

Effect of Cigarette Smoking On Pain Intensity of TMD Patients: A Pilot Study

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ABSTRACT: To evaluate the effect of cigarette smoking (CS) on pain intensity in a sample of temporomandibular disorder (TMD) patients, 352 clinical charts were reviewed. Subjects were first divided into two groups: smokers (YS) and nonsmokers (NS); then, YS were further divided into three subgroups: light smokers (LS), moderate smokers (MS), and heavy smokers (HS). Overall TMD pain intensity was higher in YS, compared to NS, and a correlation was found between pain intensity and the number of cigarettes smoked in a day by each subject. A significant difference was evident between NS and HS. The results were not evident in males; age was not correlated either with smoking or pain intensity, and the effect of CS on pain intensity was not correlated with any particular TMD diagnosis. CS seems to be a relevant factor affecting the intensity of TMD pain, thus, control of smoking habits should be considered when treating TMD patients.

Dr. Marcello Melis received his degree in pharmacy from the University of Cagliari (Italy) in 1990, and his D.M.D. from the same university in 1998. He was a resident in the Gelb Orofacial Pain Center at Tufts University, Boston, Massachusetts from 1998 to 2000. Currently, he practices in Cagliari in the field of temporomandibular disorders and orofacial pain and is an adjunct clinical instructor in the Craniomandibular Pain Center at Tufts University. He has been involved in several international research activities, focusing on temporomandibular disorders, orofacial pain, and dental occlusion, lecturing nationally and internationally, and is published in numerous scientific journals.

The relationship between cigarette smoking (CS) and temporomandibular disorders (TMD) has rarely been investigated in the literature. Altschuler¹ hypothesized the role of smoking as risk factor for the development of TMD, based on his personal experience, encouraging researchers to investigate on such association. Similarly, Jay² suggested the exploration of the effect of smoking on the genesis of symptoms of chronic fatigue syndrome, fibromyalgia, and TMD. Two surveys showed higher risk of having TMD or oral and face pain among smokers using a mailed questionnaire.^{3,4} Furthermore, an association was found between CS and bruxism,^{5,6} which, in turn, is frequently associated with TMD,^{6,7} and such association was discussed to be related to the effect of nicotine on the central nervous system.⁵

The only controlled study that examined both smokers and nonsmokers, evaluating the occurrence of signs and symptoms of TMD, was published in 2005 by Wänman.⁸ The results showed almost identical prevalence of such symptoms in the two groups, both at baseline and at a 6-year follow-up, suggesting that smoking is not related to the presence or development of TMD.⁸ However, the subjects examined were a sample of 268 subjects drawn from the inhabitants of the county of Västerbotten in

Sweden, and most of them were asymptomatic or almost asymptomatic, because moderate and severe signs and symptoms of TMD are uncommon in the general population.⁹ As a result, despite the high number of subjects included in the initial sample, the number of subjects with TMD was low in both groups.

Therefore, the aim of this study was to assess the effect of CS from a different prospective, evaluating the effect of CS on pain intensity in a sample of TMD patients.

Materials and Methods

The records of all the new patients evaluated at the Craniofacial Pain Center at Tufts University, School of Dental Medicine in the year 2007 were reviewed. The following information was collected: TMD diagnosis, TMD pain intensity, CS occurrence, number of cigarettes smoked in a day, age, and gender.

TMD diagnosis was recorded according to the Axis I of the Research Diagnostic Criteria for TMD by Dworkin and LeResche.¹⁰ Therefore, patients were diagnosed as having or not: myofascial pain/myofascial pain with limited opening; disk displacement with reduction/disk displacement without reduction with limited opening/disk displacement without reduction without limited opening; arthralgia/osteoarthritis of the temporomandibular joint (TMJ)/osteoarthrosis of the TMJ; more than one diagnosis is possible.

