Have the annual trends of total knee arthroplasty in ankylosing spondylitis patients decreased?

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Background: Ankylosing spondylitis (AS) is characterized by osteoproliferation-induced structural damage and spinal inflammation, which lead to spinal deformity and functional disability. Though AS commonly affects the axial skeleton and sacroiliac joints, up to 70% of patients have involvement of the knees and other joints. Despite pharmacological efforts, advancing joint involvement may ultimately require surgical intervention. Total knee arthroplasty (TKA) is effective in managing patients with AS, yet it remains unclear whether or not the annual rates of TKA have been affected. Therefore, the purpose of this study was to evaluate the annual trends of AS patients who underwent TKA. Specifically, we evaluated: (I) the annual trends of TKAs due to AS in the United States population; (II) the annual trends in the proportion of TKAs due to AS in the United States.

Methods: The Nationwide Inpatient Sample (NIS) was used to identify all patients who underwent TKA between 2002 and 2013 (n=6,492,873). Then, a subsequent query was performed to identify TKA patients who had a diagnosis of AS, defined by the International Classification of Disease 9th revision diagnosis code 720.0. The incidence of TKAs with a diagnosis of AS in the United States was calculated using the United States population as the denominator. Regression models were used to analyze the annual trends of AS in patients who underwent TKA.

Results: During the study period, 2,986 patients who had AS who underwent TKA were identified. The annual number of TKAs with a diagnosis of AS increased by 168% from 125 to 335. After normalizing to the US population, the incidence of TKAs with AS increased from 0.58 to 1.38 TKAs per million US adults [IRR =1.08 (95% CI: 1.07–1.09), P<0.001]. Out of the 350,122 TKAs in 2002, 125 (0.04%) were due to AS, whereas, out of the 640,695 TKAs in 2013, 335 (0.05%) were due to AS. The prevalence of AS in those who underwent TKA increased from 2002 to 2013 [coefficient =0.002 (95% CI: 0.001–0.003), P=0.004].

Conclusions: The annual trends of AS patients undergoing TKA significantly increased during the study period. To the authors' best knowledge, this is the first study to evaluate TKA trends in the AS population. The literature has reported on the ability of non-steroidal anti-inflammatory drugs (NSAIDs) and the potential of tumor necrosis factor-alpha (TNFα) inhibitors to hinder bone disease progression in AS, however, this was not shown to support to the significant changes found in TKA trends during the study period.

Keywords: Ankylosing spondylitis (AS); total knee arthroplasty (TKA); annual trends

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Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory disorder that is part of a spectrum of diseases known as seronegative spondyloarthropathies. The disease is characterized by spinal inflammation and structural damage from osteoproliferation (1,2). The prevalence of AS has been reported to be from 0.1% to 1.4% (3) globally, and 0.2% to 0.5% (4) in the United States. AS typically affects the axial skeleton and sacroiliac joints and can lead to spinal deformity, functional disability, and significant pain and stiffness (2). However, studies have shown that 25% to 70% of patients have involvement of the hips, knees, or other joints (5,6). Moreover, spinal deformities causing sagittal imbalance can affect knee flexion, which can lead to worsened disability as well as increase joint pain (7).

Management of AS revolves around symptom relief, maintenance of function, and prevention of complications, such as contractures (8,9). Pharmacologic therapies for AS include non-steroidal anti-inflammatory drugs (NSAIDs), other analgesics, sulfasalazine, and anti-tumor necrosis factor α (TNFα) agents (10). The TNFα inhibitors have led to decreased disease activity and improved functional capacity in AS patients (11). The American College of Rheumatology guidelines recommend that adults who have active AS should initially be treated with NSAIDs and exercise, and then progress to TNFα inhibitors if the initial treatment fails. Additionally, the use of slow-acting anti-rheumatic drugs (SAARDs) and locally administered parenteral glucocorticoids have been recommended in AS patients who have active peripheral arthritis (8). Despite the pharmacological efforts, joint involvement may become progressively disabling and painful, ultimately necessitating surgical intervention (7).

Total knee arthroplasty (TKA) has been proven to be effective at improving pain in AS patients (12). Yet, despite TKA being known as an effective management technique for patients with AS, it remains unclear whether or not the annual rates of TKA in AS patients have been affected. Therefore, the purpose of this study was to evaluate AS patients who underwent TKA using a large national administrative database. Specifically, we examined the annual trends of TKA in AS patients. Specifically, we evaluated: (I) the annual trends of TKAs due to AS in the United States population; (II) the annual trends in the proportion of TKAs due to AS in the United States.

