Impact of Race and Gender on Utilization Rate of Total Shoulder Arthroplasty

STEPHEN YU, MD; SIDDHARTH A. MAHURE, MD; NISHA BRANCH, MD; BRENT MOLLON, MD, FRCSC; JOSEPH D. ZUCKERMAN, MD

abstract

Marked underutilization rates of total joint arthroplasty in minorities compared with nonminorities exist, with a paucity of literature surrounding inequities related to total shoulder arthroplasty (TSA). Using the Statewide Planning and Research Cooperative System database, patients who underwent elective TSA in New York State (NYS) were identified and characterized by age, race, gender, medical comorbidities, and payor status. Patients were stratified into 4 separate 5-year periods from 1990 to 2009. Comorbidity severity was defined using the Elixhauser criteria. A total of 10,538 elective TSAs were identified, with half of the procedures occurring in the most recent time quartile. Whites accounted for 70% of the procedures, whereas blacks accounted for 5%. During the 20-year period, the age-adjusted incidence of TSA in white men and women increased by 417% and 421%, respectively, whereas the incidence for black men and women increased by 378% and 329%, respectively. Black men had the lowest utilization rate among all subgroups, and overall disparity between races continued to widen over time. Blacks had significantly more comorbid conditions ($P<.001$) than whites when undergoing TSA. Blacks were more likely to have Medicaid insurance and less participation in Medicare ($P<.001$). Racial and gender disparities clearly exist in TSA utilization rates in NYS and may be worsening. Although reasons for these disparities are likely multifactorial, a deeper understanding of the factors involved in patient selection and access to care is necessary to appropriately address these disparities and effect change at a system-wide patient and provider level. [Orthopedics. 2016; 39(3):e538-e544.]

In the United States, identifiable racial and gender disparities exist among a variety of medical conditions, procedures, and surgical outcomes.1-6 Large population studies, such as the Johnston County Osteoarthritis Project, suggest that black individuals have a higher prevalence of knee osteoarthritis and symptomatic burden compared with white individuals.5 Despite this increased relative burden of osteoarthritis, there is a disproportionate underutilization of total joint arthroplasty when compared with nonminorities.2-5 Evidence consistently illustrates that despite efforts to increase health care access and treatment, musculoskeletal health disparities continue to persist in our society. Several theories have been proposed to explain this observation, ranging from cultural differences and social attitudes toward medicine to limitations in access to care and inadequate referrals to appropriate health care.1-3,7 Although the reasons are likely multifactorial in nature, any identified disparity must be addressed to provide equal health care to all.

The field of orthopedic surgery recently has begun to investigate the impact of health disparities on the management of osteoarthritis and total joint arthroplasty utilization rates.4-7,11 Although evidence is most robust in hip and knee arthroplasty,
the magnitude, causes, and potential solutions of disparities in many other orthopedic conditions are still poorly characterized. In addition, studies related to total shoulder arthroplasty (TSA) remain limited.12 With the nationwide utilization rate of TSA increasing by more than 2.5-fold between 2000 and 2008,13 a trend that has continued in recent years,14 disparities in TSA are increasingly relevant to clinicians, hospitals, and payors.

The purpose of this study was to assess the presence of gender or racial and ethnic disparities in patients undergoing TSA. Based on previous literature demonstrating the underutilization of total joint arthroplasty in minorities, the current authors hypothesized that the utilization of TSA would exhibit similar trends: men would demonstrate a relative underutilization of TSA compared with women, blacks would demonstrate an underutilization compared with whites, and black men would have the lowest utilization rate among race and gender subgroups.

MATERIALS AND METHODS

The Statewide Planning and Research Cooperative System (SPARCS) is a comprehensive inpatient and ambulatory surgery database established in 1979 and maintained by the New York State (NYS) Department of Health. Since 1982, the SPARCS inpatient database has procured discharge records for all patients admitted to licensed NYS hospitals. The database captures information related to patient demographics (including gender and race), hospital diagnoses (via International Classification of Diseases, Ninth Revision [ICD-9]), and in hospital surgical procedures (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]). SPARCS has been successfully used as a valid database in multiple other studies in similar time and trend analyses.15,17

Using the SPARCS database, all TSA procedures between 1990 and 2009 were identified using the ICD-9-CM code 81.80 for TSA. In 2003, the Food and Drug Administration approved the use of reverse TSA. Although anatomic TSA and reverse TSA are different procedures used for different indications, they shared the same ICD-9-CM code within the SPARCS database until 2010, when reverse TSA was given its own separate code (81.88).18 As the current study was based on data before the introduction of the 81.88 code, it was not possible to distinguish whether a reverse or anatomic prosthesis was used.

