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ASSOCIATION BETWEEN DURATION OF SMOKELESS TOBACCO USE, VAPING, AND INTER-INCISAL MOUTH OPENING IN PATIENTS WITH ORAL SUBMUCOUS FIBROSIS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Oral submucous fibrosis (OSMF) is a chronic potentially malignant disorder strongly associated with smokeless tobacco use and characterized by progressive reduction in mouth opening. The objective is to assess the association between duration of smokeless tobacco use, vaping, and inter-incisal mouth opening in patients with oral submucous fibrosis.

Materials and Methods: This was a cross-sectional study conducted at Tertiary Care Hospital Karachi, from March 2024 to July 2025, including 355 patients diagnosed with oral submucous fibrosis.

Results: The mean age was 31.7 ± 9.4 years, and mean duration of smokeless tobacco use was 8.9 ± 4.6 years. Mean inter-incisal mouth opening was 27.8 ± 7.1 mm. Mouth opening declined significantly with increasing duration of tobacco use, from 33.4 ± 4.9 mm in patients with ≤5 years exposure to 21.4 ± 4.8 mm in those with >10 years ($p<0.001$). Vaping users had lower mouth opening than non-users (24.2 ± 5.9 vs 29.1 ± 6.8 mm; $p=0.011$). Severe restricted mouth opening was significantly associated with duration >10 years (58.3% vs 21.4%; $p<0.001$), Grade III–IV OSMF (78.6% vs 24.0%; $p<0.001$), and vaping exposure (36.9% vs 23.2%; $p=0.028$).

Conclusion: Longer duration of smokeless tobacco use, higher exposure frequency, and vaping were significantly associated with reduced mouth opening and greater severity of OSMF. Early risk factor modification may help reduce progression of functional impairment.

Keywords: Oral submucous fibrosis, smokeless tobacco, vaping, inter-incisal mouth opening, trismus.

INTRODUCTION

Oral submucous fibrosis (OSMF) is a chronic, progressive, potentially malignant condition involving inflammation and fibrosis of the oral mucosa, which results in stiffness, burning sensation and progressive rigidity of the mouth.[1] It is a significant public health issue in South Asia, where there is high prevalence of smokeless tobacco and areca nut consumption.[2,3] It has a profound impact on quality of life and has a potential for malignant transformation.[4,5] Use of smokeless tobacco products, betel quid, gutka, pan masala and others is strongly linked to the development of OSMF.[2] Prolonged exposure to these products stimulates fibroblasts, collagen synthesis, collagen degradation, and mucosal fibrosis.[4] Disease severity and severity of symptoms has been found to depend on the

duration and frequency of exposure.[6] Limited mouth opening is one of the key features of OSMF, typically measured by inter-incisal distance.[7] Decreased inter-incisal opening is an indicator of disease severity, and impacts nutrition, oral health, speech and surgical access.[8,9] A number of studies have found that duration of smokeless tobacco use is linked to a reduced mouth opening and higher severity of disease.[10,11]

Recently, e-cigarettes and electronic nicotine delivery systems have become popular among the young.[8] While vaping has been often considered as a healthier option to traditional smoking, recent studies have reported potential effects on oral mucosa, oxidative stress and inflammatory changes that could result in oral disease.[10] The potential link with OSMF severity and trismus is not well understood. Earlier studies have shown a strong association between duration of smokeless tobacco use and degree of fibrosis, with higher duration associated with greater degree of trismus and decreased inter-incisal distance.[11,12] Other research has shown that multiple exposures to harmful habits may be additive to disease severity.[13,14] These observations suggest the need to assess for conventional as well as emerging exposure, such as vaping. Smokeless tobacco use is prevalent in Pakistan and OSMF is a common clinical presentation.[13] But, there are scarce data from this region on the combined effect of duration of smokeless tobacco use, vaping and inter-incisal mouth opening on OSMF.[15] These associations may suggest potential risk factors and strategies for early intervention. Since OSMF is a progressive and potentially irreversible disease, assessment of time of exposure and other behavioural risk factors can be used for prevention and surveillance of the disease.[16]

Objective: To assess the association between duration of smokeless tobacco use, vaping, and inter-incisal mouth opening in patients with oral submucous fibrosis.

MATERIALS AND METHODS

This was a cross-sectional study conducted at Tertiary Care Hospital Karachi, from March 2024 to July 2025, including 355 patients diagnosed with oral submucous fibrosis.

Inclusion Criteria

- Patients aged ≥18 years diagnosed with oral submucous fibrosis
- Patients with history of smokeless tobacco use and/or vaping
- Patients willing to provide detailed habit history
- Patients providing informed consent

Exclusion Criteria

- Patients with prior oral surgery affecting mouth opening
- Patients with temporomandibular joint disorders unrelated to OSMF
- Patients with oral malignancy at presentation
- Patients with systemic fibrotic disorders
- Patients with incomplete exposure or clinical records

Data Collection: After institutional approval, data were collected using a structured proforma. Demographic data such as age, gender, duration of smokeless tobacco use (years), frequency of use, vaping status, duration of vaping, type of product used, and OSMF clinical severity were recorded. Inter-incisal mouth opening was measured in millimeters with a vernier caliper as the greatest distance between the upper and lower central incisors. The duration of smokeless tobacco and vaping exposure was used to stratify patients. Other variables such as burning sensation, mucosal blanching and fibrosis bands were noted. The main outcome variables were inter-incisal mouth opening and its relationship with duration of exposure and vaping.