Methods

Data source

The Nationwide Inpatient Sample (NIS) was reviewed from 2002 to 2013. The NIS database provides the largest all-payer database of inpatient hospital admissions in the United States. A stratified sample of approximately 8 million records is collected annually by the database, which is part of the Healthcare Cost and Utilization Project (13). Data includes demographics, insurance type, International Classification of Diseases, Ninth Revision (ICD-9) diagnosis and procedure codes, admission and discharge data, and total charges (14). The NIS database is publically available and contains de-identified data, therefore, this study was deemed exempt by the Institutional Review Board.

Study population

All patients who underwent a primary TKA, defined by the ICD-9 procedure code 81.54, performed between January 1, 2002 and December 31, 2013 were identified (n=6,492,873). Then, to create a cohort of AS patients who underwent TKA, all TKA patients who had a diagnosis of AS, defined by the ICD-9 diagnosis code 720.0, were identified.

Outcomes

The incidences of TKAs due to AS were obtained by dividing the number of TKAs due to AS by the annual US population, obtained from the census bureau. The proportion of TKAs due to AS was also evaluated for each year by dividing the number of TKAs due to AS by the total number of TKAs.

Data analysis

Poisson regression analysis was used to analyze whether there was an annual increase in the incidence of the TKAs due to AS 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 TKAs 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 TKAs due to AS. The annual change

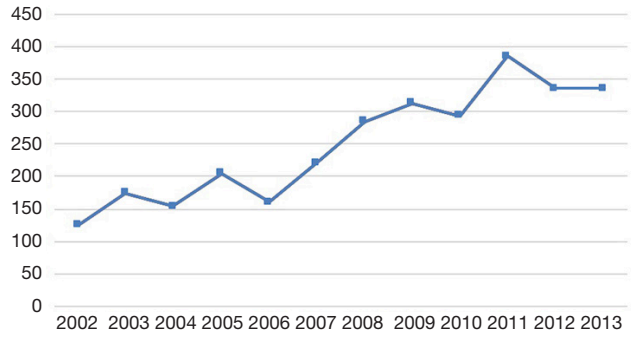

Figure 1 The annual volume of TKAs due to ankylosing spondylitis from 2002 to 2013 in the United States. TKAs, total knee arthroplasties.

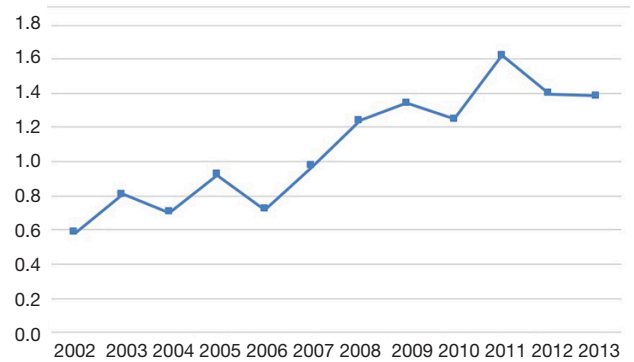

Figure 2 The annual incidence of TKAs due to ankylosing spondylitis, per 1 million adults, from 2002 to 2013 in the United States. TKAs, total knee arthroplasties.

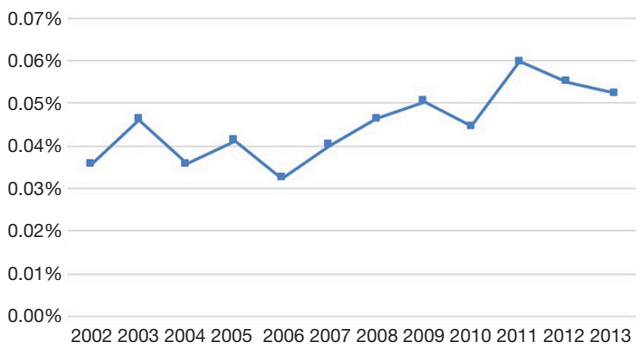

Figure 3 The annual changes in the proportion of TKAs due to ankylosing spondylitis from 2002 to 2013. TKAs, total knee arthroplasties.

in the proportion of TKAs due to AS 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). All figures were developed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA).

Results

During the study period, 2,986 patients who had AS who underwent TKA were identified. The annual number of TKAs with a diagnosis of AS increased by 168% from 125 to 335 (*Figure 1*). After normalizing to the US population, the incidence of TKAs with AS increased from 0.58 to 1.38 TKAs per million US adults [IRR =1.08 (95% CI: 1.07–1.09), P<0.001] (*Figure 2*).

