ORIGINAL RESEARCH ARTICLE

Evaluation of the Relationship Between Gingival Pigmentation and Smoking

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Abstract

Purpose: The abnormal deposition of melanin in the oral mucosa results in melanin pigmentation. Affected is keratinized gingiva. Physiologic or pathological factors induce gingival discolouration. This study aimed to examine the association between oral-gingival pigmentation and nicotine dependency among smokers.

Materials and Methods: : Our study included 255 people over 18 who smoked, didn't take drugs, didn't have pigmentation-causing systemic disorders, and didn't have active infectious infections. Subjects' pigmentation was measured using the Hedin scale. Subjects' cigarette addiction was diagnosed using the Fagerstrom Test for Nicotine Dependence (FTND).

Results: In our study of 255 smokers, 27.5% are aware of mouth discoloration. 41.6% of participants had pigmentation. Mandibular gingiva had the greatest pigmentation, grade III. The participants' FTND scores are 4.68±3.12. 32.9% of the groups had very low FTND scores, followed by 17.6% with moderate, 11% with medium, 9.8% with strong, and 28.6% with extremely high.

Conclusions: According to the Fagerstrom questionnaire, smoking increases the frequency of pigmentation. Determining smokers' addiction level helps to evaluate study results. This study's Fagerstrom questionnaire will serve to guide smoking studies.

Key words: Fagerstrom test for nicotine dependence; Melanin pigmentation; Smokers melanosis

Introduction

Melanin pigmentation occurs as a result of abnormal deposition of melanin in the oral mucosa. The area most affected by this condition is the keratinized gingiva.[1]Melanin is synthesized from tyrosine and dihydroxyphenylalanine (DOPA) via dopaquinone by oxidation of tyrosinase.[2]The color of healthy gingiva is typically pink. Gingival color varies according to keratinization, thickness, vascularization, and the presence of melanocytic cells. Color can vary between light chestnut and dark brown. Pigmentation degrees were examined in four groups in the first evaluations published in the literature. The gingiva was graded as normal pink, light brown, medium brown, and dark brown.[3] Gingival discoloration can be seen in both physiological and pathological conditions. Melanocytic lesions or melanocytic pigmentations caused by excessive melanin accumulation in the basal and suprabasal layers of the epithelium are the most common pigmentations affecting the protective gingiva. Physiological pigmentation is usually symmetrical, permanent and does not change the normal structure of the gingiva. It is more common in women than men.[4] It has been reported that clinically observable oral melanin pigmentation is more common in some ethnic groups, particularly the black race. Authors from various countries have investigated the relationship between gingival pigmentation and smoking.[5−10] Gingival discoloration was classified as melanoplaki, smoking-related melanosis, drug-related discoloration, and amalgam discoloration at the 2017 American Periodontology Workshop.[11] Smoking has reportedly been linked to oral melanin pigmentation, particularly in the anterior gingiva. Regardless of age or gender, many people can have these pigmented regions, which can be single or several and have no impact on overall health but they may cause aesthetic concerns. Melanosis due to smoking is a benign local pigmentation of the oral mucosa, usually seen in the attached gingiva. Hedin originally identified it in white Europeans in 1977. This circumstance was unrelated to genetics,

drug use, or other systemic disorders. The mandibular anterior gingiva has been site of the most of smoking-related melanosis cases, but it can also occur in other parts of the mouth. A specific scale is used to categorize the level of pigmentation. According to this scale, the first degree represents the presence of light, visible pigmentation in a limited area; the second degree represents the presence of moderate pigmentation that is more widespread; the third degree represents the presence of heavy pigmentation that causes the pigmented areas to blend into a dark, continuous band. [1,12] Smoking activates melanocytes, which results in pigmentation. It has been shown that melanocytes, which are stimulated by genetic factors in some people, can produce more melanin when activated by smoking. Melanocytes have been demonstrated to produce more melanin in response to polycyclic amines like nicotine and benzprene, which have been found to bind tightly to melanin by penetrating the oral mucosa. It is believed that oral melanin shields the mucosa from cigarette smoke and other irritating harmful substances by adhering to the tissue. [5]

The Fagerstrom Test for Nicotine Dependence is the most often performed test for determining smoking addiction (FTND). In 1978, Fagerstrom originally suggested the Fagerstrom Tolerance Questionnaire (FTQ). The eight test items were adapted from the nicotine addiction hypothesis. The final version of the test was generated by connecting the carbon monoxide and nicotine levels of the participants with their responses to the questions. FTND was established in 1991, when Heatherton et al reevaluated this test. The test items for "The first cigarette of the day" and "How many cigarettes are consumed each day" were reordered and decreased from eight to six questions based on the premise that the findings changed at different rates. By doing a validity analysis and translating the test into Turkish, it is used in studies of nicotine addiction. The Fagerstrom Test for Nicotine Dependence (FTND) consists of six questions, and each question earns a unique score. The substance of the examination comprises a score for every question. According to test results, nicotine addiction is classified as very low dependence (0 to 2 points), moderate dependence (3 to 4 points), medium dependence (5 to 6 points), high dependence (6 to 10 points), and very high dependence (11 or more points) (8 to 10 points). [13,14]

