Does Increased Body Mass Index Influence Outcomes After Rotator Cuff Repair?

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Purpose: To investigate the influence of pre-existing obesity (body mass index [BMI] $\geq$ 30) on outcomes after rotator cuff repair surgery. **Methods:** We collected data on adult patients who underwent surgical repair for symptomatic full-thickness rotator cuff tears confirmed by imaging between 2012 and 2015. The required follow-up was 3 years. At baseline and 6, 12, 24, and 36 months, the American Shoulder and Elbow Surgeons score, Western Ontario Rotator Cuff index, and visual analog scale pain scores were collected. Complications were assessed by a chart review. Obesity was defined as BMI $\geq$ 30. Chi-square analysis and Student's *t*-test examined differences between categorical and continuous variables at baseline. Generalized estimating equations examined the effects of fixed factors on outcome variables longitudinally from baseline to 36 months. **Results:** Thirty-nine percent of 213 subjects were obese (mean BMI = 29.2; range, 16-48; standard deviation, 5.8). There were no statistically significant differences between obese and nonobese subjects in other baseline characteristics. When controlling for covariates, obese subjects reported no differences in Western Ontario Rotator Cuff, American Shoulder and Elbow Surgeons, or visual analog scale pain scores when compared with nonobese subjects at baseline and over 3 years from surgery. Although obese patients were more likely to have inpatient surgery, there was no difference in the incidence of postoperative complications. **Conclusions:** Contrary to our hypothesis, obese participants who underwent rotator cuff repair reported no difference in functional outcome or pain scores compared with nonobese participants over 3 years. In addition, obesity was not associated with postoperative complications in this study. However, as we hypothesized, obese participants were more likely than nonobese participants to have repair in the inpatient setting. **Level of Evidence:** Level III, retrospective comparative study.

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Rotator cuff injuries are among the most prevalent musculoskeletal injuries and important causes of disability in the United States. The prevalence of full-thickness rotator cuff tears in the population older than 60 years has been estimated to be between 25% and 30%, increasing to a prevalence of 50% at 80 years of age.[1,2]

Another common health problem in the United States is obesity. High rates of obesity in the United States have been well documented. In 2011-2012, 34.9% of the U.S. population was obese, with more than two-thirds of adults considered either overweight or obese.[3] Obesity is a major health concern and is associated with an increased risk of hypertension, type 2 diabetes, stroke, osteoarthritis, sleep apnea, and some cancers.[4] Obesity also increases both cardiovascular disease mortality and all-cause mortality.[4] Furthermore, medium and severe obesity have been demonstrated to increase the risk of postoperative complications and unplanned hospital admissions after surgery.[5]

Increased body mass index (BMI) has been associated with an increased incidence of rotator cuff tendonitis and rotator cuff tears.[6,7] Although the association of obesity and rotator cuff injuries has been reported, the literature is extremely limited regarding surgical outcomes for

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obese patients. The few studies addressing this issue report differing conclusions.[8-10]

Because of the large number of obese patients undergoing surgery and the scarce amount of information on the subject, further investigation is warranted to elucidate the effect of increased BMI on surgical outcomes in rotator cuff disease. Increased knowledge regarding outcomes will enable physicians to make more informed decisions for obese patients regarding treatment allocation, with the ultimate goal to improve outcomes after rotator cuff repair.

The purpose of this study was to investigate the influence of pre-existing obesity (BMI $\geq$ 30) on outcomes after rotator cuff repair surgery. We hypothesized that after rotator cuff repair, obese patients would have worse functional outcomes and more complications compared with nonobese individuals.

Methods

Study Design

This study was a retrospective review of prospectively collected data from an ongoing shoulder pain registry. The registry consists of both operative and nonoperative patients with a primary diagnosis of tendinosis, partial rotator cuff tear, or full-thickness rotator cuff tear. For the registry recruitment, following Institutional Review Board approval, patients presenting to an orthopaedic sports clinic with known symptomatic rotator cuff pathology were offered enrollment in this shoulder registry with recruitment ongoing since 2010. Multiple regression-based imputation was conducted based on a missing at random assumption with no less than 10 iterations being conducted that would allow N = 213 completed sets of data. Registry participants were a convenience sample of those with a new patient visit and were nonrandomized and nonconsecutive. Inclusion criteria consisted of subjects 18 years of age or older who underwent arthroscopic rotator cuff repair for a full-thickness rotator cuff tear as confirmed by magnetic resonance imaging or diagnostic musculoskeletal ultrasound and had attained 3 years of follow-up. Exclusion criteria for the present study included prior surgery, fracture, dislocation, infection, and inflammatory joint disease of the affected shoulder.

Three fellowship-trained surgeons (A.B., J.E.C., B.S.M.) at a single orthopaedic institution performed rotator cuff repair, with all surgeries being conducted arthroscopically. Treatment allocation (surgery) was determined by patient and surgeon agreement. Although the repair technique was not standardized in this patient population, in general tears smaller than 1 cm in anteroposterior were repaired with a single-row technique, whereas bigger tears of complex tears were repaired with a double-row technique. All subjects were immobilized for 4 to 6 weeks before initiating formal physical therapy.

Patients provided basic demographic information at baseline and self-reported outcome measures at the initial visit and at 6-, 12-, 24-, and 36-month follow-up from baseline date via mailed questionnaires. The primary dependent variable was the American Shoulder and Elbow Surgeons (ASES) score, with the primary independent variable of interest being BMI. Secondary dependent variables were the pain visual analog scale (VAS) and the Western Ontario Rotator Cuff (WORC) index.

Height and weight were measured at registry enrollment and used to calculate BMI. Subjects were then classified into categories of obese (BMI $\geq$ 30) or nonobese (BMI $<$ 30) using criteria outlined by the National Institutes of Health.[11]

Outcome Measures

All patients completed the WORC, the ASES, and a VAS score for pain at baseline and each follow-up time point.

The ASES, the primary outcome measure in this study, consists of questions that assess pain, activity, and instability of the shoulder. The survey features a VAS for severity of pain followed by 10 questions about pain with different activities. For the activity questions, possible answers range from unable to do (0) to not difficult (3). The ASES also asks a series of yes/no questions about pain and medication for pain, followed by one yes/no question and a VAS to indicate shoulder instability. Total score is calculated between 0 and 100, with lower scores indicating worse pain and disability.[12] The ASES has been found to be reasonably reliable, valid, and responsive.[12-15] Although the ASES includes a question regarding instability, which was an exclusion factor for our study, it was developed and validated as a measure applicable to a variety of shoulder diagnoses and is well represented and reported on in rotator cuff literature.[16,17]

The WORC score comprises 5 domains: (1) pain and physical symptoms, (2) sports and recreation, (3) work function, (4) social function, and (5) emotional function. Responses are recorded using a VAS as described above.[18] Higher scores are associated with worse quality of life. This test has been shown to be valid, reliable, and responsive.[13,18-20]

The VAS is used to assess pain. The VAS employs a 100-mm scale and labels at each end of the scale to indicate the extremes, for example no pain and worst pain possible[21]; the patient then draws a line perpendicular to the scale to indicate where his or her experience falls. A higher score indicates worse pain for the patient. This method allows patients to more precisely indicate how they feel based on an infinite number of points. This tool has been demonstrated to be valid, reliable, and responsive.[22-24]