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Time Trends in Characteristics of Patients Undergoing Primary Total Hip and Knee Arthroplasty in California, 2007-2010

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ABSTRACT

Background: As the number of total hip and knee arthroplasty cases increases, it is important to understand the burden of factors that impact patient outcomes of these procedures. This article examined the time trends in key demographics, clinical characteristics, comorbidity burden (Deyo-Charlson Comorbidity Index [CCI]), and presence of depression in patients undergoing primary total hip arthroplasty and total knee arthroplasty using population-based, all-payer inpatient database, California Healthcare Cost and Utilization Project, from 2007 to 2010.
Methods: Chi-square tests and analysis of variance were used. Multivariate logistic regression analyses were also performed to compare the prevalence of depression in 2007 to later years.
Results: In the primary total hip arthroplasty cohort, the prevalence of depression significantly increased by 20%, mean age decreased by 0.4 years, mean length of stay (LOS) decreased by 0.5 days, and having a CCI score of $\geq$3 increased by 30% (P value < .001 for all) over the study period. Similarly, in the primary total knee arthroplasty cohort, the prevalence of depression increased by 23%, the mean age decreased by 0.4 years, mean LOS decreased by 0.4 days, and the prevalence of CCI score of $\geq$3 increased by 35% (P value < .001 for all).
Conclusion: Despite the younger age of the joint arthroplasty population over time, we found increased prevalence of depression and comorbidity scores but shorter LOS. Further study is needed to determine the impact of the changing demographics of the total joint population and the best strategies to optimize their outcome with these procedures.

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Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are highly successful surgeries in terms of cost-effectiveness, pain reduction, and improvement in quality of life for patients with hip or knee osteoarthritis [1–5]. The incidence of both surgeries is increasing and is expected to reach 3.48 million by the year 2030 [6]. The result is an increased demand on hospital resources to provide adequate care to THA and TKA patients. Therefore, it is important to understand whether patient characteristics and complexity are changing over time, and if so, how they are changing in order to better optimize healthcare resources. This is particularly true as bundled payment reimbursement programs continue to spread and providers become increasingly responsible for managing care through an entire care episode.

In an attempt to begin to assess the critical population characteristics of patients undergoing total joint arthroplasty, we examined the age, prevalence of depression, and medical comorbidity rates using a large population-based database. The null hypothesis was that there are no significant trends over time in these THA and TKA patients' characteristics.

Materials and Methods

Data Source

The data were extracted from the population-based, all-payer California Healthcare Cost and Utilization Project database [7] for

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Table 1
Clinical and Demographic Characteristics of Study Cohorts in 2007-2010.

Variable	Primary THA (N = 65,067)	Primary TKA (N = 132,406)
Gender		
Female	38,222 (59%)	83,074 (63%)
Male	26,845 (41%)	49,348 (37%)
Age, mean (SD), y	68.9 (10.1)	68.9 (9.3)
50-<59	13,688 (21%)	24,196 (18%)
60-<69	20,531 (32%)	44,982 (34%)
70-<79	19,534 (30%)	44,210 (34%)
80+	11,314 (17%)	19,017(14%)
Race		
White	57,011 (88%)	107,752 (81%)
Black	2975 (5%)	6956 (5%)
Hispanic	131 (0.1%)	434 (0.1%)
Asian	1776 (3%)	5749 (4%)
Others	3174 (5%)	11,515 (9%)
Insurance		
Medicaid	1355 (2%)	3541 (3%)
Private	23,245 (36%)	40,272 (30%)
Others	40,467 (62%)	88,593 (67%)
Length of stay, mean (SD), d	3.4 (2.2)	3.4 (1.6)
Deyo-Charlson Comorbidity Index, mean (SD)	0.5 (1.0)	0.6 (1.0)
0	42,839 (66%)	79,321 (60%)
1	14,569 (22%)	35,852 (27%)
2	4791 (7%)	10,824 (8%)
≥3	2868 (4%)	6409 (5%)
Depression	5483 (8.4%)	11,878 (9%)
Alcohol abuse	822 (1.3%)	1149 (0.9%)
Drug abuse	397 (0.6%)	660 (0.5%)
RA/inflammatory arthritis	2041 (3.1%)	4401 (3.3%)

Values are the number (%) unless indicated otherwise.
THA, total hip arthroplasty; TKA, total knee arthroplasty; SD, standard deviation; RA, rheumatoid arthritis.

hospital discharges after primary, unilateral TKA (n = 132,406; International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] procedure 81.54) or THA (n = 65,067; ICD-9-CM procedure 81.51) for adults aged 50 and older from 2007 to 2010, the most recent data available for this large, diverse state. We included subjects with osteoarthritis (ICD-9-CM diagnosis codes: 715.0(0, 4, 9), 715.1(0-8), 715.2(0-8), 715.3(0-8), 715.8(0, 9), 715.9(0-8)) and excluded subjects who underwent more than one knee or hip arthroplasty within a year. This exclusion required us to use data from 2006 to allow for a look back period for previous surgeries for subjects undergoing treatment in 2007. Therefore, subjects who underwent surgery in 2006 were not included as index cases.

