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Effects of Smoking on Subjective and Objective Measures of Pain Intensity, Functional Impairment, and Health-Related Quality of Life in Lumbar Degenerative Disk Disease

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■ BACKGROUND: Numerous studies assessed the effects of smoking on lumbar degenerative disk disease (DDD); they focused on patient-reported outcome measures (PROMs) and yielded conflicting results.

■ METHODS: In this 2-center study on consecutive patients receiving surgical treatment for lumbar DDD, subjective functional impairment (SFI) in terms of PROMs including visual analog scale back and leg pain, Roland-Morris, Oswestry Disability Index, Euro-Qol-5D, and a Short-Form 12 physical component summary was determined at baseline, 3 days, 6 weeks, 6 months, and 1 year postoperatively. Age- and sex-adjusted T-scores of objective functional impairment (OFI) were determined using the Timed Up and Go test up to 6 weeks postoperatively. The responder status was defined by the minimal clinically important difference.

■ RESULTS: We analyzed 375 patients ($n = 96$ [25.6%] smokers and $n = 279$ [74.4%] nonsmokers). SFI on any of the PROMs before treatment was similar in smokers and nonsmokers. Smokers were more likely to have OFI in univariate logistic regression analysis (95% confidence interval 1.31–3.37, $P = 0.002$). In multivariate analysis, however, this relationship became insignificant (95% confidence interval 0.85–2.38, $P = 0.184$). The smoking status had no predictive capacity on the 6-week SFI or OFI responder status, and there were no differences in any of the PROMs until the 1-year follow-up.

■ CONCLUSIONS: PROMs measuring SFI for pain intensity, functional impairment, and health-related quality of life were similar in smokers and nonsmokers before surgery for lumbar DDD, as well as postoperatively. The smoking status has negligible impact on the Timed Up and Go test, which appears to be a robust assessment tool for OFI.

INTRODUCTION

The prevalence of smoking is estimated to be between 19.7% and 45.7%[1] despite well-known risks for cancer, coronary heart disease, and stroke.[2] Additionally, there is reportedly a higher prevalence of low back pain in smokers.[3-5] In instrumented procedures for lumbar degenerative disk disease (DDD), smoking is known to adversely affect the rates of nonunion, while smoking cessation before surgery has been shown to increase the union rate.[6] The impact of smoking on surgical outcome, however, is still a matter of controversy:

Key words
- Lumbar degenerative disk disease
- Objective functional impairment
- Patient-reported outcome measures
- Smoking
- Subjective functional impairment
- Timed Up and Go test

Abbreviations and Acronyms
BMI: Body mass index
CI: Confidence interval
DDD: Degenerative disk disease
EQ-5D: Euro-Qol-5D
hrQoL: Health-related quality of life
LDH: Lumbar disk herniation
LSS: Lumbar spinal stenosis
MCID: Minimal clinically important difference
MCS: Mental component score
ODI: Oswestry Disability Index
OFI: Objective functional impairment
PCS: Physical component summary

PLIF: Posterior lumbar interbody fusion
PROMs: Patient-reported outcomes measures
RMDI: Roland-Morris Disability Index
SF-12: Short-Form survey with 12 questions
SFI: Subjective functional impairment
TUG: Timed Up and Go
VAS: Visual analog scale

While smoking was found to be a negative outcome predictor in some studies,[7-10] other groups[11,12] including previous findings from our own series[13,14] could not confirm this finding. Thus in 2010 and 2011, we prospectively followed a patient cohort undergoing noninstrumented lumbar spine surgery dichotomized by their smoking status and assessed visual analog scale (VAS) back and leg pain intensity and a short-form survey with 12 questions (SF-12) after 1[13,14] and 4.5 years.[14] No significant differences in outcome were found between the 2 groups. All these studies share patient-reported outcome measures (PROMs), which are subjective measures of pain intensity, functional impairment, and health-related quality of life (hrQoL). These measures may not be affected solely by smoking[7,15] but can also be subject to other factors such as depression and employment status, for instance.[15] So far, no study has employed objective measures to determine differences in the functional status between smoking and nonsmoking patients with lumbar DDD before and after surgery. Recently, the Timed Up and Go (TUG) test was proposed as a measure of objective functional impairment (OFI) in lumbar DDD.[16]

The aim of this study was to investigate the effect of smoking on subjective and objective measures of pain intensity, functional impairment and hrQoL in patients with lumbar DDD, as determined by well-established PROMs and the TUG test.

