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Original research article

Assessment of oral hygiene habits and periodontal status of patients during and after orthodontic treatment

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Abstract

Objective: This study evaluated the relationship between orthodontic treatment, oral hygiene practices, and periodontal health in individuals undergoing or completed orthodontic treatment.

Materials and Method: Systemically healthy patients undergoing or completed stable orthodontic treatment were included in the study. The periodontal status of 142 participants was determined using a comprehensive oral hygiene questionnaire and clinical oral examinations to assess various periodontal indices. Chi-square and t-tests were used for statistical analyses to compare periodontal status metrics between groups.

Results: Statistical analyses revealed no significant differences between oral hygiene habits, periodontal indices, or periodontal status between the ongoing treatment (OT) and post-orthodontic treatment (PT) groups ($p>0.05$). However, significant differences were noted in attachment level, dental visit frequency, and reasons for visits between the OT and PT groups ($p<0.05$). While participants generally showed similar oral hygiene awareness and practices, differences arose in toothbrushing times during orthodontic treatment and adherence to orthodontist recommendations.

Conclusion: This study investigated the effect of OT on oral health and concluded that OT did not change oral hygiene habits but affected attachment levels. Orthodontists should consistently guide patients on oral hygiene and managing clinical attachment loss. In these cases, the patient should be referred to a periodontist when necessary.

Keywords: Gingivitis; oral hygiene; orthodontics; questionnaire

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[Abstract in Turkish is at the end of the manuscript]

Introduction

Microbial dental plaque is a complex biofilm that accumulates on teeth and in the oral cavity and contains more than 500 bacteria.[1] Dental caries and periodontitis, two of the most common microbially developed diseases worldwide, are directly caused by the dynamic and polymicrobial oral microbiome.[2] Plaque-induced gingivitis begins with the accumulation of microbial dental plaque on the gingiva with localized inflammation.[3] Periodontitis is closely associated with polymicrobial dental plaque.[4] Plaque accumulation is also a concern with orthodontic devices because it hinders access to good oral hygiene measures and gingival indices.[5] Clinical data from clinical studies indicate a potential association between orthodontic treatment and decreased periodontal health.[6,7] Orthodontically treated patients have a significantly greater risk of developing white spot lesions, as oral hygiene is more difficult to maintain.[8] In addition, orthodontic treatment has been shown to reduce gingival inflammation caused by crowding.[9] Microbial dental plaque can be removed by tooth brushing and similar oral hygiene habits.[10] While it is important to provide orthodontic patients with information on appropriate oral hygiene at the start of their treatment, it can be difficult for them to maintain adequate oral hygiene.[11]

Knowing the oral hygiene needs of patients and their compliance with oral hygiene regimens is essential for understanding patients' oral hygiene practices.[12] Being aware of the patient's level of knowledge, attitude, and orthodontic practices can help the clinician better understand patients and their role as clinicians. This also enables the orthodontic team to reflect on the areas

that we could pay closer attention to when educating patients in an orthodontic practice.[13] Patients have a key responsibility for maintaining their oral health by practicing proper, effective, and comprehensive oral hygiene.[14] It is worth encouraging orthodontists to put in additional effort to motivate patients to maintain good oral hygiene throughout the entire treatment process.[15] Every patient receiving orthodontic treatment should be encouraged and informed about the changes that the gingiva undergo in relation to orthodontic therapy and the need to maintain appropriate oral hygiene habits.[14]

When measuring the habits of patients and their daily use of products such as toothbrushes, dental floss, mouthwash, interdental brushes, and other cleaning oral materials or frequency of use, questionnaires can be used.[12] Studies have been conducted to measure oral hygiene habits in orthodontic patients.[13,14,16]

The objective of this study was to assess the correlation between oral hygiene practices and the state of periodontal health and disease in individuals undergoing or finished orthodontic treatment.

Materials and Method

Study Settings

The Clinical Research Ethics Committee of the Bolu Abant İzzet Baysal University, approved this study (2022/168). Informed consent was obtained from all participants before enrollment in the study. Before participation, all patients were informed about the purpose and the questionnaire, and written informed consent was obtained from the patients in accordance with the Helsinki Declaration.[17] Details on the adherence to the STROBE criteria for cross-sectional studies were reported.

The study was completed at the Faculty of Dentistry, Department of Periodontology between July 2022 and December 2023 and included individuals who were receiving orthodontic treatment (OT) or post-orthodontic treatment (PT).