Patients were stratified by age, gender, and race. Racial groups included “white,” defined as non-Hispanic Caucasians, and “black,” defined as non-Hispanic blacks. Age was stratified into 5 subgroups: younger than 55 years, 55 to 64 years, 65 to 74 years, 75 to 84 years, and 85 years or older. Date of surgery was used to divide patients into 4 separate 5-year time periods: period I (1990-1994), period II (1995-1999), period III (2000-2004), and period IV (2005-2009). The Elixhauser comorbidity method (ECM) was used to classify patients based on number of preoperative comorbidities.10,19,20 ECM scores were totaled, with each comorbidity equally weighted, and classified as: “none” when no comorbidities were documented, “moderate” when the ECM total was 1 to 4, and “severe” when the ECM total was 5 or greater. Payor status also was collected for each patient.
Census Bureau and estimates for NYS, population-adjusted incidence was reported as rate per 100,000 people, race-gender groups were directly adjusted for age, and the overall population undergoing elective TSA was directly adjusted for race and gender.\(^\text{21}\)

A quadratic regression model was used to compare the age-gender adjusted TSA utilization during the study time period to compare growth rates between racial groups and was validated statistically using an \(F\) test. A Kruskal-Wallis \(H\) test was used to determine whether there were differences in Elixhauser score between race groups. A post-hoc, pairwise comparison using Dunn’s procedure with a Bonferroni correction assessed differences between Elixhauser groups.\(^\text{22}\) Association between race and payor status at the time of elective TSA was determined using Pearson chi-square analysis.

### RESULTS

A total of 10,538 documented TSAs were performed in NYS from 1990 to 2009 across all races and ethnicities. Since 1990, TSA utilization increased more than 550%, with the population-adjusted incidence increasing from 1.32 to 7.19 procedures per 100,000 (Table 1). Although there was a steady rise in the number of procedures performed since 1990, the number of TSAs performed increased most dramatically during the second decade of the study (Figure 1). Nearly half (46.1%) of the TSA cases performed during the study period occurred in period IV.

Whites represented 70% \((n=7342)\) of the total sample, and blacks represented 5% of the total sample \((n=478)\). Period I was established as the reference period, and the age-adjusted incidence per 100,000 persons was 1.07 for white men, 1.25 for white women, 0.15 for black men, and 0.76 for black women (Table 2). Age-adjusted incidence rates increased for all subgroups by the end of the study period, with white men and white women exhibiting the largest relative growth at 417% and 421%, respectively, versus black men and black women, exhibiting growth at 378% and 329%, respectively.

The distribution of TSA utilization by age group for whites and blacks is shown in Table 3. The age group of 75 to 84 years exhibited the largest increase in utilization for both race groups from period I to period IV. The age distribution for whites remained relatively stable throughout the study period. For blacks, the age distribution shifted, with the age group younger than 55 years predominating during period I and then the age group 75 to 84 years predominating during period IV.

Results from the quadratic regression model of both racial groups are shown in Figure 2. A large difference in utilization was evident between white and black patients, and the disparity widened over time.

The ECM by racial group for all patients throughout the time period is shown in Table 4. Differences in Elixhauser condition (none, moderate, and severe) were significantly higher for blacks \((P<.001)\), and pairwise comparisons revealed statistically significant differences between races in all categories of Elixhauser severity \((P<.031)\). There was a statistically significant association between race and payor status (chi-square=363.810, \(P<.001\)), with lower numbers of blacks on Medicare but higher numbers on Medicaid (Table 5).
**DISCUSSION**

Epidemiologic studies have consistently shown both racial and gender disparities continue to exist in the diagnosis, treatment, and management of osteoarthritis.\(^7,8,12,23,24\) Nonetheless, the current literature focuses primarily on hip and knee arthroplasty. Due to the expanding indications and increased success of TSA, as well as the aging population’s willingness to consider operative management for the treatment of glenohumeral osteoarthritis, TSA has become an increasingly common procedure in NYS. With utilization of TSA becoming more prevalent during the past few decades, the significance of identifying any disparities within this surgical population becomes ever more important.

The current authors’ review of the New York SPARCS database revealed gender and racial disparities clearly existed and persisted throughout the 20-year period analyzed. White women had the highest TSA utilization rates and black men had the lowest TSA utilization rates; as time progressed, the disparities only widened amid a significant popularization of the procedure.

