome scores at 1-year follow-up, Constant scores and EQ-5D were available in 17 of 26 patients (65%) for group 1, 40 of 59 patients (68%) for group 2 and 22 of 36 patients (61%) for group 3. All three groups showed significant improvement in the 1-year Constant score and EQ-5D compared with that preoperatively (p<0.05). However, we found no statistical differences among the three groups in the 1-year Constant score and EQ-5D, both for the absolute and Δ values (Table 2).

The most common postoperative complication was wound infection. Group 1 had 5 patients (19%) with complications; group 2 had 12 patients (20%) with complications while Group 3 had 3 patients (8%) with complications. This was not statistically significant (p=0.39).

### Discussion

The results of this study showed no differences among the different BMI groups in preoperative functional status and QoL and postoperative functional outcome, QoL and postoperative complication rate. All three BMI groups showed significant improvement in the 1-year Constant score and EQ-5D compared to preoperative measures.

The absence of BMI influence on outcome in this study does not concur with the results of other studies that evaluated the role of BMI in postoperative outcomes after hip and knee arthroplasty.[6,7] A possible explanation for this discrepancy could be the increased loading and demand the lower limbs are exposed to compared to the shoulders. Hence, a minor impairment after arthroplasty in the lower limbs could have a higher impact compared to the shoulder. In addition, the more sedentary lifestyle that is often related to patients with higher BMI could also have skewed the results. A less physically active person is going to put less strain on the prosthesis and hence risk fewer complications postoperatively. With less activity come also lower demands from the patient related to both function and QoL. This is something the questionnaires do not take into consideration.

Martino and Gulotta[8] reviewed the literature to identify studies reporting outcomes of TSA in obese patients. They evaluated about 20 studies of different designs. Similar to our study, Statz et al.[14] found reasonable improvement in postoperative outcome and comparable complication rate in obese patients compared to non-obese patients who underwent rTSA. Also, Anakwenze et al.[15] reported no association

**Table 1. Demographics of the groups.**

|  | Group 1 (BMI <25 kg/m²) | Group 2 (overweight, BMI 25-30 kg/m²) | Group 3 (obese, BMI >30 kg/m²) | P |
|---|---|---|---|---|
| Number (%) | 26 (21) | 59 (49) | 36 (30) | |
| Mean age (SD) | 67.8 (10) | 69.9 (8.5) | 69.2 (6.7) | 0.74 |
| Sex (M, F) | 11, 15 | 34, 25 | 14, 22 | 0.16 |
| Type of prosthesis TSA, rTSA | 13, 13 | 38, 21 | 25, 11 | 0.28 |
| ASA class | | | | 0.63 |
| ASA 1 | 2 | 5 | 3 | |
| ASA 2 | 18 | 43 | 24 | |
| ASA 3 | 6 | 11 | 9 | |
| ASA 4 | | | | |
| Mean preoperative Constant score (SD) | 33.3 (14.3) | 34.5 (12.6) | 36.2 (11.5) | 0.54 |
| Mean preoperative EQ-5D (SD) | 0.47 (0.16) | 0.48 (0.20) | 0.50 (0.17) | 0.95 |

**Table 2. Mean Δ and constant scores.**

|  | Group 1 (BMI <25 kg/m²) | Group 2 (overweight, BMI 25-30 kg/m²) | Group 3 (obese, BMI >30 kg/m²) | P |
|---|---|---|---|---|
| Mean absolute 1-year Constant score (SD) | 66.3 (19.0) | 69.3 (18.9) | 68.0 (10.5) | 0.65 |
| Mean absolute 1-year EQ-5D (SD) | 0.82 (0.35) | 0.79 (0.24) | 0.78 (0.15) | 0.98 |
| Mean Δ 1-year Constant score (SD) | 33.0 (19.4) | 34.8 (16.0) | 31.8 (12.6) | 0.85 |
| Mean Δ 1-year EQ-5D (SD) | 0.35 (0.29) | 0.31 (0.25) | 0.28 (0.15) | 0.90 |

between obesity and 1-year risk for revision or 3-year mortality risk. Morris *et al.*[16] investigated a prospective registry and identified 77 patients with rTSA with a minimum of 2 years follow-up. They found a comparable improvement in function and mobility in different BMI groups. Similar results were also reported by Pappou *et al.*[17] and Vincent *et al.*[18] On the other hand, other studies found that obesity was negatively associated with postoperative functional and QoL gains, postoperative complication rate, reoperation and revision.[8] One possible explanation could be that these studies had a larger sample size and more patients with obesity and morbid obesity. Singh *et al.*[10] found in their study a lower rate of mortality after TSA among the patients with higher BMI.

The present study has some limitations. The retrospective study design resulted in missing data in a number of patients. Also, the questionnaires used have a ceiling/floor effect and therefore might not optimally evaluate the difference between the study groups over/below a certain threshold. However, these questionnaires are broadly utilized and allow for comparison with other studies in the field. Furthermore, an independant observer not involved in patient management collected medical records.

## Conclusions

In conclusion, this study showed that BMI did not affect functional outcome, QoL and postoperative complication after TSA. These results can help physicians and patients to make reasonable perioperative expectations and planning.

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