Study Population

The required sample size was determined according to the results of the power calculation using chi-square analysis (G*Power 3.1 software; Heinrich Heine University, Dusseldorf, Germany) to compare the two groups: degrees of freedom (df)= 2, α (margin of error) = 0.30, power (1-β) = 0.90 and effect size (f)= 0.30. It was determined that the required sample size had to be at least 142.

Eligibility Criteria

Patients aged 18-44 years and systemically healthy patients who had received or were receiving orthodontic treatment were included in the study. The study did not include patients involved in Invisalign (Align Technology, Arizona, USA), functional or lingual fixed orthodontics.

Study Design

A total of 142 people aged 18- 44 years who had no systemic disease and who were receiving or had completed OT at Bolu Abant İzzet Baysal University were included in the study. Of the 142 individuals, 71 were in OT, and 71 were in PT. Periodontal indices (plaque index, gingival index, bleeding on probing, periodontal pocket depth, clinical attachment level, and gingival recession) were obtained from all patients. The diagnosis of the patient's periodontal condition was made according to the 2017 World Workshop on Classification of Periodontal and Peri-Implant Diseases and Conditions[18] with the periodontal indices and radiographic films taken from the patient. Participants were asked 54 multiple-choice questions about demographic information, health status, oral hygiene awareness, oral hygiene habits during OT, and habits.

Periodontal indices

A calibrated examiner (T.S.) conducted a clinical oral examination, which involved evaluating periodontal health. The periodontal evaluation included the following measurements: plaque index (Silness&Loe), probing pocket depth, gingival index (Loe&Silness), bleeding on probing (Ainamo&Bay), gingival recession, and clinical attachment level. The plaque index was assessed by visual inspection of the accumulated plaque in the gingival area, and the plaque was classified into 1 of 4 grades. The gingival index was assessed according to color and tissue consistency according to the severity of existing inflammation of the marginal gingiva. Bleeding on probing was assessed by carefully inserting a UNC-15 periodontal probe (PCP15; Hu-Friedy, Chicago, IL, USA) into the gingival sulcus. All measurements and evaluations for each individual were made in the same session and from 6 regions of the teeth (mesiobuccal, buccal, distobuccal, distolingual, lingual, and mesiolingual).

Questionnaire

Participants who failed to respond to all survey questions in the investigation or who deviated from the specified instructions were omitted from the study. The response options for the inquiries varied between two and eighteen, with the inclusion of a "do not know" alternative for questions containing informational content.

A questionnaire was employed to elucidate the attitudes, awareness, and behavioral patterns concerning dental care practices among individuals with orthodontic interventions. Participants who had undergone OT were tasked with completing a comprehensive survey consisting of 54 multiple-choice inquiries. This questionnaire included 11 items aimed at gathering general and demographic data, encompassing factors such as age and sex, as well as 36 inquiries focusing on oral hygiene practices, including attitudes toward toothbrush maintenance, among other relevant aspects. Additionally, seven items were used

to assess participants' awareness and knowledge regarding toothbrush care and maintenance.

A physician (T.S.) administered the survey to the patients. If needed, the physician facilitated the questionnaire by asking the patients the questions in Turkish.

Statistical Method

IBM SPSS Statistics software (version 26.0. Armonk, NY: IBM Corp.) was used for the statistical analyses. Regarding the presentation of the data, categorical data were expressed as frequency and percentage. The chi-square test was used to compare the questionnaire results of the participants whose treatment continued and whose treatment ended. Independent sample t-test was used to compare the plaque indices, gingival indices, periodontal probing depths, bleeding on probing, gingival recessions, and clinical attachment levels of the patients whose treatment ended and continued. The level of significance was set at a p-value <0.05.

Results

Demographic characteristics

There were no statistically significant differences in age distribution, sex, marital status, parental education level, income status, or housing status (p>0.05).

Periodontal indices and conditions

There was no statistically significant difference between patients with OT and PT in terms of the plaque index, incidence of bleeding on probing, gingival index, gingival recession, and probing pocket depth values (p>0.05).

Statistically significant differences were observed when comparing patients with OT with post-orthodontic patients, particularly concerning the value of attachment level (p<0.05). The mean value of attachment level of the patients who underwent OT was 1.82±0.68 and the mean value of attachment level of the post-orthodontic patients was 2.25±1.25.

The incidence of periodontal disease or the health status of people with OT and PT was not significantly different (p>0.05). Among the individuals with OT, 50.7% were diagnosed with gingivitis, whereas post-orthodontic patients (49.3%) were diagnosed with gingivitis.

