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Does Total Ankle Arthroplasty Belong in the Comprehensive Care for Joint Replacement?

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A R T I C L E I N F O

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A B S T R A C T

The Comprehensive Care for Joint Replacement (CJR) model seeks to lower costs and improve quality for primary lower extremity joint replacements. This includes total ankle arthroplasty (TAA), which is performed far less frequently than total hip (THA) and knee (TKA) arthroplasty. We used the SPARCS database to identify 537 TAA and 239,053 elective primary THA or TKA procedures from 2009 to 2014, excluding hip fractures. Compared with THA and TKA, TAA had a shorter mean length of stay (2.2 versus 3.2 days), greater mean cost ($20,817 versus $17,613), lower rate of disposition to nursing and rehabilitation facilities (17% versus 52%), and lower rate of 90-day readmission (4.9% versus 5.8%). In multivariable-adjusted regression models of TAA versus THA and TKA, length of stay was 30% shorter ($p < .001$), costs were 14% greater ($p < .001$), and risk of disposition to nursing and rehabilitation facilities was 86% lower ($p < .001$), with no significant difference in 90-day readmission ($p = .957$). Patients undergoing TAA had different patterns of short-term resource usage compared with patients undergoing THA and TKA, most notably higher short-term costs. The economic viability of TAA is threatened by alternative payment models that reimburse hospitals for TAA at the same rate as THA and TKA.

On April 1, 2016, the Centers for Medicare and Medicaid Services (CMS) implemented the Comprehensive Care for Joint Replacement (CJR) model for 67 major metropolitan areas in the United States. According to the CMS, "The CJR model aims to support better and more efficient care for beneficiaries undergoing the most common inpatient surgeries for Medicare beneficiaries: hip and knee replacements (also called lower extremity joint replacements)" (1). To accomplish these objectives, the CJR uses quality metrics and bundled payments that encompass an episode of joint replacement care, which begins with the index admission and ends 90 days after discharge.

Although primary total hip (THA) and knee (TKA) arthroplasty are the most common inpatient surgeries for Medicare beneficiaries, hip hemiarthroplasty and total ankle arthroplasty (TAA) are also included in the CJR under the umbrella definition of lower extremity joint replacement. Hip hemiarthroplasty is almost exclusively reserved for the treatment of acute hip fractures. In contrast, THA and TKA are treatments for chronic joint degeneration. The CJR acknowledges that geriatric hip fracture patients have differences in their general medical condition and short-term healthcare resource usage compared with elective joint replacement patients and has therefore stratified its reimbursements to providers for the presence of a hip fracture (2,3).

During the feedback period for the proposed CJR rule, the American Academy of Orthopaedic Surgeons and the American Orthopaedic Foot and Ankle Society (AOFAS) urged the CMS to reconsider the inclusion of TAA in the CJR (4,5). Similar to hip fracture patients who undergo hip hemiarthroplasty, patients with end-stage ankle arthritis who undergo TAA were believed to represent a different patient population with different healthcare needs than those undergoing THA and TKA. The specific differences cited by the AOFAS included the greater implant costs, longer operating times, increased procedure complexity, and prolonged immobilization necessitating greater usage of postoperative acute care services (5). Despite these concerns about TAA, the CMS ultimately considered it equivalent to THA and TKA in the final CJR rule (3).

We share many of the same concerns as the American Academy of Orthopaedic Surgeons and AOFAS about TAA's inclusion in the CJR. However, we were unable to identify any previous studies that directly compared the short-term clinical and economic outcomes of

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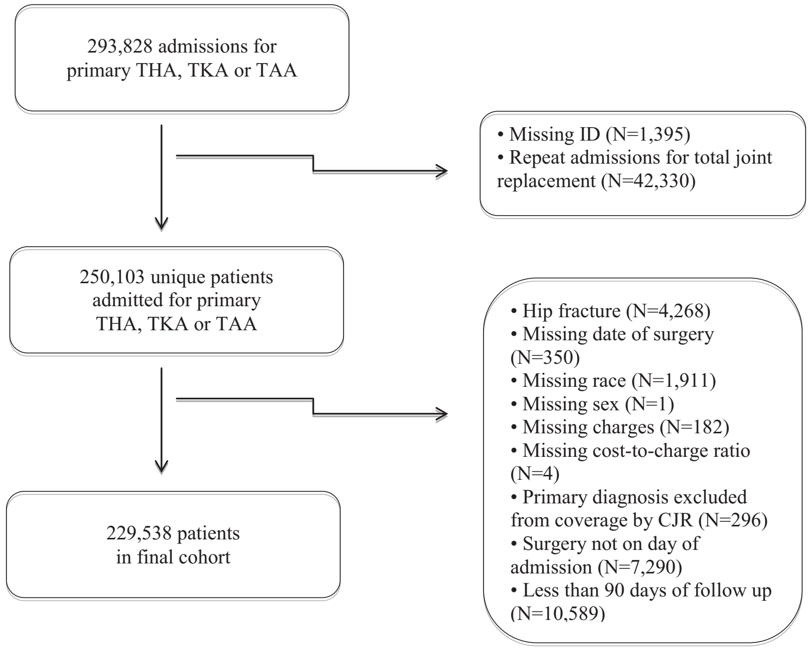

Fig. The study cohort selection flowsheet. The data in parentheses are not additive, because some patients had multiple exclusions. CJR, Comprehensive Care for Joint Replacement; ID, identification; TAA, total ankle arthroplasty; THA, total hip arthroplasty; TKA, total knee arthroplasty.

