



## Original Research

## A retrospective study: Does cigarette smoking induce cervical disc degeneration?

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## ABSTRACT

**Objective:** To investigate cigarette smoking's relevance with cervical disc degeneration.

**Methods:** We randomly selected 320 patients who came to our spine disease department outpatient clinic with chief complaint of neck-shoulder pain during June 2014–June 2016. According to the detailed smoking history, these patients were divided into 3 different groups, which were active smoker group (AS), passive smoking group (PS) and never-smoker group (NS). Each patient's Miyazaki's magnetic resonance imaging (MRI) classification of cervical disc degeneration was analyzed based on their cervical MRI films. In addition, VAS scores were applied to evaluate the degree of patients' neck-shoulder pain. With the help of statistical techniques, relevance between cigarette smoking, cervical disc degeneration and neck-shoulder pain were analyzed.

**Results:** In the NS group, the overall Miyazaki score, especially for C2/3, C3/4, C5,6 segments, are superior to those in the PS group, in addition, the Miyazaki scores for C1/2 – C6/7 segments in NS group beat the same segments in AS group with statistical significance ( $P < 0.05$ ). In the AS and PS group, discs from C4/5 to C5/6 segments which score IV and V on Miyazaki classification account for a larger proportion than those discs from C1/2 to C3/4 segments with statistical significance ( $P < 0.05$ ). In the AS group, male cases have larger proportion of Miyazaki level IV and V discs than female with statistical significance ( $P < 0.05$ ). While in the AS and PS group, Miyazaki scores of patients whose smoking history ranges from 5 to 10 years are superior to those with smoking history longer than 10 years, with statistical significance ( $P < 0.05$ ). In addition, VAS scores also vary among the three groups, in which, VAS scores in AS group are higher than those in the NS group.

**Conclusion:** Smoking could accelerate the process of cervical disc degeneration, presenting with more severe neck-shoulder pain on the patients. In addition, the impact of smoking on the lower cervical discs is greater than the upper cervical discs.

## 1. Introduction

Intervertebral disc degeneration (IVDD) is the leading cause of low back pain and cervical spondylosis of the main reasons, although the current treatment can alleviate the condition, but cannot terminate the degeneration. Intervertebral disc is a non-vascular tissue with insufficient blood supply, hence, its primarily relies on the nutritional supply via blood capillary penetration of the vertebral bodies through the endplate [1]. Previous researches reported that insufficient blood supply may be related to the occurrence of degenerative diseases of the intervertebral disc [2,3], and atherosclerosis could serve as a possible reason for the lack of blood supply [4]. In addition, epidemiological and clinical studies further clarify the risk factors for atherosclerosis, such as

smoking, hyperlipidemia [5].

In present China, the smoking rate of citizens above 18-year-old is 31.06%, among adult male, the rate is 59.7%, and 3.8% among women [6]. Currently in the United States, 30% of the population is current smokers, 10% of which are passive smokers [7]. Smoking is associated with many diseases, among them, respiratory system diseases and cardiovascular diseases are currently dominating. Negative influence of smoking is evident in many orthopedic cases, including delayed fracture healing, reduced bone mineral density, elevated risk of fracture and nonunion of bone graft in spinal fusion surgeries [8]. Previous studies mainly focused on the relationship between atherosclerosis risk factors and low back pain or lumbar IVDD, and the conclusions the studies drew were not exactly concordant, in addition, few studies or

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research pinpoint on the effect of smoking inflicted on the degeneration of cervical discs. The role of smoking in cervical disc degeneration and possible mechanism of the degeneration still remain clear. The aim of this study was to investigate the relationship between smoking and cervical disc degeneration as well as neck/shoulder pain, and further to provide supportive evidence for clinical epidemiological studies and preliminary researches of the relationship between smoking and cervical disc degeneration.

## 2. Materials and methods

### 2.1. Participants

The present study was approved by the authors' human subjects Institutional Review Board. All procedures described in this study were approved by the Ethics Committee of our institution. All patients provided their written informed consent. In addition, the study has been reported in line with the STROCSS criteria [9].

320 adult patients were randomly selected from patients who came to our hospital spine surgery outpatient clinic during June 2014 ~ June 2016 with chief complaint of neck/shoulder pain. No author in our team has access to any information that could possibly identify individual participants during our data collection or any period of our study (see Table 1).

Inclusion criteria are as follows: (1) age  $\geq 18$  years old and  $\leq 70$  years old; (2) All patients came to our department's clinic with chief complaint of neck-shoulder pain for the first time, and the symptoms were not treated systematically in advance in any form; (3) All patients underwent cervical MRI. (4) All patients were office workers; (5) Patients were voluntarily recruited into the study.

Exclusion criteria are as follows: (1) For patients who passed the inclusion criteria 2, the symptoms must not be treated systematically in advance in any form; (2) Cases with cervical trauma, infection, ankylosing spondylitis, cancer and congenital deformity were ruled out; (3) Patients with heavy labor work history.

