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ORIGINAL ARTICLE

Effect of smoking on complications following primary shoulder arthroplasty

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Background: The purpose of this study was to examine the effect of smoking on the incidence of complications after primary anatomic total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA).

Methods: All patients who underwent primary TSA or RSA at our institution between 2002 and 2011 and had a minimum 2-year follow-up were included. Smoking status was assessed at the time of surgery. Current smokers, former smokers, and nonsmokers were compared for periprosthetic infection, fractures (intraoperative and postoperative), and loosening after surgery.

Results: The cohort included 1834 shoulders in 1614 patients (814 in smokers and 1020 in nonsmokers). Complications occurred in 73 patients (75 shoulders; 44 in smokers and 31 in nonsmokers). There were 20 periprosthetic infections (16 in smokers and 4 in nonsmokers), 27 periprosthetic fractures (14 in smokers and 13 in nonsmokers), and 28 loosening (14 in smokers and 14 in nonsmokers). Smokers had lower periprosthetic infection-free survival rates (95.3%-99.4% at 10 years; $P = .001$) and overall complication-free survival rates (78.4%-90.2%; $P = .012$) than nonsmokers. Multivariable analyses showed that both current and former smokers had significantly higher risk of periprosthetic infection in comparison with nonsmokers (hazard ratio [HR], 7.27 and 4.56, respectively). In addition, current smokers showed a higher risk of postoperative fractures than both former smokers (HR, 3.63) and nonsmokers (HR, 6.99).

Conclusions: This study demonstrates that smoking is a significant risk factor of complications after TSA and RSA. These findings emphasize the need for preoperative collaborative interventions, including smoking cessation programs.

Level of evidence: Level II; Retrospective Design; Prognosis Study

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Shoulder arthroplasty has been established as a successful procedure that leads to marked improvements in shoulder pain, function, and quality of life in patients with end-stage joint arthritis.^{2,5} Despite its success, shoulder arthroplasty has been associated with various complications, including postoperative periprosthetic infection (0.4%-2.9%)^{4,30,35} and

fractures (2.3%-3.0%).^{3,29,37} Furthermore, humerus or glenoid loosening rates approach approximately 30% at 15 to 20 years of follow-up.²⁴ Patient-specific factors that have been demonstrated to increase the rates of these common complications include younger age, higher body mass index (BMI), rheumatoid arthritis, and diabetes mellitus.^{7,11,13,17,23}

Smoking habit has been suggested as a deleterious factor of postoperative outcomes in various surgeries.³⁴ Recent studies for total hip and knee arthroplasties showed that preoperative smoking status could affect the incidence of complications, such as periprosthetic infection, fractures, and systemic pathologic changes.^{15,20,21,27,28} On the other hand, there is a paucity of studies examining the effects of smoking on shoulder arthroplasty as well as the potential benefits of smoking cessation before or after the procedure.

The purpose of this study was to examine the effect of smoking on the incidence of common complications after primary total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA).

Materials and methods

Study cohort

This is a retrospective case-control study regarding the effect of smoking on the incidence of complications after shoulder prosthesis using the prospectively collected data from our institution's Total Joint Registry.¹ Our study cohort consisted of every patient who was 18 years or older, underwent shoulder arthroplasty (TSA or RSA) from 2002 to 2011, and had a minimum of 2-year follow-up or follow-up to revision surgery.

In this registry, patients' information is prospectively captured through in-person examinations and interviews, trained abstractor chart review, and questionnaires.³¹ Systematic follow-up intervals include 1 year, 2 years, and 5 years postoperatively and every 5 years thereafter. In addition to the data collected through the registry (demographics, comorbidities, indications, operative factors, outcomes, complications), our study required detailed data from the electronic medical record on both current smoking status and former history of smoking. These databases report smoking status as being current, quit (including the period), or never.

Outcomes

Complication rates after primary TSA or RSA were measured. Previous studies have showed that periprosthetic infection, intraoperative and postoperative periprosthetic fracture, and loosening are possibly associated with smoking in lower extremity arthroplasty.^{15,20,21,27,28} Periprosthetic infection was defined by the presence of positive joint fluid culture, positive synovial or bone tissue culture, intraoperative findings, or positive blood culture associated with a clinical presentation consistent with periprosthetic infection. Superficial infections (suture infections or stitch abscesses) were not analyzed. Loosening was defined at the time of revision surgery as an intraoperatively loose glenoid or humeral components.

Effect of smoking

Patients were separated into 2 groups based on their smoking status (smoker or nonsmoker). Smoker was defined as a patient who had a documented history of tobacco use, in the form of cigarettes, cigars, or chewing tobacco, during his or her lifetime.¹² Stratified factors in smoking status were also analyzed. These focused on the effect of smoking cessation. Using the clinical databases, all smokers were stratified successfully into 2 categories: current smoker, who had smoked within 1 month before surgery; and former smoker, who had not.¹² Quantitative stratification in pack-years was not performed because this information was poorly documented.

Predictors of interest

Covariates were identified in the Total Joint Registry and included sex, age, BMI, type of surgery (TSA or RSA), rheumatoid arthritis, and diabetes mellitus on the basis of previous studies.^{7,11,13,17,23}

Statistical analyses

Statistical analyses were performed using JMP Pro 10 (SAS Institute Inc., Cary, NC, USA). Survival free of periprosthetic infection, fractures, loosening, and overall complications was estimated using Kaplan-Meier survival analysis. Univariate and multivariable-adjusted analyses for each event were examined using Cox regression, excepting the analyses of intraoperative fractures with the use of logistic regression. Variables including smoking status, sex, age (per 10 years), BMI (per unit), type of surgery (TSA or RSA), rheumatoid arthritis, and diabetes mellitus were assessed for association with each event. The level of significance was set at $P = .05$.

Results

Clinical and demographic characteristics

A total of 1614 patients underwent 1834 shoulder arthroplasties during 2002 to 2011, including 1332 TSAs and 502 RSAs (Table I). The mean age at the time of surgery was 69 years (range, 19-92), and 52% of patients were female. Overall, 814 shoulders in 716 patients had a smoking history at the time of surgery; 140 (17%) shoulders were current smokers, and 674 (83%) were former smokers who had quit smoking at least 1 month before surgery.

Frequency of complications after shoulder arthroplasty

Of the 1834 shoulders that underwent TSA or RSA, 20 (1.1%) periprosthetic infections (16 in smokers and 4 in nonsmokers), 27 (1.5%) periprosthetic fractures (14 in smokers and 13 in nonsmokers), and 28 (1.5%) loosening (14 in smokers and 14 in nonsmokers) were identified (Table II). Survivorship analyses showed that smokers had significantly lower survival rates compared with nonsmokers for 10-year survival free of periprosthetic infection (95.3% [95% confidence interval (CI), 89.7-97.9] to 99.4% [95% CI, 98.5-99.8];

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