

Have the annual trends of total hip arthroplasty in rheumatoid arthritis patients decreased?

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Background: Rheumatoid arthritis (RA) is characterized by chronic systemic and synovial inflammation, resulting in damage to both cartilage and bone. Medical treatment, which has increasingly relied upon disease modifying anti-rheumatic drugs (DMARDs), may fail to slow disease progression and limit joint damage, ultimately warranting surgical intervention. Up to 25% of RA patients will require lower extremity total joint arthroplasty. Though total hip arthroplasty (THA) is known to improve quality of life and functional measures, clarification is still required with respect to the impact of increased DMARD use on annual rates of THA. Thus, the purpose of this study was to evaluate: (I) the annual trends of THAs due to RA in the United States population; (II) the annual trends in the proportion of THAs due to RA in the United States.

Methods: This study utilized the Nationwide Inpatient Sample (NIS) to identify all patients who underwent THA between 2002 and 2013 (n=3,135,904). Then, THA patients who had a diagnosis of RA, which was defined by the International Classification of Disease 9th revision diagnosis code 714.0, were identified. The incidence of THAs with a diagnosis of RA in the United States was calculated using the United States population as the denominator. Regression models were used to analyze the annual trends of RA in patients who underwent THA.

Results: Review of the database identified 90,487 patients who had a diagnosis of RA and underwent THA from 2002 to 2013. The annual prevalence of RA in those who underwent THA slightly decreased over the specified time period, with 28.7 per 1,000 THAs in 2002 and 28.6 per 1,000 THAs in 2013; however, this change was not statistically significant ($R^2=0.158$, $P=0.200$).

Conclusions: The annual rates of THA among RA patients did not show any significant change between 2002 and 2013. DMARD use has decreased both disease progression and joint destruction, and DMARDs are now often utilized as primary treatment. The increase in population of the country during the study period may have overestimated THA trends. Moreover, patients may be more likely to opt for surgical management, given the advances in operative techniques as well as peri- and post-operative course.

Keywords: Rheumatoid arthritis (RA); total hip arthroplasty (THA); annual trends

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Introduction

Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disease that is characterized by systemic inflammation and synovial inflammation (1). The disease leads to functional disability, significant pain, and eventual permanent joint destruction as a result of the prolonged inflammation within the synovium that causes damage to the cartilage and bone. The treatment goals of RA are to slow the progression of the disease and minimize joint damage; however, joint destruction can still occur over time and may ultimately require surgical intervention. Researchers have found that approximately 3% to 25% of RA patients will require lower extremity total joint arthroplasty (2-4). As such, total hip arthroplasty (THA) has been documented as an acceptable and effective means of increasing the quality of life and functional measures in RA patients (5,6).

Disease progression and quality of life have significantly improved with the recent use of disease modifying anti-rheumatic drugs (DMARDs) for the medical management of RA (7-9). Moreover, in a recent systematic review, their efficacy has been shown to be beneficial in terms of clinical response and radiographic progression of disease in RA patients (10). In addition, the various DMARDs have been shown to have similar efficacy for the treatment of RA (11); therefore, prompt initiation of DMARD therapy is recommended by the American College of Rheumatology (12). With the increased use of DMARDs, it remains unclear whether or not there has been any effect on the annual rates of THA.

Therefore, considering the increased use of DMARDs, the purpose of this study was to examine the annual changes in the number of THAs in this population of patients. Specifically, we evaluated: (I) the annual trends of THAs due to RA in the United States population; (II) the annual trends in the proportion of THAs due to RA in the United States.

Methods

Data source

This study used the Nationwide Inpatient Sample (NIS) from 2002 to 2013. The NIS database is the largest publicly available all-payer inpatient admissions database in the United States and is part of the Healthcare Cost and Utilization Project (13). Approximately 7 to 8 millions inpatient records are collected annually, which is roughly a 20% random stratified sample of inpatient admissions.

Within the database are patient demographics along with hospitalization variables, comorbidities, International Classification of Diseases, Ninth Revision (ICD-9) procedure and diagnosis codes, total in-hospital charges, hospital lengths of stay, and discharge dispositions. Since the NIS data is de-identified and publically available, this study was deemed exempt by the hospital's Institutional Review Board.

Study population

This study identified all patients who had a primary THA, defined by the ICD-9 procedure code 81.51, performed between January 1, 2002 and December 31, 2013 (n=3,135,904). Then, to create a cohort of RA patients who underwent THA, an additional query was performed to identify all patients who had RA defined by the ICD-9 diagnosis code 714.0.

