J Shoulder Elbow Surg (2014) 23, e267-e274

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Nationwide shoulder arthroplasty rates and revision burden in Germany: analysis of the national hospitalization data 2005 to 2006

Matthias F. Hollatz, MD[a], Andreas Stang, MD, MPH[a,b,*]

[a]*Institut für Klinische Epidemiologie, Medizinische Fakultät, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany*
[b]*Department of Epidemiology, School of Public Health, Boston University, Boston, MA, USA*

Background: The aim of this study was to provide nationwide shoulder arthroplasty rates in Germany based on the national hospitalization file and to estimate the revision burden for shoulder arthroplasty and its determinants.
Methods: We analyzed the nationwide, population-based, German diagnosis-related groups data from the years 2005 and 2006. Procedure codes and diagnosis were analyzed for each hospitalization. Overall, 16,488 primary shoulder arthroplasties and 1302 revisions were performed during the study period. Age-standardized rates, age-specific rates, rates by indication, and revision burden were calculated.
Results: The age-standardized hemiarthroplasty (HA) rates were 3.6 per 100,000 person-years (standard error [SE], 0.1) for men and 9.3 per 100,000 person-years (SE, 0.1) for women and clearly exceeded the age-standardized total shoulder arthroplasty (TSA) rates of 1.7 per 100,000 person years (SE, 0.1) for men and 3.7 per 100,000 person-years (SE, 0.1) for women. The revision burden was 4.7% for HA and 15.0% for TSA. Multivariable-adjusted analysis showed increasing age was associated with a lower relative burden of revision, and an increased Charlson comorbidity index and male gender were associated with a higher relative burden of revision. The adjusted relative burden of revision was considerably higher for TSA than for HA (adjusted relative burden of revision, 2.89; 95% confidence interval, 2.60-3.22).
Conclusion: We found more than 2-fold higher primary rates for HA than for TSA and up to 3-fold higher shoulder arthroplasty rates for women than for men. TSA had a 3-fold higher relative burden of revision than HA.
Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

Keywords: Shoulder arthroplasty rates; revision burden; risk factor; Germany; total shoulder arthroplasty; shoulder hemiarthroplasty

The rate of shoulder arthroplasties has increased considerably during the last 2 decades, with an annual increase of 7% for hemiarthroplasty (HA) and 11% for total shoulder arthroplasty (TSA), both exceeding the annual increase in hip and knee arthroplasty rates.[5] Despite these striking increases, comprehensive nationwide data on these

Investigational Review Board approval was not required for this study.

*Reprint requests: Andreas Stang, MD, MPH, Institute of Clinical Epidemiology, Medical Faculty, Martin-Luther-University Halle-Wittenberg, Magdeburger Str 8, D-06112 Halle (Saale), Germany.
E-mail address: andreas.stang@uk-halle.de (A. Stang).

1058-2746/$ - see front matter © 2014 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2013.12.008

rates are rarely available and differ in quality.[20] The national joint register of Norway, Australia, and New Zealand supplied extensive data and revealed differences in the use of HA and TSA. Whereas in Norway the TSA is a relatively rare procedure, most shoulder arthroplasties in Australia and New Zealand involve TSA.[1,7,14] An analysis of the Nationwide Inpatient Sample of the United States showed that high-volume surgeons and hospitals choose TSA for the treatment of osteoarthritis more often than HA.[13]

Nationwide revision rates differ between the different types of shoulder arthroplasties in some countries. Whereas in Norway the reversed TSA had about 2-fold higher 5-year and 10-year failure rates than HA, the revision rates of HA, TSA, and reversed TSA were about the same in Australia and New Zealand.[2,7,14]

Although age and gender appear to be associated with the risk of revision of shoulder arthroplasties, these factors are inconsistently associated with HA and TSA.[7,23,24]

The aim of this study was to quantify nationwide primary shoulder arthroplasty rates for HA and TSA stratified by gender, age, and indication. Furthermore, we estimated the revision burden (RB) and studied potential determinants.

Materials and methods

As a result of an amendment to the hospital financing system in Germany in 1999, the diagnosis-related groups (DRG) reimbursement system became compulsory for hospitals in 2004. According to Section 21 of the hospital financing law (Krankenhausentgeltgesetz, KHEntG), all hospitals that are reimbursed by the DRG system annually transfer their individual hospitalization data to the Institute for the Hospital Remuneration System (InEK). Not reimbursed by the DRG-system are psychiatric or psychotherapeutic departments, ambulatory settings, and hospital stays that were reimbursed by the statutory accident insurance in the 7 specialized hospitals for workplace accidents in Germany.

