J Shoulder Elbow Surg (2013) 22, 869-876

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

SHOULDER

Isometric strength, range of motion, and impairment before and after total and reverse shoulder arthroplasty

Brian Puskas, MD[a], Kevin Harreld, MD[a], Rachel Clark, BA[b], Katheryne Downes, MPH[c], Nazeem A. Virani, MD, MPH[b], Mark Frankle, MD[a,*]

[a]*Shoulder & Elbow Division, Florida Orthopaedic Institute, Tampa, FL, USA*
[b]*Clinical Research Department, Foundation for Orthopaedic Research and Education, Tampa, FL, USA*
[c]*Office of Research, University of South Florida, Tampa, FL, USA*

Background: Medicare Part A provides similar resources for coverage of inpatient hospitalization costs for patients treated with total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA). This is based on an assumption that TSA and RSA are used to treat similar patient populations with comparable disease severity. However, no objective clinical information is available to support this resource allocation. The purpose of this study is to quantify the disease severity and subsequent improvement from primary TSA, primary RSA, and revision arthroplasty (TSA and RSA).

Methods: From March 2004 through May 2006, 174 shoulders (87 primary TSA, 55 primary RSA, and 32 revision cases) were prospectively studied using Biodex (Biodex Medical Systems, Shirley, NY, USA) isometric strength and standardized video range of motion measurements performed by an independent third-party observer at 1 week before surgery and at an average of 49 months (range, 32-69 months) postoperatively. Patient impairment ratings were calculated using the Florida Impairment Guidelines.

Results: Primary TSA had the lowest average preoperative impairment (21%), and revision arthroplasty had the highest (28%). All patients demonstrated improvement in the parameters tested. At an average 49 months, all 3 groups demonstrated a similar reduction in impairment ratings (TSA: 21% to 10%; RSA: 25% to 15%; revision arthroplasties: 28% to 20%).

Conclusion: There are distinct differences in preoperative disease severity among patients undergoing primary TSA, primary RSA, and revision arthroplasty. Greater impairment is evident in patients undergoing a revision arthroplasty. However, all groups may be expected to achieve improvements and maintain these improvements 4 years postoperatively.

Level of evidence: Level II, Prospective Cohort Design, Treatment Study.

Keywords: Shoulder arthroplasty; cost-effectiveness; impairment; strength; range of motion; economic evaluation

When nonoperative treatments are unsuccessful, total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA) effectively decrease pain and improve function in patients with end-stage degenerative shoulder disease.[1,3,6,9,12,15-18] The indications for these 2 distinct procedures vary greatly, reflecting differences in the

This study was approved by the Western Institutional Review Board (Study # 1098441).

*Reprint requests: Mark Frankle, MD, Shoulder & Elbow Division, Florida Orthopaedic Institute, 13020 N Telecom Pkwy, Tampa, FL 33637, USA.

E-mail address: frankle@pol.net (M. Frankle).

1058-2746/$ - see front matter © 2013 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2012.09.004

underlying patient populations. However, these 2 patient populations are considered equivalent for purposes of hospital resource allocation, as directed in Section 1886(d) of the Social Security Act. This provision sets forth a system of hospital payment under Medicare Part A, which covers the costs of inpatient hospitalization in which reimbursement rates are the same for patients in a given homogenous cluster, called a diagnosis-related group (DRG).

Each DRG has a payment weight assigned to it based on the average resources used to treat Medicare patients. When the amount of resources used is not known, as was the case when RSA was introduced in the United States in 2004 and 2005, payment was based on the assumption that patients within a given category are clinically similar, have similar severity of disease, and are therefore expected to use the same level of hospital resources. The assignment of a DRG code is therefore linked to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) code. This ICD-9-CM code (81.80) was the same for RSA and TSA from 2004 to 2006. As a result, TSA and RSA are both currently assigned the same resources from Medicare Part A.