Data analysis

The incidences of THAs due to RA were obtained by dividing the number of THAs due to RA by the annual US population, obtained from the census bureau. The proportion of THAs due to RA was also evaluated for each year by dividing the number of THAs due to RA by the total number of THAs. Poisson regression analysis was used to analyze whether there was an annual increase in the incidence of the THAs due to RA in the United States population, due to the count nature of the dependent variable. The United States population was used as an offset term in the regression model. The changes in the incidence of THAs are represented using incidence rate ratios (IRRs), with IRR >1 denoting an increase in the procedural volume. Linear regression analyses were used to study the annual changes in the proportion of THAs due to RA. The annual change in the proportion of THAs due to RA is denoted by the regression coefficient (slope). A P value of less than 0.05 was used as the threshold for statistical significance. The 95% confidence intervals were calculated for the different measures used in the study. All of the data were analyzed with SPSS version 23 (IBM Corporation, Armonk, New York, USA).

Results

A total of 90,487 patients who had a diagnosis of RA and underwent THA over the specified time period were identified. The annual number of THAs with a diagnosis of

RA increased by 59.3% from 5,764 to 9,180 (*Figure 1*). After normalizing to the US population, the incidence of THAs with RA increased from 2.7 to 3.8 THAs per million US adults [IRR =1.04 (95% CI: 1.04–1.04), $P < 0.001$] (*Figure 2*).

Out of the 201,167 THAs in 2002, 5,764 (2.87%) were due to RA, whereas, out of the 321,005 THAs in 2013, 9,180 (2.86%) were due to RA. The prevalence of RA in those who underwent THA remained the same from 2002 to 2013 [coefficient =0.01 (95% CI: -0.01 to 0.04), $P = 0.200$] (*Figure 3*).

Discussion

There has been a significant impact on the treatment of RA due to newer pharmaceutical innovations. Moreover, disease progression and joint destruction have decreased with the use of DMARDs (10). Chronic, as well as newly diagnosed, RA patients are now being managed with DMARDs as their primary treatment (14,15). Additionally, patients have reported considerable improvements in quality of life, as measured by health assessment surveys and disability questionnaire scores, with early and aggressive treatment (16). After analyzing the annual trends of RA patients who underwent THA, the present study found that there was no significant change in the prevalence of THA between 2002 and 2013.

There were several limitations to this study. There are inherent limitations with the use of large administrative databases for retrospective analysis. All databases have the potential for bias with data entry and errors in reporting diagnosis codes (17). Additionally, the accuracy of the diagnosis of RA within administrative databases has been debated (18), since it has been reported that there is a low positive predictive value when using diagnosis codes alone for the identification of patients who have RA (19). On the other hand, Bozic *et al.* (20) found that patient records were in line with coding comorbidity data from large administrative databases. The positive predictive value for a clinical diagnosis of RA, and the accuracy of the databases, may be strengthened since the patients diagnosed with RA by coding data from large databases required a surgical intervention (21,22). Furthermore, medications that patients were taking during their hospitalization were not reported in the NIS database, therefore information regarding RA patients' DMARD use could not be determined; however, biological agent monotherapy as a treatment plan has been reported in approximately 34% of RA patients (1) and methotrexate monotherapy treatment

has been recorded in as many as 50% of RA patients (23). Additionally, hydroxychloroquine was found to be the most commonly prescribed drug by a survey questionnaire sent to rheumatologists (24). Noteworthy is the increase in the United States population from approximately 288 million to 316 million during our study period, which could have potentially inflated the study results and overestimated the trends of THA if the increase in the population was skewed towards an older-aged demographic. Despite these limitations, we believe that the results of the present study provide an important insight into recent trends of THA in RA patients.

Previous studies have found a stable trend in the number of RA-associated surgical procedures performed annually, which is in accordance with the results of the present study. Momohara *et al.* (25) conducted a multicenter study in Japan and found that the total number of THAs and total knee arthroplasties (TKA) had remained stable between 1998 to 2008. Similarly, Yasui *et al.* (26) showed that the number of total joint arthroplasties, including knee, hip, elbow, shoulder, and ankle, had remained stable over the 3-year study period, despite an increase in the proportion of patients taking biological DMARDs. Manrique Arija *et al.* (27) also reported that there was no change in the number of THAs performed annually in RA patients at a single hospital in Spain from 1998 to 2007. An aging population may mask the true efficacy of DMARD therapy, despite the breakthroughs in the medical management of RA. Alternatively, new advances in THA have significantly improved patient quality of life and satisfaction (28), while shorter hospital stays, improved pain control, and earlier achievement of rehabilitation goals have been accomplished with breakthroughs in anesthetic regimens and postoperative pain management (29-31). Considering all of these factors, the threshold for RA patients to opt for surgical management may, therefore, be lower than it was in the past.

However, previous studies contradict the results of this investigation. Shourt *et al.* (32) showed that the rates of THA, TKA, joint reconstruction procedures, revision arthroplasty, and soft tissue procedures were trending downward over a 27-year period in Minnesota. Likewise, da Silva *et al.* (33) showed from 1955 to 1995, that the rates of THAs, TKAs, and revision of total joint arthroplasties among RA patients in Rochester, Minnesota have declined. This was similar to the results found by Hekmat *et al.* (16), who used a community-based register in Sweden and found a decrease in the annual incidence of THAs from 1997 to 2007.

