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Short- and long-term effects of smoking on pain and health-related quality of life after non-instrumented lumbar spine surgery

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ABSTRACT

Objectives: A myriad of negative bodily health effects related to tobacco smoking is known while its detrimental effects on the spine in particular are less defined. The goal of the current study is to compare long-term outcome between smokers and non-smokers after non-instrumented lumbar spine surgery.
Patients and methods: Prospective observational study on $n = 172$ consecutive patients undergoing non-instrumented spine surgery for lumbar disc herniation (LDH) or lumbar spinal stenosis (LSS) with a follow-up (FU) of 4.5 years. Patients were dichotomized according to their smoking status at the time of surgery. Back pain and health-related quality of life (HRQoL) were assessed using the visual analogue scale (VAS) and the Short-Form (SF)-12. Any subsequent lumbar spine surgeries since the index surgery were registered. Logistic regression analysis was used to estimate the effect size of the relationship between smoking and the responder status to surgery in terms of pain and HRQoL-metrics.
Results: Complete FU data was available for $n = 29$ (55%) smokers and $n = 75$ (63%) non-smokers. At discharge, 1 month, 1 year and 4.5 years, smokers were as likely as non-smokers to achieve a favourable response to surgery in terms of VAS back pain and the SF-12 mental and physical component scale metric. A subgroup analysis on active smokers throughout the entire study interval did not find an inferior responder rate than in never-smokers. A trend for additional lumbar spine surgery performed in 17.2% of the smoking and 8.2% of the non-smoking patients during FU was observed (OR 2.39, 95% CI 0.67–8.57, $p = 0.179$).
Conclusion: Up to 4.5 years following non-instrumented lumbar spine surgery, there was no difference in the pain or HRQoL-responder status of smokers and non-smokers. Smokers may be more likely to undergo re-do surgery in the long term, but more data is needed to confirm this statistical trend.

1. Introduction

Smoking is commonly known to exert negative effects on bodily health such as a 25-fold increased risk for lung cancer, a 2- to 4-fold increased risk for coronary heart disease or stroke [1], as well as to represent a cause of premature death [2]. In Germany for example, more than 114.000 premature deaths, 1.6 million years of potential life lost and 21 billion Euros are the socio-economic burden of smoking [3]. Despite these well-known risks, the smoking prevalence is still high and varies greatly across different European countries from as low as 19.7% in Portugal to as high as 45.7% in Bulgaria [4]. What is usually less known to smokers and health-care providers is that low back pain (LBP) is more prevalent amongst smokers [5,6] and even more so in patients with numerous pack-years (PY) [7].

According to a Finnish longitudinal study [8], daily smoking was identified to be a risk factor in male patients for a lumbar disc herniation (LDH) requiring surgical treatment. Moreover, reduced bone quality secondary to the effects of smoking results in an increased risk of 13% in women and 23% in men to suffer from osteoporotic vertebral fractures [4,6]. The rates of perioperative complications and mortality were found to be higher in smokers undergoing surgery [9,10]. Perioperative smoking cessation was indeed shown to effectively lower the risk of these complications [11–13]. Regarding spine surgery in particular, the role of the patient's smoking

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status pertaining to surgical complications and postoperative outcome is less investigated [6]. Smokers undergoing lumbar spine surgery are at higher risk for wound infections [14,15]. The risk of non-union has been shown to be 5-times higher for smokers undergoing spinal fusion surgery as compared to non-smokers [16] while fusion rates were found to be better after smoking cessation [17,18].

In a previous prospective observational study on a patient cohort undergoing non-instrumented spine surgery for LDH [19], the health-related quality of life (HRQoL)-response to surgery was equal in smokers and non-smokers after one year. However, given the progressive nature of degenerative disc disease (DDD), significant outcome differences might become evident in the long-term only. Accounting for these late effects, it was the aim of the current study to provide long-term follow-up (FU) data in this cohort [19].

2. Materials and methods

2.1. Study design and patient identification

In this prospective cohort study, all consecutive patients with symptomatic and radiologically confirmed LDH or lumbar spinal stenosis (LSS) undergoing non-instrumented spine surgery at the Department of Neurosurgery of the Cantonal Hospital St. Gallen between October 2010 and February 2011 were included. Surgical patient management for LDH, exclusion criteria and study visits were described in detail in our previous report [19]. Surgical candidates for microscopic decompression had neurogenic claudication with or without associated neurologic deficits for a minimum of 12 weeks. LSS was diagnosed by means of cross-sectional imaging; usually magnetic resonance imaging (MRI) or computed tomography (CT) with or without myelography. In patients reporting mechanical LBP in view of degenerative spondylolisthesis and/or segmental instability in standing flexion/extension X-rays, surgical fusion was performed in addition to decompression. These patients were, however, excluded from the current study.

