J Shoulder Elbow Surg (2016) 25, 913–919

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Preoperative patient-reported scores can predict postoperative outcomes after shoulder arthroplasty

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Background: Total shoulder arthroplasty and reverse total shoulder arthroplasty are increasingly used to improve pain and function in patients with glenohumeral arthritis or cuff tear arthropathy. Our objective was to determine if preoperative patient-reported outcome measures predict which patients will achieve clinically meaningful improvements after shoulder arthroplasty.

Methods: Preoperative and 1-year postoperative 12-Item Short Form Health Survey (SF-12) Physical Component Summary (PCS) and Mental Component Summary (MCS) scores and American Shoulder and Elbow Surgeons (ASES) pain and function scores were prospectively collected from 107 patients who underwent total or reverse shoulder arthroplasty. The minimum clinically important difference (MCID) defined meaningful clinical improvement. Receiver operating characteristic analysis was used to calculate threshold values and *C* statistic. Multivariate logistic regression analysis was performed to determine preoperative measures that were indicative of achieving the MCID postoperatively.

Results: Threshold values below which patients were more likely to achieve MCID were 12 for ASES function, 25 for ASES pain, 46 for SF-12 PCS, and 42 for SF-12 MCS. Multivariate analysis revealed that preoperative ASES function (area under the curve, 0.79; $P = .006$) and ASES pain (area under the curve, 0.90; $P < .001$) measures were predictive of achieving the MCID postoperatively. Patients with higher preoperative SF-12 MCS scores had a higher likelihood of achieving MCID for each measure.

Conclusion: We determined threshold values that predict clinically meaningful improvement after shoulder arthroplasty. Patients with higher preoperative mental health scores and lower physical function and pain scores were more likely to gain significant benefits from surgery. These results can be used to facilitate shared decision-making and to forecast expected benefits after shoulder arthroplasty.

Level of evidence: Level II; Retrospective Design; Prognosis Study

Keywords: Total shoulder arthroplasty; reverse total shoulder arthroplasty; patient-reported outcomes; shoulder arthroplasty outcomes; ASES score; SF-12 score

Shoulder arthroplasty is a highly effective procedure for improving function and decreasing pain in patients with glenohumeral disease or rotator cuff tear arthropathy. Since the development of total shoulder arthroplasty (TSA) by Neer in

This study has been approved by the UCSF Institutional Review Board (#10-02764).

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1058-2746/$ - see front matter © 2016 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2016.01.029

the 1970s,[21] very good medium- and long-term results have been demonstrated with TSA.[5,12,26] More recently, reverse total shoulder arthroplasty (RTSA) has become a popular option, particularly in the setting of rotator cuff deficiency or revision. Although early studies of RTSA showed higher complication rates compared with conventional TSA,[8,11,17,29] recent studies demonstrate outcomes and complication rates similar to those of TSA.[18,24,33]

An increasing number of TSAs and RTSAs are being performed for degenerative shoulder disease.[16,30-32] Despite the overall success of shoulder arthroplasty, certain patients experience less than optimal clinical or functional results after surgery.[9,14] In addition, differences exist in patient selection based on age, gender, body mass index (BMI), and geographic region. These findings emphasize the importance of understanding factors that contribute to patient outcomes after shoulder arthroplasty. In recent years, evaluation of the success of procedures has shifted away from physician-based measures toward patient-reported outcome measures (PROMs), many of which have been used to describe outcomes after arthroplasty.[22,28]

Preoperative assessment provides insight into the patient's perception of his or her preoperative level of function and pain and is an important predictor of postoperative outcome in hip and knee arthroplasty.[2] Postoperatively, PROMs demonstrate the impact of arthroplasty on pain, function, and patient satisfaction. In total hip arthroplasty, preoperative pain and function (both mental and physical) have been shown to be strongly predictive of postoperative pain and functional status.[1,2,7,15,23] Total hip arthroplasty patients with worse baseline pain and function scores had greater absolute improvement but still had overall worse outcomes compared with patients with better preoperative status.[15] Thus, the use of preoperative pain and function levels can guide discussion with patients about expected benefit after arthroplasty and support shared decision-making processes.[2]

Current studies have reported clinical, patient-reported, and radiographic outcomes as well as complications of TSA and RTSA, but none have investigated the association between preoperative patient function and postoperative outcomes.[3,5,12,18,24,26,33] The objective of this study was to determine if preoperative PROMs predict which patients will achieve clinically meaningful improvements after TSA and RTSA. We hypothesized that threshold values will define the probability of achieving these improvements and that shoulder-specific outcome measures will be better predictors than those that measure general health.

Materials and methods

Data for this study were obtained from a prospectively collected shoulder arthroplasty outcomes database maintained at the authors' institution. The shoulder arthroplasty surgeries included in this study were performed by 3 sports medicine and shoulder fellowship-trained orthopedic surgeons (C.B.M., B.T.F., A.L.Z.).

There were no major complications in the study population. A team of research assistants enrolled patients during clinic visits and collected demographic information and patient-reported outcome surveys on paper. These data were then entered into a privacy-protected electronic database (Research Electronic Data Capture [REDCap] system). The database includes demographic information (age, gender, BMI) and patient-reported outcome scores for TSA and RTSA. Preoperative and 1-year postoperative 12-Item Short Form Health Survey (SF-12) Physical Component Summary (PCS) and Mental Component Summary (MCS) scores as well as American Shoulder and Elbow Surgeons (ASES) pain and function scores were assessed from patients who underwent primary TSA or RTSA with Food and Drug Administration–approved shoulder arthroplasty implants at a single institution between 2011 and 2014. Patients included in the study had preoperative patient-reported outcome scores and at least 1 year of postoperative follow-up. Exclusion criteria were patients with pathologic fracture or malignant neoplasm.

There were 107 patients who met our inclusion criteria. This represents 81% of the 132 patients undergoing either TSA (50 patients) or RTSA (82 patients) in our shoulder arthroplasty outcomes database for the study period. Twenty-five patients were not included because they were lost to follow-up. The most common primary diagnosis was osteoarthritis (45%), followed by rotator cuff arthropathy (29%). Table I shows the primary diagnosis for all included patients. The average age of the patients was 66.8 years (standard deviation, 11.6) for RTSA and 66.2 years (standard deviation, 9.9) for TSA. In the RTSA population, 52% were male compared with 59% in the TSA group. The average BMI was 34.6 for patients undergoing RTSA and 29.2 for those undergoing TSA.

SF-12 and ASES PROMs were collected preoperatively and 1 year postoperatively. Respective scores were determined using the scoring algorithms for each outcome measure. The SF-12 version 2 survey was used for this study, which includes the same 12 questions as the original SF-12 survey but has been modified to improve formatting and

Table I Primary diagnoses for patients undergoing shoulder arthroplasty

Diagnosis	Percentage of patients
Osteoarthritis	45
Rotator cuff arthropathy	29
Failed shoulder replacement	12
Infection	6
Fracture	4
Malunion	1.5
Avascular necrosis	1.5
Failed open reduction–internal fixation	1