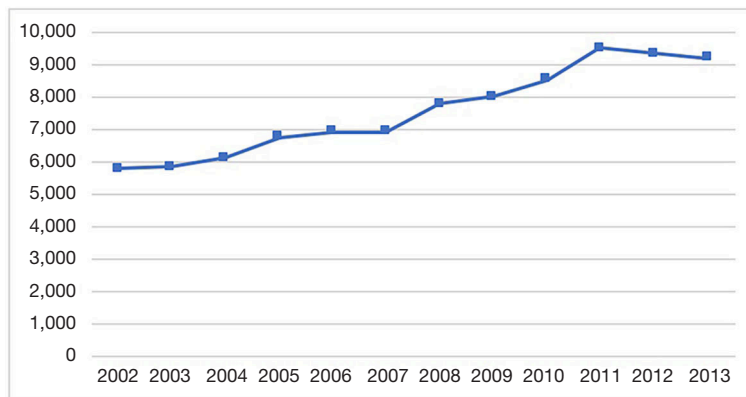


Figure 1 The annual volume of THAs due to rheumatoid arthritis from 2002 to 2013 in the United States. THAs, total hip arthroplasties.

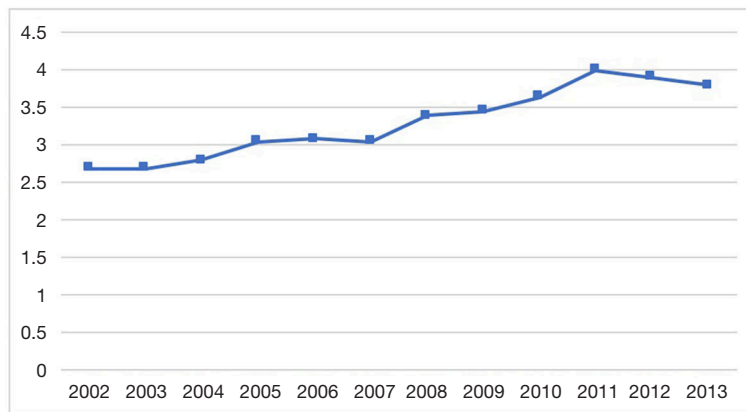


Figure 2 The annual incidence of THAs due to rheumatoid arthritis, per 100,000 adults, from 2002 to 2013 in the United States. THAs, total hip arthroplasties.

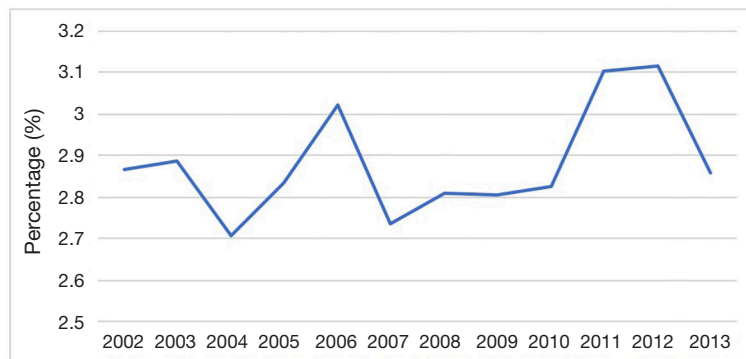


Figure 3 The annual changes in the proportion of THAs due to rheumatoid arthritis from 2002 to 2013. THAs, total hip arthroplasties.

The effectiveness of DMARDs and their impact on the rate of THAs in RA patients must be inferred due to the ethical dilemmas centred around withholding treatments in order to conduct clinical research (34). The findings presented by these studies lend support to a more significant impact of the medical management of RA. Alternatively, a greater emphasis on the early detection and treatment of RA may have led to a decrease in the rate of THAs in RA patients and improved patient outcomes (35).

In conclusion, the present study was able to analyze the annual trends of RA patients who underwent THA by using the NIS database, demonstrating that the rates of THA performed in RA patients had remained relatively stable over the past decade. Our findings are most likely due to the overshadowing effect that the increase in the United States population by roughly 28.8 million people during the study period had on the efficacy of DMARDs. Longer observational studies are needed with a more stable populace in order to determine the true impact of DMARDs on THA in RA patients. Also, studies using mono- and dual therapy should be conducted, and the trends of THA in each treatment group compared, in order to determine the impact of the various DMARDs on disease progression.

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Footnote

Conflicts of Interest: MA Mont: AAOS, Cymedica, DJ Orthopaedics, Johnson & Johnson, Journal of Arthroplasty, Journal of Knee Surgery, Microport, National Institutes of Health (NIAMS & NICHD), Ongoing Care Solutions, Orthopedics, Orthosensor, Pacira, Peerwell, Performance Dynamics Inc., Sage, Stryker: IP royalties, Surgical Techniques International, TissueGene. M Chughtai: DJ Orthopaedics, Sage Products, Stryker. The other authors have no conflicts of interest to declare.

Ethical Statement: This study was deemed exempt by the hospital's Institutional Review Board.

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