Oral hygiene training and dental history

There was no statistically significant difference between patients with OT and PT in terms of visiting the dentist beforehand, learning oral hygiene habits from the dentist or another person or platform, demonstrating brushing on the model, using plaque disclosing tablets, and using an index to assess the disease (p>0.05).

Systemic and smoking statuses of participants

No statistically significant difference was detected between patients with OT and PT in relation to the occurrence of systemic and psychological problems (p>0.05).

There was no statistically significant difference in terms of smoking status and frequency between patients OT and PT (p>0.05). A total of 23.9% of the patients with OT and 18.3% of the post-orthodontic patients stated that they smoked. While 1.4% of the patients with OT indicated that they smoked more than one pack per day; this percentage was 4.2% for the post-orthodontic patients.

Tooth brushing habits of participants and products

There was no statistically significant difference in tooth brushing frequency, duration, method, products used during tooth brushing, and toothbrush replacement between patients with OT and PT (p>0.05) (Table 1).

Dental visits of participants

There was a statistically significant difference between participants with OT and PT in terms of age at first dental visit, frequency of dental visits, and reasons for dental visits (p<0.05) (Table 2).

Oral hygiene awareness of participants

There was no statistically significant difference between the participants with OT and PT in terms of their responses related to oral hygiene awareness (p>0.05) (Table 3).

Oral hygiene and products used for orthodontics

There was a statistically significant difference between the participants whose treatment continued and ended in terms of tooth brushing times during orthodontic treatment and adherence to the orthodontist's recommendations (p<0.05) (Table 4).

Table 1. *Tooth brushing habits of patients with OT and PT*

			Group			
			OT	PT	Total	p
How often do you brush your teeth?	Once a month	n	2	1	3	0.396
		%	2.8%	1.4%	2.1%	
	2-3 times a month	n	3	1	4	
		%	4.2%	1.4%	2.8%	
	Once a week	n	1	0	1	
		%	1.4%	0.00%	0.7%	
	2-3 times a week	n	0	2	2	
		%	0.00%	2.8%	1.4%	
	Once a day	n	8	12	20	
		%	11.3%	16.9%	14.1%	
	2 or more times a day	n	57	55	112	
		%	80.3%	77.5%	78.9%	
How long do you brush your teeth?	Less than 1 minute	n	8	12	20	0.442
		%	11.4%	18.4%	14.4%	
	Between 1-2 minutes	n	34	38	72	
		%	48.6%	55.1%	51.8%	
	More than 2 minutes	n	28	19	47	
		%	40.0%	27.5%	33.8%	
Which of the specified products do you use? (More than one answer can be given)	Toothbrush	n	67	67	134	0.294
		%	94.4%	94.4%	94.4%	
	Powered toothbrush	n	10	8	18	
		%	14.1%	11.3%	12.7%	
	Toothpaste	n	60	62	122	
		%	84.5%	87.3%	85.9%	
	Dental floss	n	13	22	35	
		%	18.3%	31.0%	24.6%	
	Interdental brush	n	39	12	51	
		%	54.9%	16.9%	35.9%	
	Mouthwash	n	20	14	34	
		%	28.2%	19.7%	23.9%	
	Toothpick	n	5	9	14	
		%	7.0%	12.7%	9.9%	
How do you brush your teeth?	Horizontal direction (Forward-Backward)	n	18	22	40	0.788
		%	25.3%	31.4%	28.4%	
	From the tooth-gingiva junction towards the tooth	n	36	32	68	
		%	50.7%	45.7%	48.2%	
	Zigzag	n	10	10	20	
		%	14.1%	14.3%	14.20%	
	Random	n	7	6	13	
		%	9.9%	8.6%	9.2%	
What type of toothpaste do you have?	Whitening	n	27	34	61	0.175
		%	38.0%	47.9%	43.0%	
	Anti-caries	n	21	24	45	
		%	29.6%	33.8%	31.7%	
	Gum protection	n	6	2	8	
		%	8.5%	2.8%	5.6%	
	Desensitization	n	9	9	18	
		%	12.7%	12.7%	12.6%	
	Content other than fluoride (Coal, probiotics, etc.)	n	4	2	6	
		%	5.6%	2.8%	4.2%	
	Natural ingredients (Aloe vera, cloves, propolis, etc.)	n	4	0	4	
		%	5.6%	0.00%	2.9%	
How often do you change your toothbrush?	1-3 months	n	28	25	53	0.704
		%	39.4%	35.2%	37.3%	
	Every 3 months	n	27	24	51	
		n	38.0%	33.8%	35.9%	
	3 months-1 year	n	14	20	34	
		%	19.7%	28.2%	23.9%	
	More than 1 year	n	2	2	4	
		%	2.8%	2.8%	2.9%	