Statistical Analysis: Data were entered and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Association between duration of smokeless tobacco use, vaping, and inter-incisal mouth opening was assessed using chi-square test and independent t-test where appropriate. A p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 355 patients were included with a mean age of 31.7 ± 9.4 years, and most were aged 18–30 years (46.2%). Males constituted 68.5% of the study population. Mean duration of smokeless tobacco use was 8.9 ± 4.6 years, with 42.8% reporting 6–10 years of exposure and 30.1% reporting >10 years. Current vaping was present in 26.5% of patients. Grade II OSMF was most common (40.3%), and the overall mean inter-incisal mouth opening was 27.8 ± 7.1 mm.

Table 1: Baseline Demographic, Habit, and Clinical Characteristics (n = 355)

Variable	Category	Total n (%) / Mean ± SD
Age (years)	Mean ± SD	31.7 ± 9.4
Age Group	18–30 years	164 (46.2%)
	31–45 years	137 (38.6%)
	>45 years	54 (15.2%)
Gender	Male	243 (68.5%)
	Female	112 (31.5%)
Duration Smokeless Tobacco Use (years)	Mean ± SD	8.9 ± 4.6
Duration Category	≤5 years	96 (27.0%)
	6–10 years	152 (42.8%)

	>10 years	107 (30.1%)
Frequency of Use	≤5 times/day	118 (33.2%)
	6–10 times/day	149 (42.0%)
	>10 times/day	88 (24.8%)
Current Vaping	Yes	94 (26.5%)
OSMF Grade	Grade I	81 (22.8%)
	Grade II	143 (40.3%)
	Grade III	98 (27.6%)
	Grade IV	33 (9.3%)
Inter-incisal Mouth Opening (mm)	Mean ± SD	27.8 ± 7.1

A clear inverse relationship was observed between exposure duration and mouth opening. Mean inter-incisal opening declined from 33.4 ± 4.9 mm in patients using smokeless tobacco for ≤5 years to 21.4 ± 4.8 mm in those with >10 years exposure (p<0.001). Similarly, mouth opening decreased with increasing frequency of use, from 31.9 ± 5.3 mm in ≤5 times/day users to 22.5 ± 4.7 mm in >10 times/day users (p=0.002). Vaping users also had significantly lower mouth opening than non-users (24.2 ± 5.9 vs 29.1 ± 6.8 mm; p=0.011).

Table 2: Inter-Incisal Mouth Opening According to Exposure Variables

Variable	Category	Mouth Opening (Mean ± SD, mm)	P-value
Duration of Smokeless Tobacco	≤5 years	33.4 ± 4.9	<0.001
	6–10 years	27.6 ± 5.2	<0.001
	>10 years	21.4 ± 4.8	<0.001
Frequency of Use	≤5/day	31.9 ± 5.3	0.002
	6–10/day	27.1 ± 5.0	0.002
	>10/day	22.5 ± 4.7	0.002
Vaping Status	Users	24.2 ± 5.9	0.011
	Non-users	29.1 ± 6.8	0.011

Duration >10 years was present in 58.3% of restricted-opening patients compared to 21.4% without restriction (p<0.001). Grade III–IV OSMF was seen in 78.6% versus 24.0% (p<0.001), while vaping exposure was higher among those with restricted opening (36.9% vs 23.2%; p=0.028). Burning sensation and fibrous bands were also significantly more frequent in patients with severe restriction.

Table 3: Factors Associated with Severe Restricted Mouth Opening (<20 mm)

Variable	Category	Restricted Opening Present (n=84)	Restricted Opening Absent (n=271)	P-value
Duration >10 years	Yes	49 (58.3%)	58 (21.4%)	<0.001
Frequency >10/day	Yes	36 (42.9%)	52 (19.2%)	0.001
Vaping Exposure	Yes	31 (36.9%)	63 (23.2%)	0.028
Grade III–IV OSMF	Yes	66 (78.6%)	65 (24.0%)	<0.001
Burning Sensation	Yes	61 (72.6%)	145 (53.5%)	0.006
Fibrous Bands	Yes	70 (83.3%)	158 (58.3%)	0.002

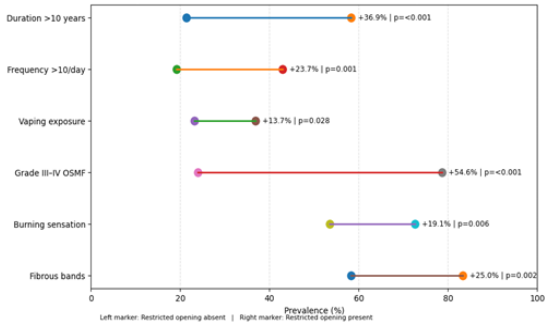

Figure 1: Risk Factor Gradient for Severe Restricted Mouth Opening in Patients with Oral Submucous Fibrosis

Mean mouth opening was lower among vaping users (24.2 ± 5.9 vs 29.1 ± 6.8 mm; p=0.011), while mean duration of tobacco use was longer (10.1 ± 4.4 vs 8.5 ± 4.2 years; p=0.018). Advanced OSMF (Grade III–IV) was more common in vaping users (54.3% vs 30.7%; p=0.003), and restricted opening <20 mm occurred more frequently (33.0% vs 20.3%; p=0.029), suggesting a possible association between vaping and greater disease severity.