Our major objective is to study the relationship between oral-gingival pigmentation and nicotine dependence, as measured by the Fagerstrom nicotine addiction test, among smokers. The gingival color of the participants will be analyzed using the Hedin scale, and their nicotine dependence will be measured using the Fagerstrom test.

Material and Methods

This study was conducted with the approval of the Ankara University Faculty of Dentistry Research Ethics Committee under protocol number 36290600/66. The study included 255 patients enrolled in the Ankara University Faculty of Dentistry who were smokers older than 18, did not use medicines, did not have any ongoing infectious illnesses, and did not have any systemic conditions that may have produced pigmentation After signing an informed consent form, participants completed a questionnaire to examine sociodemographic information, oral hygiene, smoking history, and intraoral discoloration. The mandibular gingiva, maxillary gingiva, and lips and cheeks were assessed for pigmentation. The oral-gingival pigmentation was classified using the Hedin scale. In the first degree, there is apparent pigmentation in a small area, in the second degree there is moderate pigmentation and the pigmented regions are more widespread, and in the third degree there is severe pigmentation and the pigmented areas merge into a continuous black band. The participants examined in our study were selected from the Turkish population as ethnic origin. However, following the Hedin scale recordings, the participant's skin tones

were assessed in two groups (dark, fair) to ensure that different physical attributes did not influence the study's findings The Fagerstrom test was used to classify the participants' smoking habits. As a result of the Fagerstrom test, the subjects were divided into five groups. The pigmentation rating and smoking levels determined by the Fagerstrom test were statistically evaluated. Plaque index and gingival index scales were used to determine the participants' oral hygiene levels and gingival health status. [1]

Fagerstrom Test for Nicotine Dependence

1-How soon after waking up do you light your first cigarette?

- Within 5 minutes 3
- 6−30 minutes 2
- 31−60 minutes 1
- After 60 minutes 0

2-Do you find it challenging to refrain from smoking in places where it is prohibited?

- Yes 1
- No 0

3-Which cigarette would you hate most to give up?

- The first one in the morning 1
- Any other 0

4- How many cigarettes do you consume each day?

- 10 or less 0
- 11−20 1
- 21−30 2
- 31 or more 3

5-Do you smoke more often in the early morning hours compared to the rest of the day?

- Yes 1
- No 0

6-Do you smoke if your illness keeps you in bed for the majority of the day?

- Yes 1
- No 0

Scores are as follows: 1-2 = very low dependence, 3-4 = low dependence, 5 = moderate dependence, 6-7 = high dependence, and 8+ = very high dependence.

Statistical Analysis

Using the software IBM SPSS Statistics 28, analyses were undertaken. The associations between two independent categorical variables were investigated using Chi-square analysis. Independent Sample T Test was utilized to examine differences between two independent groups, whereas One-Way Analysis of Variance was utilized to examine differences between three or more independent groups (ANOVA).

Results

According to the findings of the survey, 55.7% of the participants are men and 71.4% are single. 36.1% of participants had fair skin, while 63.9% of them are brunettes. Examining the individuals' oral hygiene habits reveals that 97.6% of them brush their teeth everyday, however 14% have bleeding gums. 14.5% of their teeth are loose. 27.5% of individuals are aware of the discolouration in their mouths.

Table 1. Distributions of 255 patients by clinical parameters

	n	%
Pigmentation		
Yes	106	41,6
No	149	58,4
+Pigmentation Region (n=106)		
Cheek and Lips	58	54,7
Maxiller Gingiva	89	84,0
Mandibular Gingiva	98	92,5
Pigmentation Degree (n=106)		
Grade I	30	28,3
Grade II	37	34,9
Grade III	39	36,8
Plaque Index		
0	44	17,3
1	110	43,1
2	69	27,1
3	32	12,5
Gingival Index		
0	57	22,4
1	178	69,8
2	19	7,5
3	1	0,4