If you have dentures and total removable dentures, which of the following products do you use? (More than one answer can be given)	Superfloss	n	3	1	4	0.174
		%	4.3%	1.4%	2.9%	
	Denture cleaning tablet	n	1	0	1	
		%	1.4%	0.0%	0.7%	
	None	n	20	15	34	
		%	29.0%	21.2%	24.6%	
	I have no dentures	n	45	55	99	
		%	65.2%	77.4%	71.7%	
Which of the following products do you use if you have an implant?	Water flosser	n	4	1	5	0.410
		%	5.63%	1.4%	3.6%	
	Interdental brush	n	4	3	7	
		%	5.63%	4.3%	5.0%	
	Superfloss	n	0	1	1	
		%	0.00%	1.4%	0.7%	
	I have no implant	n	63	65	128	
		%	88.73%	92.9%	90.9%	

OT: Orthodontic treatment PT: Post-orthodontic treatment

Table 2. *Dental visits of patients with OT and PT*

			Group			
			OT	**PT**	**Total**	**p**
What was the age of your first dentist visit?	0-2 years	n	4	6	10	0.001
		%	5.6%	8.4%	7.0%	
	3-6 years	n	19	18	37	
		%	26.8%	25.4%	26.1%	
	7-18 years	n	43	46	89	
		%	60.6%	64.8%	62.7%	
	After 18 years	n	5	1	6	
		%	7.0%	1.4%	4.2%	
How often do you visit the dentist?	Once in 6 months	n	46	34	80	0.005
		%	65.7%	48.6%	57.2%	
	Once in 1 year	n	13	16	29	
		%	18.6%	22.9%	20.8%	
	Once in 2 years	n	3	13	16	
		%	4.3%	18.5%	11.4%	
	Once in 6 years	n	7	6	13	
		%	10.0%	8.6%	9.2%	
	More than 6 years	n	1	1	2	
		%	1.4%	1.4%	1.4%	
In which cases do you go to the dentist?	Toothache	n	32	27	59	0.001
		%	45.1%	38.6%	41.8%	
	Having prosthesis made/renewed	n	2	4	6	
		%	2.8%	5.7%	4.3%	
	Scaling	n	5	7	12	
		%	7.0%	10.0%	8.5%	
	Routine dental visit	n	29	31	60	
		%	40.9%	44.3%	42.5%	
	I do not go	n	3	1	4	
		%	4.2%	1.4%	2.9%	
What is the most crucial purpose of brushing your teeth?	Prevention of gingival diseases and caries	n	35	33	68	0.128
		%	49.3%	46.5%	47.9%	
	To make the teeth look cleaner by removing food debris from tooth surfaces	n	12	17	29	
		%	16.9%	23.9%	20.4%	
	Prevent bad breath and have a fresher breath	n	5	4	9	
		%	7.0%	5.6%	6.3%	
	To make the teeth look more beautiful	n	8	9	17	
		%	11.3%	12.7%	12.0%	
	Not losing the teeth	n	11	8	19	
		%	15.5%	11.3%	13.4%	