Overall TMD pain intensity of the last six months was recorded using a numeric rating scale (NRS), with values ranging from 0 (no pain) to 10 (intolerable pain). Such tool was chosen because it is well accepted by the patients, easy to administer and to record, and adequately sensitive.^{11,12}

The number of cigarettes smoked (CS) in a day by each subject was recorded based on the patient's self-report. Subjects were first divided into two groups: smokers (YS) and nonsmokers (NS); then, the YS were further divided into three subgroups: light smokers (LS) when they reported smoking of one to five cigarettes a day; moderate smokers (MS) when they reported smoking of six to 14 cigarettes a day; heavy smokers (HS) when they reported smoking more than 14 cigarettes a day.

Age and gender of the subjects were recorded; they were then divided into three age categories: up to 20 years, from 21 to 50 years, more than 50 years.

The total number included 748 subjects, among whom, 521 were diagnosed with TMD. During the review of the clinical charts, 166 were excluded because of missing information, and three were excluded because the only diagnosis was temporomandibular joint subluxation (not included in Axis I of the Research Diagnostic Criteria for

TMD by Dworkin and LeResche¹⁰). The final number of patients who were evaluated was 352.

Statistics: A student's *t*-test was used to evaluate differences in pain intensity between YS and NS, analysis of variance (ANOVA) was performed while comparing NS, LS, MS, and HS, and pair-wise comparisons followed when significant difference was found. To correct for type-I error, the Bonferroni method was used. All tests were also performed for males and females separately.

Pearson correlation analysis was performed to evaluate the correlation between the number of cigarettes smoked by each subject, age, and pain intensity. Evaluation of the interaction between age and smoking was also explored using 3x4 ANOVA. The Chi square test was used to assess the relationship between CS and TMD diagnoses.

Statistical significance was set at $p < 0.05$, analysis of the data was conducted using Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL).

The Institutional Review Board of Tufts-New England Medical Center/Tufts University Health Sciences approved the study.

Results

The subjects were not equally distributed among the groups, because NS were more numerous than YS ($N=314$ and $N=38$ respectively); however, in the YS group, there was a similar distribution of subjects within the subgroups: LS ($N=15$), MS ($N=12$), and HS ($N=11$) (Table 1). Statistically significant difference of overall TMD pain intensity was found between NS and YS ($p=0.007$), and among NS, LH, MS, and HS ($p=0.005$). However, although a trend for increasing values of pain intensity was evident going from NS to LS, from LS to MS, and from MS to HS, multiple comparisons showed statistical significance between NS and HS only ($p=0.004$) (Table 1, Figures 1 and 2). Examining genders separately, such differences were evident for females only.

A positive correlation was found between the number of cigarettes smoked in a day and pain intensity for the entire sample and the female group ($p < 0.0001$ and $p=0.001$, respectively); no significant correlation was observed for the male group.

A 3x4 ANOVA showed that there was a significant main effect between pain intensity and CS for the entire sample and females only ($p=0.003$ and $p=0.008$, respectively); the interaction was not significant for males.

Also, there was no main effect between pain intensity and age, and CS and age.

Chi square analyses showed that there was no significant relationship between CS and any of the Axis I TMD diagnoses.

Table 1

Overall TMD Pain Intensity (NRS) In the Groups

Group	N	Overall pain intensity (NRS) (mean±SD)
NS	314	5.5(±2.5)**
YS	38	6.6(±2.1)*
LS	15	5.8(±1.8)
MS	12	6.3(±2.3)
HS	11	8.1(±1.4)**

N: number of subjects; TMD: temporomandibular disorders; NRS: numeric rating scale; SD: standard deviation; NS: nonsmokers; YS: smokers; LS: light smokers; MS: moderate smokers; HS: heavy smokers.

*Statistically significant difference between NS and YS (p=0.007)

**Statistically significant difference between NS and HS (p=0.004)

Discussion

The results of the present study show a significant higher intensity of TMD pain in YS, when compared to NS. In order to evaluate if the number of cigarettes smoked in a day by each subject would affect symptoms,

NS were further divided into three subgroups: LS, MS, and HS. Although it was evident that there was a trend of increasing values of pain intensity going from NS to LS, from LS to MS, and from MS to HS, such differences were only significant between NS and HS. A correlation was also found between pain intensity and the number of cigarettes smoked in a day. Such results were not evident in the male sample. The probable reason is the small number of male smokers included in the sample (NS=50; LS=5; MS=2; HS=3). In fact, in the total sample of 352 patients, 292 were female and only 60 were male, in the group of NS 264 were female and only 50 were male. In the subgroups of LS, MS, and HS females were 10, 10, and 8 respectively, while males were only 5, 2, and 3 respectively. This is also related to the higher prevalence of TMD among women than among men.¹³ However, we cannot exclude a different effect of CS on TMD pain in different genders.