However, little objective information exists to provide for a rational allocation of resources based on the severity of the underlying shoulder condition. Patients managed with RSA are generally felt to represent a different patient population from those undergoing TSA. Patients treated with RSA suffer from muscular insufficiency of the rotator cuff and also variable amounts of glenohumeral cartilage loss, whereas, patients undergoing TSA suffer primarily from articular cartilage disease. Patients requiring a revision from a previous arthroplasty may also have additional pathology. These differences are not captured in the current allocation scheme.

The purpose of the current study was to characterize disease severity preoperatively and postoperatively in 3 patient groups—primary TSAs, primary RSAs, and revision shoulder arthroplasties—using objective outcome measures. Our main hypothesis is that patients undergoing primary TSA would be less impaired than those undergoing primary RSA. Our secondary hypothesis is that patients undergoing a primary arthroplasty would have lower postoperative impairment ratings than the revision shoulder arthroplasties. Lastly, we hypothesize that identifiable patient factors will have an effect on postoperative disease severity as measured by impairment.

Materials and methods

All patients provided informed consent before participating in the study. To assess the difference in disease severity between TSA and RSA patients, we used subjective and objective measures to perform a prospective cohort study of a single surgeon's shoulder arthroplasty practice. Objective measures of isometric strength and range of motion (ROM) were obtained, as described below. Data were collected 1 week before surgery and at a minimum of 2 years postoperatively.

Table I Reasons for nonparticipation

Reason for nonparticipation	Patients	Shoulders
	No. (%)	No. (%)
Deceased	41 (10)	42 (11)
Unable to locate	47 (12)	50 (13)
Missed scheduled appointment	19 (5)	19 (5)
Moved out of state	20 (5)	20 (5)
In assisted living facility	3 (<1)	3 (<1)
No longer able to travel	33 (8)	33 (8)
Poor health	24 (6)	24 (6)
Unsatisfied with surgery	10 (3)	10 (3)
No longer desire to participate	19 (5)	19 (5)
Bilateral shoulder*	0 (0)	2 (<1)
Totals	216	222

* Only most recent shoulder included.

Patient population

Between March 2004 and May 2006, 396 shoulders in 390 patients underwent TSA (n = 204) or RSA (n = 192). All surgical procedures were performed by the senior author (M.A.F.) after failure of a reasonable trial of nonoperative management. The type of prosthesis used was consistent throughout this interval (DJO TSA and DJO Reverse Shoulder Prosthesis, Encore Medical, Austin, TX, USA). Inclusion criteria for the current study included all patients undergoing shoulder arthroplasty within the specified timeframe regardless of diagnosis or surgical history; however, patients had to complete preoperative and postoperative isometric Biodex strength testing (Biodex Medical Systems, Shirley, NY, USA) in the method described below. If the patient had bilateral shoulder arthroplasties, only the most recent shoulder was included to maintain statistical assumptions of independence of observations. There were no other exclusion criteria. Table I summarizes reasons for nonparticipation in the current study. Preoperative and postoperative data at our follow-up visits were available for 174 patients, comprising 87 with primary TSA, 55 with primary RSA, and 32 with revision arthroplasties.

Primary TSA group

A primary TSA was performed in those patients with radiographic evidence of glenohumeral arthritis on preoperative imaging (radiographs and computed tomography scan) and an intact rotator cuff by physical examination and intraoperative inspection. The TSA group consisted of 87 shoulders in 87 patients (38 women, 49 men) who were a mean age of 66 years (range, 35-89 years). Mean follow-up was 49 months (range, 32-69 months). In this group, none of the 87 primary TSA patients had undergone any previous shoulder surgeries.

Primary RSA group

A primary RSA was performed in those patients with rotator cuff deficiency of the shoulder along with glenohumeral subluxation, glenohumeral arthritis, or pseudoparesis (<90° of elevation) of the shoulder. A combination of findings from the physical examination (rotator cuff weakness, dynamic instability, and limited ROM)