MATERIALS AND METHODS

Patients scheduled for lumbar spine surgery were prospectively enrolled into a database between September 2013 and December 2015 at the Departments of Neurosurgery of the University Hospital Geneva and Cantonal Hospital St. Gallen in Switzerland. Analysis was performed retrospectively. Diagnoses entailed 1) lumbar disk herniation (LDH), 2) lumbar spinal stenosis (LSS), and 3) lumbar DDD with or without instability requiring lumbar fusion (either transforaminal lumbar interbody fusion, posterior lumbar interbody fusion [PLIF] or extreme lateral interbody fusion). Exclusion criteria were age <18 years, pregnancy, severe neurologic deficits, or other medical conditions interfering with the patients' ability to walk and perform the TUG test.

The study was approved by the Institutional Review Boards of the University of Geneva (14-079) and the Ethics Committee of St. Gallen (14/049). Written informed consent was obtained from every study participant.

Data Collection

Preoperatively, patient age, sex, current smoking status, body mass index (BMI), employment status, motor deficit, morphine use, and comorbidity (American Society of Anesthesiologists score[17] and Charlson Comorbidity Index[18]) were recorded. Disease-specific details included the underlying diagnosis and surgical procedure. Subjective measures of pain intensity, functional impairment, and hrQoL were assessed preoperatively and 3 days, 6 weeks, 6 months, and 1 year postoperatively. They included the VAS for back and leg pain intensity, Roland-Morris Disability Index[19] (RMDI; 24 items, ranging from 0 [no disability] to 24 [severe disability]), and Oswestry Disability Index[20] (ODI; 10 items, ranging from 0 [no disability] to 100 [severe disability]), as well as the Euro-Qol-5D[21] (EQ-5D; 5

items, ranging from 1 [best hrQoL] to −0.074 [worst hrQoL] using European norms) and SF-12[22] (12 items, results standardized to a mean of 50) with its 2 composite summaries, the physical component summary (PCS) and mental component summary (MCS). The TUG test was conducted in a standardized manner before and 6 weeks after surgery as previously described.[16,23] Raw TUG test times were transformed into T-scores, and the presence and severity of OFI were determined using age- and sex-adjusted norms.[23]

Study Groups

As in our previous works,[13,14] study patients were divided according to their smoking status at the time of surgery. Patients smoking at least 1 cigarette/day were defined as smokers, and nonsmokers were defined as patients who had never smoked in their life or had quit smoking at least 2 months before the surgical intervention.

Statistical Methods

Demographic baseline data were described using frequencies and percentage for categorical variables and tested for imbalance using Pearson chi-square tests. Continuous variables were described as group means and standard deviations; rank-sum tests were used for statistical comparisons. The 6-week response to surgical treatment was determined by the minimal clinically important difference (MCID) on the following scales: VAS back pain (1.2), VAS leg pain (1.6), RMDI (5.0), ODI (12.8), EQ-5D (0.359), SF-12 PCS (4.9), and TUG (3.4 seconds).[23,24] Presence and degree of OFI in smokers and nonsmokers were analyzed using Pearson chi-square tests. Logistic regression analysis was used to estimate the effect size of the relationship between smoking and OFI, as well as between smoking and 6-week responder status after surgical treatment. As patient groups were found to differ in important baseline variables, a multivariate model was adjusted for all unbalanced variables. Neither stepwise nor other automated variable selection methods were used. Long-term follow-up was reported as group means and 95% confidence intervals (CIs), with Student's t-tests used for comparison.

The software used for the statistical analysis was Stata v14 (StataCorp LP, College Station, Texas, USA). P values < 0.05 were considered statistically significant.

Sample Size/Power Calculations

No formal sample size calculation was performed, as the number of patients enrolled into the database was limited to n = 375. Given the smaller sample size of n = 96 patients in the smoking group and the 6-week response on the ODI in 70% and 81% of patients, respectively, the power of this study was determined as 42.5% to detect a significant difference with alpha set at 0.05.

RESULTS

A total of 375 patients with lumbar DDD, n = 96 (25.6%) smokers and n = 279 (74.4%) nonsmokers, were recruited. Patient baseline characteristics are shown in Table 1. Smokers were significantly younger (50.5 ± 14.4 vs. 61.8. ± 15.1 years), less likely to be retired (18.8% vs. 47%), and more likely to undergo