Women classically have been shown to be at increased risk of osteoarthritic disease.\(^4,5,23\) In addition, studies assessing utilization across geographic regions found population-adjusted rates of total hip and knee arthroplasty to be higher among women compared with men.\(^8,25\) Using the National Inpatient Sample, Jain et al\(^12\) reported women represented 57% to 65% of all TSAs. The current analysis of NYS was consistent with these findings, with white and black women representing between 58% and 62% of patients undergoing TSA. With trends consistently favoring women in both disease burden and arthroplasty utilization, increased attention could be given to gender-specific management. Women suffer a more significant disability-adjusted life year, arthritis-attributable work limitation, and increased mental and emotional components due to osteoarthritis.\(^26\) Thus, utilization of gender-specific measures in both the clinical approach and the management of glenohumeral osteoarthritis potentially can be more effective and is worthy of further consideration.

### Table 3

**Age Distribution by Time Period for TSA Patients in NYS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;55</td>
<td>19.26%</td>
<td>16.29%</td>
<td>11.83%</td>
<td>8.49%</td>
</tr>
<tr>
<td>55-64</td>
<td>20.18%</td>
<td>19.62%</td>
<td>20.51%</td>
<td>22.43%</td>
</tr>
<tr>
<td>65-74</td>
<td>35.09%</td>
<td>39.90%</td>
<td>37.47%</td>
<td>36.43%</td>
</tr>
<tr>
<td>75-84</td>
<td>23.88%</td>
<td>21.78%</td>
<td>27.91%</td>
<td>29.30%</td>
</tr>
<tr>
<td>85+</td>
<td>1.58%</td>
<td>2.41%</td>
<td>2.27%</td>
<td>3.36%</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;55</td>
<td>39.22%</td>
<td>33.33%</td>
<td>26.13%</td>
<td>19.40%</td>
</tr>
<tr>
<td>55-64</td>
<td>27.45%</td>
<td>20.24%</td>
<td>27.03%</td>
<td>21.98%</td>
</tr>
<tr>
<td>65-74</td>
<td>23.53%</td>
<td>20.24%</td>
<td>31.53%</td>
<td>33.62%</td>
</tr>
<tr>
<td>75-84</td>
<td>9.80%</td>
<td>20.24%</td>
<td>14.41%</td>
<td>21.98%</td>
</tr>
<tr>
<td>85+</td>
<td>0.00%</td>
<td>5.95%</td>
<td>0.90%</td>
<td>3.02%</td>
</tr>
</tbody>
</table>

Abbreviations: NYS, New York State; TSA, total shoulder arthroplasty.


### Figure 2

Graph showing age- and gender-adjusted incidence of total shoulder arthroplasty in New York State by race. A quadratic regression was derived and validated to model each population: total shoulder arthroplasty\(\text{year} = 1.516 - 0.965(\text{race}) - 0.197(\text{year}) + 0.027(\text{year})^2 + 0.153(\text{race})(\text{year}) - 0.019(\text{race})(\text{year})^2\), where race = 0 for Caucasian patients and race = 1 for black patients. The disparity between races was shown to be growing over time.
Race-based disparities in total joint arthroplasty utilization have been well-documented in the United States. The current study further supports these disparities in a statewide population undergoing elective TSA. Overall, the race-based disparity in TSA utilization was 70% whites compared with 5% blacks. Although blacks demonstrated an appreciable, population-adjusted percent increase in TSA utilization, their utilization is still significantly and proportionately less than whites during the same time periods. Perhaps the most striking disparity identified was that black men had the lowest utilization of TSA during the 20 years analyzed, and their utilization remained alarmingly low in comparison to other race-gender groups throughout all 4 time periods. Reports of underutilization among minority men have been echoed consistently in the total joint arthroplasty literature. Hanchate et al closely analyzed such disparities in minority men, and although they primarily determined that socioeconomic status played a large role in the underutilization of TKA in minority men, the authors added that several other plausible factors certainly contribute to this disparity, such as cultural beliefs, willingness to undergo surgery, and use of complementary medicine.

The racial disparities in total joint arthroplasty utilization are likely multifactorial in nature, and several theories have been suggested to explain this observation, including access to appropriate health care, socioeconomic status, cultural belief systems delaying initiation of care, and improvements in nonoperative management. In an effort to address these disparities, the US Bone and Joint Initiative has sought to increase arthritis education among minorities, improve access to information, and promote awareness in approaching culturally sensitive situations. Hausmann et al reported that blacks experienced discrimination in health care settings during interactions with providers and suggested that “nonverbal cues” may represent an unconscious bias on the part of providers. Although the possibility of unconscious bias in medicine certainly may exist, it is difficult to determine a direct causal relationship in the current study due to limitations of available data. Nevertheless, the profound differences in TSA utilization by blacks compared with whites and the context of previous studies should prompt further investigation.