The local institutional review board approved the study protocol (EKSG 010/075). Written informed consent was obtained from each study participant. Patients were examined at baseline as well as before discharge. They were followed using mailed questionnaires at 1 month and 1 year [19]. An additional long-term FU assessing visual analogue scale (VAS) back pain and HRQoL (Short-Form (SF)-12) was performed about 4.5 years after the index surgery. All patients were asked whether they had undergone additional lumbar spine surgery in the meantime.

2.2. Study groups

Two study groups were built according to the smoking status at the time of the index surgery [19]. Current smokers were defined as patients smoking one or more cigarettes per day. Previous smokers were defined as patients who stopped smoking at least 2 months prior to surgery. Never-smokers were defined as patients who never smoked and reported zero lifetime pack-years (PY). Previous smokers and never-smokers were combined to one group and compared to the smokers group. This approach was chosen as the literature suggests that the impact of smoking on common surgical complications is reversible after several weeks of smoking cessation [20,21]. However, some effects of smoking/nicotine on the body last up until 6 months after smoking cessation or longer [18,22].

As smoking habits may change over time, the smoking status was re-assessed at each FU. However, smokers and non-smokers were not relocated amongst the study groups when they stopped or started smoking. Accounting for any bias arising from this analysis, active smokers during the entire study interval were separately compared to never-smokers in a subgroup analysis.

2.3. Statistical methods

Analysis of categorical variables was performed using two-tailed Fisher's exact tests or Chi-Square tests as appropriate. Analysis of nominal variables was performed using two-tailed Mann–Whitney tests. Results were expressed in counts and percentages or in means and standard deviations (SD). Response to surgery was estimated using the VAS for back pain as well as two HRQoL-metrics. An improvement of at least one minimum clinically significant difference (MCID) of the respective metric was considered a positive response to surgery: 1.2 points for VAS back pain [23] and 1.75/2.76 for SF-12 physical component scale (PCS) or mental component scale (MCS) [24]. Re-do surgery rates until the last FU were considered. Univariate logistic regression was used to assess the effect size of the relationship between smoking and the pain- or HRQoL-responder status as well as with re-do surgery. As there were no group differences at baseline, no adjusted model was built. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI). The software used for the statistical analysis was Stata v14 (StataCorp LP, College Station, Texas, USA). P values <0.05 were considered statistically significant.

2.4. Surgical technique and postoperative management

Surgery was performed under general anesthesia in knee-chest position. Cefamandole (MANDOKEF, Teva Pharma AG, Basel, Switzerland) 2 g IV was used for perioperative antibiotic prophylaxis. The level was marked, followed by draping and disinfection. For single-level procedures, a 3–5 cm skin incision was made in the midline. The fascia was opened using scissors or monopolar cautery (VALLEYLAB, Covidien, Neuhausen, Switzerland), followed by an interlaminar approach. The correct level was verified with fluoroscopy (Siemens Arcadis Varic, Munich, Germany). A Leica operative microscope (Leica Microsystems, Heerbrugg, Switzerland) was brought and the ligamentum flavum was partially resected. For disc herniation surgeries, the sequester was removed and, at the discretion of the surgeon, the disc space emptied from degenerated tissue. For lumbar spinal canal stenosis surgeries, decompression was usually performed via unilateral fenestration with undercutting or as bilateral fenestration in case of bilateral osseous recessal- or foraminal stenosis. Hemilaminectomy or laminectomy was performed to a lesser extend. After a final inspection to look for bleeding, a drain was inserted and wound closure was done in the usual fashion. Postoperatively, patients had relative bed rest until the next morning in order to minimize the re-bleeding risk and anesthesia-related falls. On postoperative day 1, nurses and physiotherapists assisted the patients with mobilization. No postoperative imaging was done when the further postoperative course was uneventful. Patients were usually discharged home after postoperative day 3. Elderly patients were discharged between postoperative day 5 and 7 if no waiting time for in-patient rehabilitation prolonged hospitalization time.

3. Results

During the recruitment period $n = 202$ patients were screened of which $n = 22$ did not fulfil the inclusion criteria and $n = 8$ did not wish to participate in the study. Thus, a total of $n = 172$ patients were finally included in the study of which 53 (30.8%) were smokers and 119 (69.2%) were non-smokers; the latter included 43 previous smokers and 76 never-smokers. Throughout the long-term FU interval, $n = 8$ (4.7%) patients died unrelated to surgery and $n = 60$