Study Outcome and Covariates

The primary comorbidity of interest was depression. Comorbid depression present during the index admission was identified using the algorithm described by Elixhauser [8] according to the ICD-9-CM diagnosis code at time of discharge for surgery. We modified the depression comorbidity by adding 2 ICD-9-CM codes for major depressive episode, 296.2(0-6) and 296.3(0-6), which were not included in Elixhauser method [8]. Additionally, medical comorbidity, alcohol and drug abuse, hospital length of stay (LOS), patient demographics including age, sex, race, and insurance type were examined. Overall medical comorbidity burden was assessed with the Deyo-Charlson Comorbidity Index (CCI) [9] based on the presence of ICD-9-CM codes at the time of surgery, a validated measure of comorbidity, consisting of a weighted scale of 17 comorbidities (including cardiac comorbidity, pulmonary comorbidity, renal comorbidity, hepatic disease, diabetes mellitus, cancer, hemiplegia, and not including depression, or alcohol and drug abuse) [10,11], expressed as CCI categories of 0, 1, 2, and ≥3 comorbidities as in other work [12].

We included demographic data such as age, sex, race/ethnicity, and insurance type. The presence of rheumatoid arthritis (RA)/inflammatory arthritis and LOS were also considered. Age was categorized in 5-year age-groups: 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80 or older. Race/ethnicity was represented by 5 categories of white, black, Hispanic, Asian, and others.

Statistical Analyses

Summary statistics were calculated as the proportion or the mean ± standard deviation. The number of patients within each category of the variable was compared over time using a chi-squared test. Means of continuous variables were compared using analysis of variance in various time periods. We further examined the time trends in the proportion of patients with comorbid depression using multivariate logistic regression. The earliest year, 2007, was considered the reference year. The overall *P* value for the variable was considered an indicator of whether there was a period effect. The odds ratio in the multivariate logistic regression was used in the assessment of a time trend. We analyzed THA and TKA groups separately. All *P* values were 2-sided with statistical significance evaluated at the $\alpha = .05$ level. *P* values were further corrected for multiple comparisons with the Bonferroni method. Statistical analyses were performed using R statistical software version 3.1.3 (www.R-project.org). [13].

Results

Table 1 summarizes the characteristics of THA and TKA patients in 2007-2010. The primary THA cohort consisted of 65,067 patients; 59% were women, 17% were ≥80 years old, 88% were white, 3% were Medicaid-insured, 3.1% had an additional diagnosis of RA/inflammatory arthritis, 8.4% had comorbid depression, and 1.3% and 0.6% had an alcohol or drug abuse diagnosis, respectively. The mean LOS was 3.4 days. The mean CCI was 0.54, and 4% of patients had CCI scores ≥3.

The primary TKA cohort consisted of 132,406 patients; 63% were women, 14% were ≥80 years old, 81% were white, 2% were Medicaid-insured, 3.3% had an additional diagnosis of RA/inflammatory arthritis, 9% had comorbid depression, and 0.9% and 0.5% had an alcohol or drug abuse diagnosis, respectively. The mean LOS was 3.4 days. The mean CCI was 0.6, and 5% of patients had CCI scores ≥3.

Time Trends in Demographic and Clinical Characteristics

In THA group, the mean age decreased by 0.4 years (69.0 to 68.6 years). While there was an increase in the proportion of the 2 youngest age-groups of 50-59 years and 60-69 years, there was a reduction in those aged ≥70 years over the 4-year study period. A significantly higher proportion of patients had a CCI score ≥3 in the most recent year compared with the earliest year, increasing approximately by 30% (from 3.8% to 4.9%). LOS decreased from an average of 3.7 days in 2007 to 3.2 days in 2010 ($P < .001$; Table 2). We noted a significant increase in the prevalence of comorbid depression over the study period, increasing 20% (from 7.5% to 9.0%; Table 2). During the same period, alcohol and drug abuse rates increased from 1.1% to 1.5% and from 0.5% to 0.8%, which were slight but statistically significant increases.

Similarly, in TKA group, we note the greatest increase in proportion of patients with a CCI score ≥3 in the most recent year compared with the earliest year by 35% (4.0% to 5.4%) and a

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