Cultural perceptions and attitudes toward seeking medical care also can contribute to the disparities observed. Blacks have been reported to typically interpret joint pain as a normal part of aging rather than as a disease process, thereby contributing to a delay in seeking medical care. Factor-Litvak et al corroborated this theory, suggesting that these coping strategies tend to emphasize self-care or alternative and complementary medicine for pain management. Studies have suggested potential deterrents that may play a role in seeking medical care, such as general distrust toward the medical community and a perceived difficulty in communicating the risks and benefits of management. These cultural barriers can all potentially contribute to delay in seeking professional orthopedic care and may limit the window of opportunity for successful nonoperative management. As a result, African Americans and Hispanics often present in a more functionally debilitated state, which can make recovery following TSA more difficult and may lead to inferior outcomes.

The trends in age distribution over time among whites and blacks exhibited interesting shifts. For whites, the distribution by age group remained relatively constant, with the age group of 65 to 75 years predominating in all 4 time periods. For blacks, the age distribution heavily favored younger demographics, with the age group of 65 to 75 years presenting in all 4 time periods. The current study showed that for patients undergoing TSA, blacks had significantly more comorbid conditions than...
whites. In their nationwide survey, Lopez et al12 found statistically similar Charlson Comorbidity Indexes between ethnicities in the general population. However, the current study demonstrated that blacks presented with significantly more medical comorbidities than whites when undergoing TSA. This observation also has been reported in the total hip and knee arthroplasty literature.10 The greater prevalence of medical comorbidities in blacks also may explain the observed race discrepancies in the current study, as having numerous medical conditions may preclude patients from undergoing elective TSA.

Significant differences were observed in the distribution of payor status between whites and blacks (P<.001). In comparison to whites, blacks were insured more often by Medicaid and participated in Medicare to a significantly less degree. This distribution in payor status among race groups is similar to other published numbers surrounding TSA and race on a nationwide basis.13 Throughout the study time period, the TSA utilization of blacks favored a younger demographic than whites. This trend potentially could explain the observation that there was a less than expected number of blacks enrolled in Medicare. In addition, it is well established in hip and knee arthroplasty literature that Medicaid as a payor is a contributor to disparities in health care because Medicaid may be associated with inferior outcomes in addition to lower reimbursement figures.20,34 Although the findings for the current study may reflect such reasons for disparity found in TSA, this inference cannot be drawn from the database and would require a more granular analysis of payor status and its relationship to race-gender disparity. With the changing health care environment and advent of the bundled payment care initiative soon to affect TSA, it is becoming increasingly important to elucidate any payor-disparity relationships, and further investigation is essential.

The NYS SPARCS database is a commonly used database for studies of this type.15-17 However, there are several limitations when using statewide databases and due to the retrospective nature of the study, causal determinations cannot be made regarding the disparity observed. Another potential drawback of this study could be owed to a migratory effect, as patients may come from elsewhere to be treated with a TSA within NYS. This would result in an overestimate of TSA utilization. It is also possible that this effect may be offset, to some unknown degree, by patients who reside in NYS and required TSA but underwent the procedure in another state. It is also difficult to comment on the generalizability of information from this database. The application of the current results is primarily applicable to NYS as a whole and potentially to other states with a similar population demographic.

Finally, only 2 racial groups, non-Hispanic whites and non-Hispanic blacks, were used for analysis. Although there are shortcomings of not including all race-gender groups in the current analysis, the reasons for this approach were multifold. TSA is a much less popular procedure relative to hip and knee arthroplasty, and when isolated, each race-gender subgroup that was omitted from the current study, especially in the earlier periods of this study, insignificantly contributed to the total utilization. In addition, prior studies investigating the relationship between race groups and access to orthopedic care have focused on only white and black racial designation, and more reliable comparison and conclusions can be drawn from mirroring analogous approaches.2,9,10

CONCLUSION

The current study suggests racial and gender disparities in TSA utilization are persisting and may, in fact, be worsening over a 20-year period. Black men had the lowest utilization rate among all race and gender groups, and this trend persisted throughout the entire study period. Black patients also were found to have a higher amount of medical comorbidities when presenting for TSA and were more likely to be insured by Medicaid. More research is needed to define the causality and confounders of race and gender disparities in TSA to achieve equality among patients requiring care. An understanding of racial preferences or barriers to seeking health care will allow health care providers to appropriately address these identified disparities and effect change at a system-wide patient and provider level.

REFERENCES

11. Ibrahim SA, Franklin PD. Race and elective