+: In this variation, individuals may have several pigmentation areas

Table 1 shows pigmentation occurrences and levels. Table shows 41.6% of people are pigmented. Mandibular gingiva had the greatest pigmentation, grade III. The participants' FTND scores are 4.68±3.12. 32.9% of the groups had very low FTND scores, followed by 17.6% with moderate, 11% with medium, 9.8% with strong, and 28.6% with extremely high. Most of them were low-dependence. Table 2 shows that pigmentation is highest in heavy smokers and diminishes correspondingly with dependence. Examining Table 3 reveals that the rate of individuals with very low dependence in the FNBT group is 11.8%, whereas an increase is found in the group with very high dependence. The lowest value was seen in the low dependence group with only 5.6%. Table 4 compares maxillary gingiva pigmentation between FNBT groups. In the very low and low dependence categories, 52.9% and 50% are observed, while other groups show 100%. Table 5 shows that the first two FNBT groups had values of 70.6% and 83.3%, while the remaining groups have 100%. Table 6 shows that persons with very low and low FNBT dependency have lower plaque index values than those with moderate, high, and very high FTND dependency. In Table 7, participants with pigmentation had significantly greater plaque index values than subjects without pigmentation. Those who have pigmentation had significantly lower gingival index scores than those who do not.

Discussion

The purpose of this study is to assess the prevalence of oral melanin pigmentation and its association with periodontal health among Turkish smokers. The Fagerstrom questionnaire was often utilized in research of thoracic illnesses. In addition to the various systemic risks associated with smoking and nicotine addiction, its negative effects on periodontal tissues are well-documented. Numerous studies on smoking have been conducted in the field of periodontology, but none have utilized the Fagerstrom questionnaire. The Fagerstrom questionnaire adopted in this study will be a model for future studies on smoking.

Nonsmokers' pigmentation rates have been the subject of research. Asian inhabitants are more pigmented than their European counterparts. [7] According to the results of a study conducted on the Turkish population, the population's melanin level was somewhere between that of Europe and Asia. Similar results were found in our study, where the smoking rate was 41.6%. [10] Smokers and former smokers had larger pigmentation levels than nonsmokers, according to previous research. Our data suggest that the prevalence of nicotine dependence among smokers and the pigmentation rates of very mildly dependent individuals are lower than those of severely dependent individuals. Since only smokers were included in the study, it is anticipated that the rates will be lower among individuals who have quit smoking and those who have never smoked. Pigmentation studies have previously focused on the mandibular and maxillary gingival areas, as well as the cheek and lip regions. [10] In the present study, 92.5% of the pigmentation was found in the mandibular gingiva, followed by 84.0% in the maxillary gingiva and 54.7% in the cheek and lip regions. In studies comparing smokers and nonsmokers on many periodontal parameters, the gingival index values of smokers were statistically lower than those of nonsmokers. [10] In our study, the plaque index and gingival index were also assessed. In earlier investigations, only differences in gingival index values between smokers were statistically significant; however, in the current study, both plaque index and gingival index differences were statistically significant. [15]

The Fagerstrom questionnaire found that those with serious addictions had a lower gingival index than other groups. Contrary to expectations, the gingival index values of the low dependency group were found to be much lower than those of the medium dependence group. Individual differences in gingival index distribution were attributed to variables other than smoking. As expected, unlike gingival index, plaque indices were higher in the highly dependent group. Negative effects of smoking on gingival tissues, such as the delay of the inflammatory response and the loss of vascularization, contribute to the decrease in gingival index values as smoking rates increases. [15]

As a defense against UV radiation, physical stress, heat, neoplasmic forms, pharmaceutical use, multiple systemic illnesses, and other factors, oral tissues have melanin pigmentation. In our study, we discovered melanin pigmentation in groups with very mild addiction. This illustrates that smoking and other irritants are not the only causes of melanin pigmentation. Due to the varying skin tones of the research participants, pigmentation was seen in the first set of Fagerstrom questionnaire responders. In groups with low levels of cigarette smoking, fewer individuals reported pigmentation. These analyses demonstrate that smoking is not the only cause of the etiological factors that result in melanin pigmentation in oral tissues. Hereditary factors, neoplasms such as melanoma,

Table 2. Comparision Between FTND Groups and Pigmentation Status

		Pigmentation				Total		Chi Square	p
		Yes		No					
		n	%	n	%	n	%		
FTND	Very Low Dependence	17	**20,2**	67	**79,8**	84	100,0		
	Low Dependence	18	40,0	27	60,0	45	100,0		
	Moderate Dependence	13	46,4	15	53,6	28	100,0	28,712	**0,000***
	High Dependence	14	**56,0**	11	**44,0**	25	100,0		
	Very High Dependence	44	**60,3**	29	**39,7**	73	100,0		
	Total	106	41,6	149	58,4	255	100,0		