Patients who meet the above criteria were further divided into active smoking (AS) group, passive smoking (PS) and never smoking (NS) group. Among all the selected patients, 124 were included in the AS group, 55 were included in the PS group and 141 in the NS group. In the AS group, 113 are male, 11 are female, while in the PS group, 25 are male and 30 are female. In the NS group, there are 86 male patients and 55 female patients.

For the cases in AS group, according to the definition of smokers of Wu et al. [10], combined with the characteristics of smoking in China [11], following inclusion criteria was applied: cigarettes smoked daily  $\geq 20$ , the number of years of smoking history  $\geq 5$  years. Patients in PS group are not active smoker, who were involuntarily exposed in cigarettes smoking environment every day for more than 2 h, and the whole period of passive smoking should be greater than 5 years. Cases in NS group were never smokers. General information as follows was gathered: age, sex, body mass index (BMI), history of diabetes mellitus, hypertensive history, hypertriglyceridemia, history of chronic pharyngitis, history of alcohol abuse, smoking history, occupation, etc., and was compared to analyze whether any statistical difference of such

general information among the 3 groups exist.

### 2.2. Evaluation criteria

The cervical MRI (3.0T, Philips) of each patient was analyzed. The intervertebral discs were graded using the Miyazaki disc degeneration grading system [12] (grade 1–5, the higher the grade, the more severe the degeneration of the intervertebral disc). The degree of neck/shoulder pain was scored by visual analogue scale (VAS) scoring criteria.

### 2.3. Statistical analysis

The enumeration data obtained from the three groups were expressed as percentage, and the measurement data were expressed as mean  $\pm$  standard deviation. SPSS 18.0 was used for data entry and statistical analysis. R test was applied to compare the inter-group difference of enumeration data, while for the measurement data, *t*-test was used to analyze its inter-group difference. P value less than 0.05 was regarded as statistically significant.

## 3. Result

1. Smoking can induce cervical intervertebral disc degeneration and further lead to neck and shoulder pain.
2. Smoking tends to negatively affect lower segments of cervical discs more severely than upper segments.
3. Patients with degenerated cervical discs along with smoking history tend to have more severely degenerated discs than those without smoking history.
4. The degenerative effect of smoking present more severe in female patients than in males.

Among the three groups, there were no significant differences were noticed in age, hypertension history, history of diabetes mellitus, BMI, alcoholism and occupational type ( $P > 0.05$ ) (Table 1).

Miyazaki grades of each segment cervical spine from the three groups were recorded in Table 2. In the NS group, the overall Miyazaki score, especially for C2/3, C3/4, C5,6 segments, are superior to those in the PS group, in addition, the Miyazaki scores for C1/2 – C6/7 segments in NS group beat the same segments in AS group with statistical significance ( $P < 0.05$ ). In the AS and PS group, discs from C4/5 to C5/6 segments which score IV and V on Miyazaki classification account for a larger proportion than those discs from C1/2 to C3/4 segments with statistical significance ( $P < 0.05$ ).

Comparison of Miyazaki grading of cervical disc degeneration between male and female in three groups was recorded in Table 3. In the AS group, male cases have larger proportion of Miyazaki level IV and V discs than female with statistical significance ( $P < 0.05$ ).

Miyazaki grades of discs in AS group and PS group with two categories of different cigarette smoking history were recorded in Table 4. While in the AS and PS group, Miyazaki scores of patients whose smoking history ranges from 5 to 10 years are superior to those with smoking history longer than 10 years, with statistical significance

**Table 1**  
Comparison of the general data of the three groups of patients.

Patients groups	n	Sex (male/ female)	Age (x $\pm$ s years)	BMI(x $\pm$ s, kg/m <sup>2</sup> )	Hypertension history [n (%)]	Diabetes history [n (%)]	Alcohol use history [n (%)]
Never smoker group	141	86/55	48.1 $\pm$ 3.1	21.1 $\pm$ 1.7	39 (27.7)	9 (6.3)	47 (33.3)
Passive smoker group	55	25/30	48.1 $\pm$ 2.6	20.9 $\pm$ 1.4	16 (29.1)	10 (18.1) <sup>b</sup>	19 (34.5)
Active Smoker group	124	113/11	47.8 $\pm$ 2.8	20.6 $\pm$ 1.7	34 (27.4)	14 (11.3)	45 (36.2)
$\chi^2(F)$ value		0.210	-0.713 <sup>a</sup>	0.720 <sup>a</sup>	0.889	2.107	2.201
<i>P</i> value		0.890	0.086	0.480	0.070	0.020	0.056

<sup>a</sup>: F value, when compared with never-smoker group patients. <sup>b</sup>  $P < 0.017$ .

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