The InEK undertakes plausibility checks and can reject wrongly coded hospitalizations; for example, InEK did not accept 0.2% of all reported hospitalizations in Germany in 2006. Because shoulder arthroplasty is an expensive surgical procedure, hospitals and their DRG coders have a strong incentive to appropriately code shoulder arthroplasty because the coding directly influences the hospital reimbursement.

The InEK forwards anonymized data to the Federal Bureau of Statistics. Since 2005, the Federal Bureau of Statistics has provided individual hospitalization data for scientific use. Hospitalizations are anonymized, which means that patients who are hospitalized more than once during the study period cannot be reidentified. We were able to use the data from 2005 and 2006, including 36.3 million hospitalizations, which has previously provided a useful data source for epidemiologic purposes, as previous studies have shown.[25-27]

Up to 100 medical procedures can be coded for each hospitalization, according to a national classification of operations and procedures (OPS). In 2005 and 2006, the OPS versions of the years 2005 and 2006 were used, respectively.[15,16]

For our study, we included all men and women (any age) who resided in Germany and underwent a primary HA (OPS 5-8240) or TSA (OPS 5-8242) or a revision of HA or TSA between 2005 and 2006. Shoulder arthroplasty revisions were defined in the form of replacements or extractions of HA or TSA as follows: OPS 5-8251: replacement HA; OPS 5-8257: extraction HA; OPS 5-8252: replacement TSA; and OPS 5-8258: extraction TSA. During the years 2005 and 2006 18,003 primary shoulder arthroplasties and revisions were performed among 36.3 million hospitalizations. We excluded some cases from all analyses: 24 because primary HA and TSA were coded together, 12 because revisions for HA and TSA were coded together, 78 because the coding of the primary shoulder arthroplasty (HA or TSA) did not correspond with the simultaneously coded revision prosthesis (eg, HA as primary arthroplasty but TSA as revision prosthesis or vice versa) implanted during the same hospitalization, 221 because the place of residence was outside Germany, unknown, or defined as homeless, and 1 case because of missing gender.

The remaining 17,667 hospitalizations were considered in this study, including 16,488 primary shoulder arthroplasties and 1302 revisions. The DRG data contains for each hospitalization 1 primary diagnosis and up to 89 secondary diagnoses coded by International Classification of Diseases, 10th Edition, German Modification (ICD-10-GM). The diagnosis that led to the hospitalization assessed at the end of the hospitalization period is defined as the primary diagnosis. In 2005, diagnoses were coded according to the ICD-10-GM version 2005.[9] In 2006, the ICD-10-GM version 2006 was used.[10]

To derive the leading cause of each of the 16,488 primary arthroplasties, we used the primary diagnosis of the hospital stay, as coded by the ICD-10-GM, that included shoulder arthroplasty and assigned it to 1 of 8 indication groups (Table I) that are the usual indications for shoulder arthroplasties.[2,7,14] In this way, we classified 15,224 of all primary arthroplasties (92.3%) in 1 indication group. For the remaining 1264 (7.7%), we checked the secondary diagnosis in the same way. The algorithm found no indication for 455 (2.8%) and more than 1 indication (up to 3) for 173 (1.0%) in the secondary diagnosis. We checked these cases individually. Overall, 157 (1.0%) could not be assigned to an indication group and were assigned to the ''unknown'' indication group.

We tried to explore reasons for revision in use of ICD-10-GM diagnosis of each of the 1302 revised shoulder arthroplasties. We were only able to distinguish 3 groups: infection (ICD T845: infection and inflammatory reaction caused a joint prosthesis) in 309 (23.7%), mechanical complication (ICD T840: mechanical complication caused a joint prosthesis) in 734 (56.4%), and other causes in 259 (19.9%). Because these groups are too inhomogeneous and do not largely reflect the medical practice, we stopped further analysis.

Owing to the anonymization of the DRG data, we could not reidentify arthroplasty patients who underwent a revision (replacement or extraction) and therefore could not provide risk estimates of arthroplasty revision. Instead, we could only quantify the RB as defined by the Swedish hip arthroplasty registry: we divided the number of revisions in the form of replacements or extractions by the number of all primary and revision shoulder arthroplasties (HA and TSA).[6] Therefore, a revision prosthesis within our study period 2005 to 2006 could be related to a primary shoulder arthroplasty undertaken before 2005. Furthermore, if the same patient underwent more than 1 revision arthroplasty in