Apparently such results do not agree with Wänman's outcome,⁸ which showed similar signs and symptoms in smokers and nonsmokers. Also, when the smokers were divided into low-frequency smokers, moderate-frequency smokers, and high-frequency smokers, no differences were found among the groups.⁸ Only pain elicited from the contralateral TMJ while clenching on a spatula occurred significantly more often among smokers than among nonsmokers, but such difference disappeared at the 6-year follow-up.⁸ Nevertheless, it is possible that CS

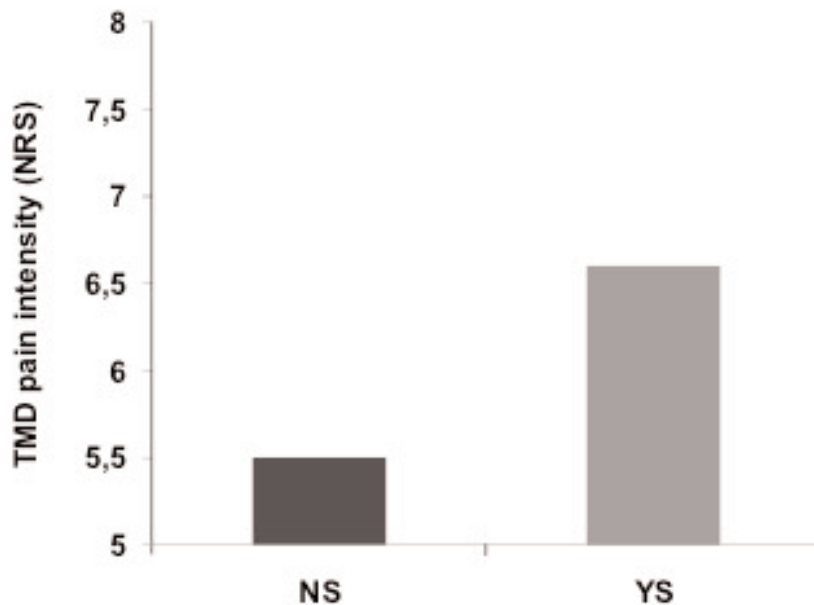


Figure 1
TMD: temporomandibular disorders; NRS: numeric rating scale; NS: nonsmokers; YS: smokers
*statistically significant difference (p=0.007)

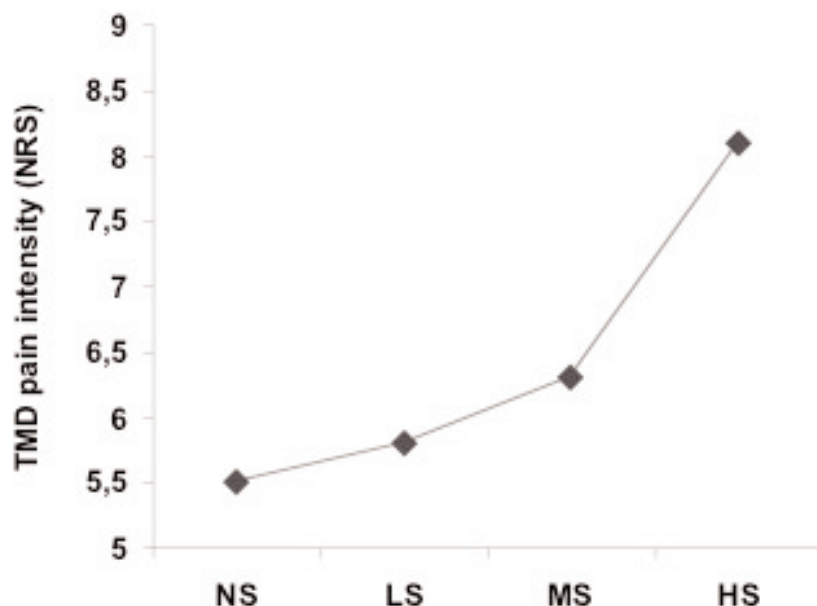


Figure 2

TMD: temporomandibular disorders;
 NRS: numeric rating scale;
 NS: non-smokers; LS: light smokers;
 MS: moderate smokers;
 HS: heavy smokers
 *statistically significant difference
 (p=0.004)