TAA versus elective primary THA and TKA. Therefore, we conducted a retrospective cohort study to explore the differences between these procedures regarding the (1) length of stay of the index admission; (2) cost of the index admission; (3) rate of disposition to nursing and rehabilitation facilities; and (4) rate of 90-day readmission.

Materials and Methods

Study Design and Setting

The New York Statewide Planning and Research Cooperative System (SPARCS) is a comprehensive healthcare data reporting system established by the New York State Department of Health. This database contains all hospital admissions that occur within New York State annually. Each record includes the patient demographics and details of the clinical course, including medical diagnoses and surgical procedures. The database creates a unique identification code for each patient, allowing researchers to retrospectively monitor patients. Because our version of the SPARCS database does not contain any protected health information, our institutional review board determined the present study was exempt from informed consent. The investigation was performed at SUNY Downstate Medical Center (Brooklyn, NY) and NYU Hospital for Joint Diseases (New York, NY).

Study Subjects

The study cohort flowchart is shown in the Fig. We initially identified 293,828 admissions from January 1, 2009 to December 31, 2014 with a Medicare Severity–Diagnosis Related Groups (MS-DRG) code of 469 or 470 and a primary International Classification of Diseases, ninth revision (ICD-9) procedure code for primary THA (81.51), primary TKA (81.54) or primary TAA (81.56). We excluded patients with an ICD-9 diagnosis code of hip fracture as defined by the CJR, those with primary ICD-9 diagnosis codes excluded from coverage by the CJR, and patients with <90 days of follow-up (1). With some patients accounting for multiple exclusions, our final study cohort consisted of 229,538 patients.

Variables

We extracted patient demographic data, including age (in years), sex (male or female), race (white or nonwhite), insurance (Medicare/Medicaid or private/other) and year of admission (2009 through 2014). Comorbidities were assessed using the Charlson/Deyo scoring method for ICD-9 coding (6).

For the index admission, the outcomes included the length of stay, cost, and disposition to a nursing or rehabilitation facility. During the follow-up period, our outcome of interest was 90-day readmission to a New York State hospital with an MS-DRG code considered surgery related by the CJR (1). Costs were derived using hospital inpatient cost transparency data provided by the New York State Department of Health (7) and expressed in 2016 US dollars using inflation rates from the Consumer Price Index (8). For each All Patient Refined Diagnosis-Related Group and its 4 levels of severity of illness for a given hospital in a given calendar year, we defined the cost-to-charge ratio as the mean cost of admission divided by the mean charge of admission.

Statistical Analysis

We used frequency tables and proportions to describe the patient characteristics stratified by the type of lower extremity joint replacement. We calculated the significance of differences in each variable using Fisher exact tests for binary variables and χ^2 tests for multilevel categorical variables. For the 6 p values we reported (Table 1), we used the Holm-Bonferroni method to correct for multiple comparisons (9).

We used geometric mean values to report averages in length of stay and cost. Geometric means were selected over arithmetic means because they are less influenced by outlier values. To calculate the magnitude and significance of differences in the length of stay and cost, we used mixed effects linear regression models. We performed logarithmic transformations on the length of stay and cost in these regression models to normalize the variables' right-skewed distributions and assigned a value of 0.001 to outcomes equal to 0 days or $0. We interpreted the regression coefficients and 95% confidence intervals (CIs) as the percentage of differences using the formula $100 \times (e^b - 1)$, where b is the parameter estimate of a log-transformed outcome variable (10).

We used frequency tables with proportions to describe the disposition and readmission rates. For these values, we calculated exact (Clopper-Pearson) 95% CIs using binomial proportions. To calculate the magnitude and significance of differences in disposition and readmission, we used mixed effects logistic regression models to calculate odds ratios and 95% CIs. We interpreted these values as the percentage of differences in risk using the formula $100 \times (\text{odds ratio} - 1)$.

All mixed effects regression models used THA and TKA as the reference group. The models were controlled for hospital and year of surgery as random effects variables and categorical age, sex, race, insurance, categorical Charlson/Deyo score, and MS-DRG as fixed effects variables. For the 4 p values we reported from the mixed effects regression models in our primary analysis, we used the Holm-Bonferroni method to correct for multiple comparisons (9). In secondary analyses, we performed each analysis on the subset of Medicare patients undergoing TAA versus THA and TKA. We performed all statistical analyses using SAS version 9.4 (SAS Institute Inc., Cary, NC).