*: p<0,05

Table 3. FTND Groups and Lip and Cheek Pigmentation Zone

| | | Lips and Cheeks | | | | Total | | | |
| | | Yes | | No | | Total | | Chi Square | p |
		n	%	n	%	n	%		
FTND	Very Low Dependence	2	**11,8**	15	**88,2**	17	100,0		
	Low Dependence	1	5,6	17	94,4	18	100,0		
	Moderate Dependence	3	23,1	10	76,9	13	100,0	65,516	**0,000***
	High Dependence	10	**71,4**	4	**28,6**	14	100,0		
	Very High Dependence	42	**95,5**	2	**4,5**	44	100,0		
	Total	58	54,7	48	45,3	106	100,0		

*: p<0,05

Table 4. FTND Groups and Maxillar Gingiva Pigmentation Zone

| | | Maxillar Gingiva | | | | Total | | | |
| | | Yes | | No | | Total | | Chi Square | p |
		n	%	n	%	n	%		
FTND	Very Low Dependence	9	**52,9**	8	**47,1**	17	100,0		
	Low Dependence	9	50,0	9	50,0	18	100,0		
	Moderate Dependence	13	100,0	0	0,0	13	100,0	44,881	**0,000***
	High Dependence	14	**100,0**	0	**0,0**	14	100,0		
	Very High Dependence	44	**100,0**	0	**0,0**	44	100,0		
	Total	89	84,0	17	16,0	106	100,0		

*: p<0,05

Table 5. FTND Groups and the Mandibular Gingiva Pigmentation Zone

| | | Mandibular Gingiva | | | | Total | | | |
| | | Yes | | No | | Total | | Chi Square | p |
		n	%	n	%	n	%		
FTND	Very Low Dependence	12	**70,6**	5	**29,4**	17	100,0		
	Low Dependence	15	83,3	3	16,7	18	100,0		
	Moderate Dependence	13	100,0	0	0,0	13	100,0	19,907	**0,000***
	High Dependence	14	**100,0**	0	**0,0**	14	100,0		
	Very High Dependence	44	**100,0**	0	**0,0**	44	100,0		
	Total	98	92,5	8	7,5	106	100,0		

*: p<0,05

Table 6. Comparative Analysis of the Plaque Index and Gingival Index Between FTND Subgroups

| FTND | Plaque Index | | Gingival Index | |
	Mean	SS	Mean	SS
1) Very Low Dependence	1,94	0,83	2,06	0,28
2) Low Dependence	1,64	0,61	1,96	0,47
3) Moderate Dependence	2,61	0,50	2,36	0,49
4) High Dependence	2,80	0,87	1,36	0,49
5) Very High Dependence	3,00	0,73	1,55	0,55
F; p	34,197;0,000*		29,520;0,000*	
Difference (Tukey)	1<3,4,5 2<3,4,5		1>4,5 2>4,5 3>1,2,4,5	

F: Analysis of Variance (ANOVA)
*:p<0,05

Table 7. FTND Groups and the Mandibular Gingiva Pigmentation Zone

| Pigmentation | Plaque Index | | Gingival Index | |
	Mean	SS	Mean	SS
Yes	2,54	0,90	1,73	0,54
No	2,21	0,90	1,95	0,52
t; p	2,834;0,005*		−3,328;0,001*	

t: Independent Sample T Test
*:p<0,05

systemic illnesses such as neurofibromatosis, Addison's disease, and Albright's syndrome, as well as the use of various medications, can also cause melanin pigmentation. By focusing on smokers in the first questionnaire, other etiological variables were removed from our study.[16] According to research, children who are passive smokers also have smoking-related melanin pigmentation. Re-garding the Fagerstrom test, more study may be conducted on the melanin pigmentations seen in the children of parents with vary-ing degrees of addiction.[17] According to a recent study on passive smokers, the maxillary and mandibular areas of the lips of women whose partners smoke are more likely to be pigmented. While both the local and systemic effects of inhaled cigarette smoke are utilized

to explain the pigmentation process, it has been emphasized that the local effects are more important.[18]

Conclusion

Our research reveals that smoking behaviors, as measured by the Fagerstrom questionnaire, are associated with an increase in the frequency of pigmentation. The Fagerstrom questionnaire was used to determine the level of cigarette addiction among the participants. It has been shown that those with mild addiction have less pigmentation than those with severe addiction. In study on smokers, determining the participants' level of addiction offers more helpful information for evaluating the results. The Fagerstrom questionnaire used in this study will act as a model for future studies on smoking.

Author Contributions

K.B.: Identification of participants and application of surveys. E.U.: Design of the study, reviewing and editing the text. E.B.: Statistical analysis and text writing. S.C.P.: Design of the study. A.U.: Identification of participants and application of surveys. S.K.C.: Identification of participants.

Conflict of Interest

Authors declare that they have no conflict of interest.

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