OT: Orthodontic treatment PT: Post-orthodontic treatment

Table 3. *Use of oral hygiene products by patients with OT and PT*

			Group			
			OT	PT	Total	p
How do you assess your current health?	Poor	n	7	6	13	0.650
		%	10.0%	8.6%	9.3%	
	Average	n	25	32	57	
		%	35.7%	45.7%	40.7%	
	Good	n	35	27	62	
		%	50.0%	38.6%	44.3%	
	Very good	n	3	5	8	
		%	4.3%	7.1%	5.7%	
Can you recognize whether you have periodontal disease yourself?	Yes	n	43	44	87	0.842
		%	62.3%	62.9%	62.1%	
	No	n	26	26	52	
		%	37.7%	37.1%	37.9%	
I have done everything I need to do about my oral health	Yes	n	42	34	76	0.178
		%	59.1%	47.9%	53.5%	
	No	n	29	37	66	
		%	40.9%	52.1%	46.5%	
When you start treatment for gum disease, do you keep your appointments with your dentist until the treatment is finished?	Yes	n	66	66	132	1.000
		%	93.0%	93.0%	93.0%	
	No	n	5	5	10	
		%	7.0%	7.0%	93.0%	
Do you follow the dentist's recommendations?	Totally	n	55	49	104	0.703
		%	79.7%	72.1%	75.9%	
	Partially	n	14	18	32	
		%	20.3%	27.5%	23.4%	
	None	n	0	1	1	
		%	0.00%	1.4%	0.7%	
What is your reason for not taking care of your mouth?	I think oral care is not important	n	6	5	11	0.199
		%	8.4%	7.0%	7.9%	
	Individual inadequacies	n	2	2	4	
		%	2.9%	2.8%	2.8%	
	It is hard to do it regularly	n	9	19	28	
		%	12.7%	27.1%	19.9%	
	I forget	n	28	18	46	
		%	39.4%	25.7%	32.7%	
	I will definitely do it	n	26	26	52	
		%	36.6%	37.4%	36.9%	
What is the most important purpose of brushing your teeth?	Prevention of gingival diseases and caries	n	35	33	68	0.128
		%	49.3%	46.5%	47.9%	
	To make the teeth look cleaner by removing food waste from tooth surfaces	n	12	17	29	
		%	16.9%	23.9%	20.4%	
	Prevent bad breath and have a fresher breath	n	5	4	9	
		%	7.0%	5.6%	6.3%	
	To make the teeth look more beautiful	n	8	9	17	
		%	11.3%	12.7%	12.0%	
	Not losing the teeth	n	11	8	19	
		%	15.5%	11.3%	13.4%	

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Table 4. *Oral hygiene habits during OT of the patients with OT and PT*

			Group			
			OT	PT	Total	p
Which products did you use during OT? (More than one answer can be given)	Toothbrush	n	61	65	126	0.424
		%	85.9%	91.5%	88.73%	
	Powered toothbrush	n	10	1	11	
		%	14.1%	1.4%	7.75%	
	Toothpaste	n	52	60	112	
		%	73.2%	84.5%	78.87%	
	Dental floss	n	16	27	43	
		%	22.5%	38.0%	30.28%	
	Interdental brush	n	43	36	79	
		%	60.6%	50.7%	55.63%	
	Mouthwash	n	17	16	33	
		%	23.9%	22.5%	23.24%	
	Toothpick	n	3	7	10	
		%	4.2%	9.9%	7.04%	
	Compact tuft toothbrush	n	1	2	3	
		%	1.4%	2.8%	2.11%	
How often do you brush your teeth during OT?	I never brush	n	3	2	5	0.439
		%	4.2%	2.8%	3.5%	
	Once a month	n	2	4	6	
		%	2.8%	5.6%	4.2%	
	2-3 times a month	n	7	2	9	
		%	9.9%	2.8%	6.3%	
	Once a week	n	1	0	1	
		%	1.4%	0.0%	0.7%	
	2-3 times a week	n	5	3	8	
		%	7.0%	4.2%	5.6%	
	Once a day	n	7	6	13	
		%	9.9%	8.5%	9.2%	
	2-3 times a day	n	46	54	100	
		%	64.8%	76.1%	70.4%	
How often do you brush your teeth after OT?	Less than 1 minute	n	8	9	17	0.041
		%	12.1%	13.1%	12.6%	
	1-2 minutes	n	28	43	71	
		%	42.4%	62.3%	52.6%	
	More than 2 minutes	n	30	17	47	
		%	45.5%	24.6%	34.8%	
How often did you visit the dentist during OT?	Once in 6 months	n	57	56	113	0.466
		%	81.4%	78.9%	80.1%	
	Once in 1 year	n	8	9	17	
		%	11.4%	12.7%	12.1%	
	Once in 2 years	n	3	2	5	
		%	4.3%	2.8%	3.6%	
	Once in 6 years	n	0	3	3	
		%	0.0%	4.2%	2.1%	
	More than 6 years	n	2	1	3	
		%	2.9%	1.4%	2.1%	
What type of toothpaste do you use during OT?	Whitening	n	27	23	50	0.093
		%	38.5%	32.8%	35.7%	
	Anti-caries	n	26	30	56	
		%	37.1%	42.8%	40.0%	
	Protecting the gums	n	9	7	16	
		%	12.8%	10.0%	11.4%	
	Anti-sensitivity	n	2	10	12	
		%	2.8%	14.3%	8.6%	
	Content other than fluoride (Coal, probiotics, etc.)	n	1	0	1	
		%	1.4%	0.0%	0.7%	
	Natural ingredients (Aloe vera, cloves, propolis, etc.)	n	5	1	6	
		%	7.1%	1.4%	4.3%	