Table 4: Comparative Risk Profile by Vaping Status

Risk Indicator	Vaping Users (n=94)	Non-Vaping (n=261)	P-value
Mean Mouth Opening (mm)	24.2 ± 5.9	29.1 ± 6.8	0.011
Duration Tobacco Use (years)	10.1 ± 4.4	8.5 ± 4.2	0.018
Grade III–IV OSMF	51 (54.3%)	80 (30.7%)	0.003
Restricted Opening <20 mm	31 (33.0%)	53 (20.3%)	0.029
Burning Sensation	63 (67.0%)	143 (54.8%)	0.047
Frequency >10/day	34 (36.2%)	54 (20.7%)	0.012

DISCUSSION

A recent cross-sectional study tested the relationship between the duration of using smokeless tobacco, vaping and opening of the mouth (inter-incisal distance) in oral submucous fibrosis patients. The results showed a correlation between duration of exposure to risk factors and severity of trismus, suggesting the progressive nature of OSMF.[17] This study showed a strong negative association between the length of smokeless tobacco use and inter-incisal mouth opening. Mean mouth opening declined from 33.4 ± 4.9 mm in patients with ≤5 years of exposure to 21.4 ± 4.8 mm in those with >10 years of use ($p<0.001$). In a similar vein, increasing frequency of smokeless tobacco use per day was found to result in lower mouth opening (31.9 ± 5.3 mm in patients with lower frequency; 22.5 ± 4.7 mm in patients using smokeless tobacco more than 10 times a day, $p=0.002$). These results indicate a dose-response effect of tobacco use on trismus. Other studies have also reported increases in fibrosis and trismus with increasing duration of exposure to areca nut and smokeless tobacco.[18] Vaping was also found to be associated with decreased inter-incisal mouth opening, with vapers having a significantly lower mean inter-incisal mouth opening than non-vapers (24.2 ± 5.9 vs 29.1 ± 6.8 mm; $p=0.011$). In addition, vaping users had longer tobacco exposure (10.1 ± 4.4 vs 8.5 ± 4.2 years; $p=0.018$) and higher prevalence of advanced OSMF (54.3% vs 30.7%; $p=0.003$). This is a cause for concern that vaping may be related to disease progression or is associated with other higher-risk characteristics. There is some evidence that exposure to multiple risks may increase the rate of progression of oral mucosal disease.[19]

Patients with severe restricted mouth opening (mouth opening <20 mm) showed a strong association with duration and frequency of use, and severity of disease. Habit duration >10 years was found in 58.3% of patients with severe restriction and 21.4% without restriction ($p<0.001$); and Grade III-IV OSMF in 78.6% of patients with severe restriction and 24.0% without restriction ($p<0.001$). Presence of fibrous bands and burning sensation were also higher among patients with severe restriction. Other studies have also shown that severe fibrosis, longer duration, and higher intensity of exposure are linked to a decreased mouth opening and severe OSMF.[20] The current vaping prevalence (26.5%) and the higher percentage of restricted opening in vaping individuals (33.0% vs 20.3%; $p=0.029$) in this study are noteworthy. Although the direct association of vaping with OSMF has not been as well studied as smokeless tobacco, the finding of a significant association warrants further research. Other studies have shown initial signs of oxidative damage and inflammation of oral mucosal tissues from vaping, which may be significant in the development of fibrosis.[21] This study has clinical implications. Mouth opening is a clinical index of disease severity and the reduction observed with an increase in exposure, indicates the need for early intervention to quit these habits. Earlier studies have stressed the importance of limiting exposure to disease-causing habits in order to reduce the severity of the disease and its complications, especially if it was done before the development of severe fibrosis.[22] In conclusion, this study shows that duration of smokeless tobacco exposure, frequency of exposure and vaping are associated with a reduction in mouth opening and a more severe disease in OSMF. Our results are in line with the previous studies, and reinforce the need to consider both old and new risks of exposure when developing preventive and therapeutic approaches.

CONCLUSION

It is concluded that longer duration of smokeless tobacco use, higher frequency of use, and vaping were significantly associated with reduced inter-incisal mouth opening and greater severity of oral submucous fibrosis. Patients with prolonged exposure, particularly those using smokeless tobacco for more than 10 years, demonstrated markedly greater restriction in mouth opening, while vaping users showed lower mean mouth opening and a higher prevalence of advanced disease. Severe restricted mouth opening was also significantly associated with advanced OSMF grade, burning sensation, and fibrous bands. These findings suggest that both traditional smokeless tobacco exposure and vaping may contribute to progression of functional impairment in OSMF.

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