cannot precipitate the occurrence of TMD signs and symptoms, yet in patients affected by TMD can produce an increase of pain intensity, although in Wänman's study, no differences in the values of Helkimo anamnestic and dysfunction indexes¹⁴ were found between the groups.⁸ However, the outcome of the present study seems to confirm the higher risk for smokers to have TMD or oral and facial pain shown by other surveys.¹⁵⁻¹⁷

The way CS can affect muscular and joint structures in order to cause an increase of TMD pain intensity is probably related to its effect on muscle metabolism,¹⁵⁻¹⁷ disk degeneration,^{18,19} and bruxism.^{5,20} In fact CS has been associated with the occurrence low back pain,¹⁵⁻¹⁷ to the presence of intervertebral disk degeneration¹⁸ and herniated disk disease,¹⁹ and it has been correlated to an increase of bruxism.^{5,20}

The biological mechanism is likely due to a reduction of blood supply caused by vasoconstriction,²¹ and to the decrease of oxygen in the bloodstream.²²

Increase of the intensity of pain in TMD patients, along with the increased number of cigarettes smoked in a day by each subject, is a very interesting element, which deserves to be considered during treatment plan. Programs for reduction and interruption of smoking habits have never been considered in management of TMD patients. Conversely, such an approach can be useful for the improvement of the symptoms.

The lack of statistical significance of the difference

between NS and LS, between LS and MS, and between MS and HS can be ascribed to a need for 15 or more cigarettes smoked in a day to have some effect on pain, or, most probably, to the small number of subjects included in each category (except for NS). In fact, only 10.8% of the subjects examined were smokers (38 individuals), and the three subgroups, LM, MS, and HS, were made up of 15, 12, and 11 individuals respectively. Therefore, although the initial number of TMD patients included in the sample was high (N=352), the number of subjects included in the subgroups of smokers was always small, and this might have reduced the significance of the results. For this reason, additional surveys on this topic are needed, possibly with a larger sample size, in order to increase the power of the study and obtain a clearer outcome. The difficulty arises from the fact that the percentage of YS among TMD patients is low, therefore a very high number of patients needs to be examined to achieve a relevant number of subjects in each category. However, extending the investigation to patients visited in a time span longer than one year (for example 10 years), a sufficient number of subjects would be enrolled for a more consistent survey.

There are two aspects regarding CS that need to be discussed. First of all the current study did not evaluate the duration of smoking habit in the patients, because such information was not included in the clinical charts, and this point can be of great importance. Secondly, the study

evaluated the number of cigarettes smoked by the subjects based on their self-report, but this information could be inaccurate especially in young people who are more likely to under-report their smoking habit.

In addition, a cause-and-effect relationship between CS and TMD has not been demonstrated, but only a correlation between the variables. In fact there might be other explanations for why subjects who smoke more cigarettes experience greater pain, for example CS can be used as a coping mechanism.

Other limitations consist of the fact that the groups compared in the current study were not matched with each other: they were numerically different, they differed in age and gender, and probably differed on anamnestic and occlusal factors, presence of vicious habits (especially oral parafunctions), income, medication intake, and previous treatments, which were not evaluated in the present study, but could have affected the results. The reason for not trying to match the samples was due to the large difference between the groups in terms of subjects included, especially after dividing the YS into HS, MS, and LS.

Further studies are needed to increase the sample size and to match the groups in order to control the mentioned variables and improve the quality of the study.

Conclusions

In light of the results of the present study, CS can be considered a relevant factor affecting the intensity of TMD pain. Therefore, control of smoking habits should be considered for the treatment of TMD patients.

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