



# Shoulder arthroplasty in New York State, 1991 to 2010: changing patterns of utilization



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**Background:** Shoulder arthroplasty is now used to treat an expanding variety of glenohumeral disorders.  
**Methods:** This study assessed the demographic patterns and utilization rates of shoulder hemiarthroplasty (HA) and anatomic or reverse total shoulder arthroplasty (TSA) within New York State (NYS) from 1991 to 2010. Using the New York Statewide Planning and Research Cooperative System database, all shoulder arthroplasty procedures that occurred within NYS during the study period were retrospectively identified and analyzed.

**Results:** During the 20-year period, 24,040 shoulder arthroplasty procedures were performed. During the second decade (2001-2010), there was a 393% increase in utilization of TSA with a 98% increase in HA. This disproportionate increase is likely due to the introduction and expanding indications of reverse TSA as an effective procedure in place of HA for the treatment of proximal humerus fractures and rotator cuff arthropathy, as rotator cuff arthropathy as a primary indication for HA was significantly less prevalent in period 2. Also notable was an identifiable disparity in race; whites represented approximately 80% of the shoulder arthroplasty procedures in both decades, whereas African Americans made up <5%. This is significantly different from the general racial demographics of NYS during both periods analyzed.

**Discussion:** It is clear that the volume of shoulder arthroplasty procedures performed in NYS is increasing, mirroring the national experience. This trend reflects the expanding indications, the general success of these procedures, the aging demographic of our population, and a greater desire and willingness of patients to consider operative management to maintain or to improve quality of life.

**Level of evidence:** Level III, Descriptive Epidemiology Study.

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**Keywords:** Demographic patterns; utilization rates; shoulder arthroplasty procedures

The treatment of glenohumeral disorders with prosthetic shoulder arthroplasty has evolved since 1893, when Jules Péan produced and implanted a prosthesis for a shoulder

with tuberculous arthropathy.<sup>1,21</sup> During the past 50 years, major developments in implant design, expanded indications, and refined operative techniques have led to improved clinical outcomes and lowered complication rates.<sup>7,8,14,19,24,29,30,35</sup> Currently, patients with a variety of degenerative and traumatic conditions affecting the glenohumeral joint are commonly treated by hemiarthroplasty (HA) and total shoulder arthroplasty (TSA), either anatomic (ATSA) or reverse (RTSA).

No IRB approval was needed.

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Recent data on the volume of shoulder arthroplasty procedures in the United States have demonstrated a 2.5-fold increase in comparing data from 2000 to 2008.<sup>18</sup> This increase is expected to continue and clearly represents the expanding indications for and general success of these procedures as well as the aging demographic of our population and the greater willingness of patients to consider operative management to maintain or to improve their quality of life.<sup>3</sup>

ATSA has been the primary operative treatment for degenerative conditions of the glenohumeral joint. Several long-term studies (>15-year follow-up) report functional improvements, implant survivorship, and patient satisfaction rates comparable to those of total hip and knee arthroplasty.<sup>5,28</sup> Whereas ATSA remains a successful treatment option, RTSA has gained increasing popularity in the United States since 2004, when the Food and Drug Administration approved its use for the treatment of shoulder disorders.<sup>2</sup> The availability of this particular implant design had a major impact on the volume of shoulder arthroplasties performed as it expanded the indications to conditions that could not be as successfully addressed by either HA or ATSA.<sup>6,11,20,34</sup> This includes diagnoses of rotator cuff arthropathy, irreparable rotator cuff tears, and proximal humerus fractures<sup>23</sup> as well as revision secondary to failed HA and failed ATSA.<sup>26,27</sup> Although RTSA may be an excellent treatment option when ATSA and HA fail to succeed, with a relatively new procedure comes a learning curve. Wiater et al reported a complication-based learning curve of approximately 40 cases, as the RTSA procedure can be technically demanding.<sup>15</sup> Despite this learning curve, RTSA has thus far proved successful in short-term and midterm studies that document clinical outcomes and functional improvements comparable to those of ATSA,<sup>9,17</sup> thereby earning its addition to the armamentarium for the treatment of glenohumeral disorders.

The purposes of this study were (1) to determine the change in the rate of utilization of shoulder arthroplasty in New York State from 1991 to 2010, (2) to determine the pattern of utilization of the different types of implants during this time, and (3) to determine whether the indications for the procedure changed between 1991 and 2010.

## Materials and methods

We used the New York Statewide Planning and Research Cooperative System (SPARCS) de-identified inpatient database to study the trends in shoulder arthroplasty from 1991 to 2010. The New York State Department of Health has maintained a census of all hospital admissions since 1982. The SPARCS database maintains discharge records for all patients hospitalized within New York State. The data are recorded by trained personnel from each hospital facility in New York State, using a universal data set

specifications format. SPARCS has been widely used to study the trends of orthopedic conditions in the hospital setting and their respective treatments.<sup>10,22,25,32,37,38</sup> Demographic data, such as the patient's age, sex, and race, and clinical data, such as principal diagnosis, secondary diagnosis, discharge disposition, and length of stay, are all reported and can be determined from the database.

Shoulder arthroplasty codes were identified by the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) procedural codes for TSA (81.80) and HA (81.81). TSA was considered a procedure that involved resurfacing of the glenoid and humerus, whereas HA was the resurfacing of the humerus alone. Of note, TSA and RTSA shared the same ICD-9 code between 1999 and 2008. As such, results of the 81.80 code during this period accounted for both procedures.

Shoulder arthroplasty procedures were identified by these ICD-9 codes and were stratified into 2 periods: period 1, 1991 to 2000; and period 2, 2001 to 2010. The two data subsets were then analyzed with specific variables including age, sex, race, primary procedure, and principal diagnosis. Continuous variables were compared with a *t* test analysis, and categorical variables were analyzed by the  $\chi^2$  test. All statistical analyses were performed with SAS version 9.3 (SAS Institute, Inc., Cary, NC, USA).

## Results

A total of 24,040 shoulder arthroplasty procedures were performed in New York State from 1991 to 2010. During period 1, 8065 procedures were performed; during period 2, 15,975 were performed (Fig. 1). In considering HA and TSA separately between period 1 and period 2, there was a 393% increase in the number of TSA procedures and a 98% increase in the number of HA procedures performed. The mean age of patients undergoing TSA was  $65.7 \pm 12.9$  years and  $68.3 \pm 10.9$  years for periods 1 and 2, respectively. Similarly, the mean age of HA patients was  $67.3 \pm 14.1$  years and  $67.7 \pm 13.5$  years for periods 1 and 2, respectively. There was no significant difference between the mean age of patients undergoing TSA or HA for the 2 periods analyzed. The percentage of women and men who underwent shoulder arthroplasty in period 1 and period 2 did not differ significantly. However, the female to male ratio for HA patients (70%:30%) and TSA patients (59%:41%) was significantly different ( $P < .001$ ).

Whites accounted for the overwhelming majority of patients undergoing shoulder arthroplasty in periods 1 (80.6%) and 2 (81.7%). African Americans were the second most common racial group, with 4.6% and 4.5% for periods 1 and 2, respectively.

The most common indication or principal diagnosis for TSA and HA is shown in Tables I and II, respectively. For TSA, osteoarthritis accounted for 63.3% of procedures during period 1, increasing to 81.8% in period 2. The next 4 diagnoses were essentially the same for period 1 and period 2; however, the respective rank and frequencies changed. In period 1, the second most common diagnosis was rheumatoid arthritis, followed by proximal humerus fracture,

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