The Knee xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

The Knee

Smoking is associated with earlier time to revision of total knee arthroplasty☆

Chin Tat Lim [a,b], Stuart B. Goodman [a], James I. Huddleston III [a], Alex H.S. Harris [a], Subhrojyoti Bhowmick [a], William J. Maloney [a], Derek F. Amanatullah [a,*]

[a] Department of Orthopaedic Surgery, Stanford University School of Medicine, 450 Broadway Street, Redwood City, CA 94063, USA
[b] Department of Orthopaedic Surgery, National University Hospital, 1E Kent Ridge Road, NUHS Tower Block, Level 11, 119228, Singapore

ARTICLE INFO

Article history:
Received 20 December 2016
Received in revised form 14 May 2017
Accepted 21 May 2017
Available online xxxx

Keywords:
Smoking
Smokers
Ex-Smokers
Non-Smokers
Revision
Total Knee Arthroplasty

ABSTRACT

Background: Smoking is associated with early postoperative complications, increased length of hospital stay, and an increased risk of revision after total knee arthroplasty (TKA). However, the effect of smoking on time to revision TKA is unknown.
Methods: A total of 619 primary TKAs referred to an academic tertiary center for revision TKA were retrospectively stratified according to the patient smoking status. Smoking status was then analyzed for associations with time to revision TKA using a Chi square test. The association was also analyzed according to the indication for revision TKA.
Results: Smokers (37/41, 90%) have an increased risk of earlier revision for any reason compared to non-smokers (274/357, 77%, $p = 0.031$). Smokers (37/41, 90%) have an increased risk of earlier revision for any reason compared to ex-smokers (168/221, 76%, $p = 0.028$). Subgroup analysis did not reveal a difference in indication for revision TKA ($p > 0.05$).
Conclusions: Smokers are at increased risk of earlier revision TKA when compared to non-smokers and ex-smokers. The risk for ex-smokers was similar to that of non-smokers. Smoking appears to have an all-or-none effect on earlier revision TKA as patients who smoked more did not have higher risk of early revision TKA. These results highlight the need for clinicians to urge patients not to begin smoking and encourage smokers to quit smoking prior to primary TKA.

1. Introduction

There has been an increasing popularity for total knee arthroplasty (TKA), with four million adults in the United States living with a knee arthroplasty as of 2013 [1]. One million TKAs are projected to be performed in the United States alone in 2015 [2]. In 2010, 67,534 revision TKAs were performed along with 632,862 primary TKAs, representing a revision TKA burden of 9.6% [3]. At the same time, smoking remains extremely popular among adults worldwide. In the United States, 18% of adults are still reported to be smoking [4]. The prevalence of smokers among total hip and total knee arthroplasty patients varies from 10% to 24% [5,6]. Smoking accounts for $289 billion in health care associated costs each year and results in 4,800,000 premature deaths annually [7].

☆ Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author at: Department of Orthopaedic Surgery, Stanford University School of Medicine, 450 Broadway Street, Redwood City, CA 94063, USA.
E-mail address: dfa@stanford.edu (D.F. Amanatullah).

http://dx.doi.org/10.1016/j.knee.2017.05.014
0968-0160/

Several patient factors affect short-term outcomes following TKA [8–10]. Smoking is an example of modifiable patient factor that can be targeted to reduce complication and mortality rates of TKA [6,11,12]. In a randomized control trial, smoking cessation intervention with counseling and nicotine replacement therapy significantly reduced wound related complications (five percent vs. 31%, $p = 0.001$), cardiovascular complications (0% vs. 10%, $p = 0.08$) and secondary surgery (four percent vs. 15%, $p = 0.07$) in patients in the smoking intervention group compared to controls [11]. Smoking has been extensively studied with regard to complications, re-admissions, re-operations and mortality [6,8,12–16]. However, there are no studies analyzing the effect of smoking status to time to revision TKA.

The impact of smoking on the time to revision TKA would provide important information for counseling and decision-making. Recommending smoking cessation before primary TKA could be a powerful tool to combat the risk of early complications in patients who smoke. This study seeks to identify whether smoking status in patients undergoing primary TKA affects timing to revision TKA in a cohort of patients who were referred to our institution for revision TKA.

2. Materials and methods

Using our department's total joint registry (tertiary joint replacement center), we retrospectively reviewed 619 revision TKAs (619 patients) that were referred to our institution for revision TKA (i.e., the primary TKA was performed elsewhere) over a 10-year period from January 2005 to December 2014. Revision was defined as re-operation after primary TKA for any reason. Patients who had undergone simultaneous bilateral TKAs or had a diagnosis of inflammatory disease were excluded. Smoking status (non-smoker, smoker, ex-smoker), smoking pack years, age, gender, body mass index (BMI) at revision TKA, American Society of Anaesthesiologist classification (ASA), indication for revision TKA (e.g., infection, aseptic loosening/osteolysis, stiffness, instability and miscellaneous etiology).

2.1. Statistical analysis

Continuous variables are reported as means and standard deviations or median and standard error of mean where appropriate. Revision rate is presented as proportion and percentage. We stratified patients by time to revision TKA and smoking status (non-smoker, smoker, ex-smoker). Time to revision TKA was stratified into time to revision in less than or equal to 7.5 years (early and mid-term) and greater than 7.5 years (late). The association between time to revision and smoking status was also analyzed according to the indication for revision. To compare the proportions of patients undergoing revision TKA, a Chi square test for proportions was used. Three separate Chi square tests were performed comparing smoker to non-smoker, smoker to ex-smoker and then non-smoker to ex-smoker. To compare the median time to revision TKA among the three smoking groups, a Kruskal–Wallis test for median was used. A post-hoc power analysis was also performed to determine the power of the study, as no prior studies exist to perform power analysis before the study. All calculations were performed using SPSS (IBM SPSS Statistics 20). A p-value of less than 0.05 was considered statistically significant.

3. Results

Six hundred nineteen revision TKAs with complete parameters were evaluated. Sixty one revision TKAs were excluded due to the lack of complete parameters. Two hundred eighty revision TKAs were performed in men (45%) and 339 (55%) were

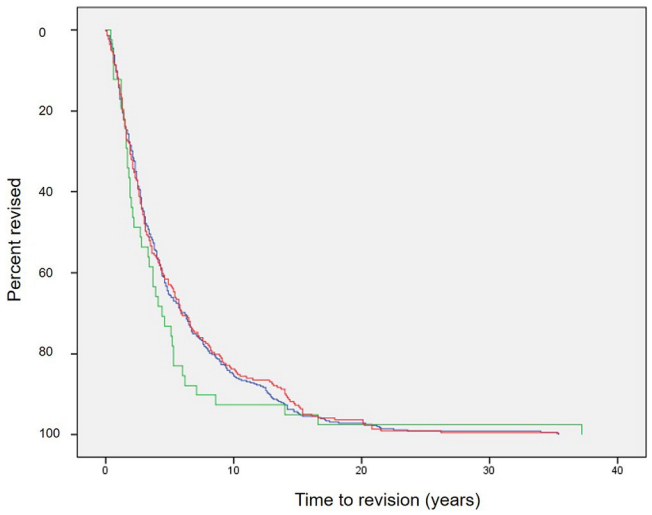

Figure 1. Rate of revision curves correlating interval from primary TKA to revision TKA at our tertiary care center stratified different smoking status (non-smoker [blue], smoker [green], ex-smoker [red]). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Please cite this article as: Lim CT, et al, Smoking is associated with earlier time to revision of total knee arthroplasty, Knee (2017), http://dx.doi.org/10.1016/j.knee.2017.05.014