Out of the 350,122 TKAs in 2002, 125 (0.04%) were due to AS, whereas, out of the 640,695 TKAs in 2013, 335 (0.05%) were due to AS. The prevalence of AS in those who underwent TKA increased from 2002 to 2013 [coefficient =0.002 (95% CI: 0.001–0.003), P=0.004] (*Figure 3*).

Discussion

Prevalence estimates of AS in the United States have been reported to range from 13.1 to 31.9 per 10,000 persons (15,16). The mainstay of treatment for AS has been medical management, with NSAIDs and exercise being considered first-line therapy (8). Since the approval of TNFα inhibitors for the management of AS, studies have confirmed their efficacy in improving clinical outcomes, functionality, and disease activity (8,11). However, it remains uncertain as to whether TNFα inhibitors slow disease progression. While TNFα inhibitors have been recommended for AS in the setting of active disease or when NSAIDs fail to work, TNFα inhibitors have yet to be established as a first-line therapy (8). On the other hand, NSAIDs have been shown to both improve pain and stiffness in both axial and non-axial disease, and to slow radiographic disease progression (17-19). Worsening joint pain and disability that has not responded to non-surgical treatment in AS patients is a major indication for arthroplasty (7). In evaluating the yearly trends of AS patients who underwent TKA, the present study found that there was a significant increase in the TKA prevalence between 2002 and 2013.

This study had limitations that were worth mentioning. A large administrative database was utilized as the primary

source of data collection, which can be subject to errors at the data entry level. The most common criticism with the use of such databases relates to the accuracy of diagnosis and procedural codes (20-22). However, use of administrative data sets have proven to be valuable, and it was shown that the combination usage of diagnostic codes with procedural codes enhances the validity and reliability of the data (23), which is how the data was used in the present study. Another potential limitation of this study is that the NIS database does not provide specific data in regards to disease activity levels or medication types; therefore, this data could not be extracted from the database. As a result, we were not able to determine if certain pharmacologic regimens affected TKA trends. However, a survey study by Zochling *et al.* (24) reported on 1,080 AS patients who had a mean age of 50 years (range, 21–86 years), and found that 78% of patients were regularly taking NSAIDs 12 months prior to the survey. Despite these limitations, the authors of this study believe the findings are accurate and provide valuable insight into the recent TKA trends in AS patients.

The most commonly reported orthopedic procedure performed in AS patients has been total hip arthroplasty, followed by spinal osteotomies (25). Despite the prevalence of knee involvement in AS reaching as high as 70%, the literature reporting on this is limited (5,6). A recent study by Mertelsmann-Voss *et al.* (26) evaluated 3,825 patients who had spondyloarthritis (SpA) and had a mean age of 57 years and found that the trends in rates of TKA significantly increased over the 14-year period, from 2.7 TKAs per 100,000 persons per year in 1991 to 2.9 TKAs per 100,000 persons per year in 2005 ($P<0.001$). The authors additionally showed that patients who did not have inflammatory arthritis also had an increase in the trends of TKA from 49.1 per 100,000 persons per year in 1991 to 134.4 per 100,000 persons per year in 2005 ($P<0.001$).

There is a paucity of literature available addressing arthroplasty trends in patients who had AS and this is the first study to analyze TKA trends in the AS population. However, the literature has shown that NSAIDs (18) and potentially TNFα inhibitors (27), slow progression of bone disease in AS; however, this did not support the results of the present study, which showed a significant increase in TKA trends in AS patients between 2002 and 2013.

In conclusion, the present study evaluated the annual trends of AS patients who underwent TKA, which demonstrated an increase in TKA trends during the study period. Longer observational studies should assess TKA trends in AS patients with stratification of the data by current medical management and age. This data would allow for the analysis of TKA trends in AS patients based on the medical regimen they are receiving and also determine the age trends in those who received TKA, which in the setting of an increasing trend would also indicate success in medical therapy as TKA is being delayed. In order to truly determine the effectiveness of the AS medical therapy guidelines, disease progression must be analyzed.

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None.

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. JW Barrington: Biome, DJ Orthopaedics, Iconacy, Mallinckrodt, Pacira, Professional Communications, Inc. Smith & Nephew, Tier 1 Healthcare and Education Research, Zimmer. CB Paulino: DePuy, A Johnson & Johnson CompanyEthicon. M Chughtai: DJ Orthopaedics, Sage Products, Stryker. The other authors have no conflicts of interest to declare.

Ethical Statement: The NIS database is publically available and contains de-identified data, therefore, this study was deemed exempt by the Institutional Review Board.

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