How often do you change your toothbrush during OT?	1-3 months	n	36	33	69	0.858
		%	50.7%	46.5%	48.6%	
	Once in 3 months	n	25	27	52	
		%	35.2%	38.0%	36.6%	
	3 months-1 years	n	8	10	18	
		%	11.3%	14.1%	12.7%	
	More than 1 years	n	2	1	3	
		%	2.8%	1.4%	2.1%	
Did you follow the recommendations of your dentist after orthodontics?	Totally	n	54	40	94	0.035
		%	77.1%	57.9%	67.6%	
	Partial	n	14	29	43	
		%	20.0%	42.1%	30.9%	
	None	n	2	0	2	
		%	2.9%	0.0%	1.5%	
What was the bristle hardness of the toothbrush that you used during OT?	Soft	n	24	22	46	0.641
		%	34.3%	31.4%	32.9%	
	Medium	n	44	47	91	
		%	62.9%	67.1%	65.0%	
	Hard	n	2	1	3	
		%	2.8%	1.4%	2.1%	
How did you brush your teeth during OT?	Horizontal direction (forward-backward)	n	19	17	36	0.393
		%	26.8%	23.9%	25.4%	
	Towards the tooth-gingival junction	n	40	36	76	
		%	56.3%	50.7%	53.5%	
	Zig-zag	n	6	13	19	
		%	8.5%	18.3%	13.4%	
	Random	n	6	5	11	
		%	8.5%	7.0%	7.7%	

OT: Orthodontic treatment PT: Post-orthodontic treatment

Discussion

In this study, the hypothesis that OT affects oral hygiene habits and periodontal status was tested. The results showed that orthodontic patients' oral hygiene habits and the products that they used did not differ if they were receiving or had completed OT. However, the frequency of dental visits and level of attachments were significantly different after OT.

Poor oral hygiene can elevate the risk of gingiva inflammation due to dental plaque, which is a significant cause of gingivitis.[19] Oral hygiene practices, such as brushing the teeth and using toothpaste, eliminate the risk of developing pathogenic dental plaque on the teeth.[20,21] During OT, 61% of the patients used orthodontic toothbrushes, 30.5% used standard toothbrushes, and 81.9% used fluoride toothpaste.[22] In a study conducted at Saveetha University, 61% of orthodontic patients used fluoride toothpaste.[23] In this study, 85.9% of the participants with OT and 91.5% of the post-orthodontic patients stated that they used a toothbrush during OT; 73.2% of the participants with OT and 84.5% of the post-orthodontic participants indicated that they used toothpaste. The orthodontic patients generally used whitening toothpaste.

The use of a toothbrush is the fundamental factor in guaranteeing oral hygiene.[24] Most orthodontic patients brushed twice daily (42.5%) or three times daily (44.4%).[12] Most people with OT brush their teeth twice a day.[14,25] In another study, 91% of the participants brushed their teeth twice a day.[26] A recent study by Anuwongnukroh *et al.*[22] found that approximately 45% of patients cleaned their teeth in the morning and before bed, 28.6% brushed after meals, and 25.7% brushed after every meal or snack. Before OT, 29% of the patients brushed their teeth for 2-3 minutes. This rate increased to 33% during treatment.[27] During OT, 64.8% of the participants with OT brushed their teeth 2-3 times a day, while this percentage was 76.1% among the post-orthodontic patients. During OT, 45.5% of the participants with OT cleaned their teeth for more than 2 minutes, whereas only 24.6% of the post-orthodontic patients brushed their teeth for 2 minutes.

Using both a manual toothbrush and a mechanical interdental device leads to improved plaque control and reduced levels of gingival inflammation in orthodontic patients compared to using only a manual toothbrush.[28] Other oral hygiene measures used daily by patients were interdental brush (68.6%), mouthwash (64.4%), dental floss (29.9%), and toothpicks (22.2%).[12] 47% of young people who have received dental treatment engaged in flossing three times per week.[25] In another study, 61% of the participants used interdental products.[26] According to Anuwongnukroh *et al.*[22], regarding supplemental tools, %19 of the patients used dental floss, 23.8% used mouthwash, 21% used toothpicks, and 36.2% used interdental brushes. Overall, 35% to 45% of the patients followed the instructions for dental flossing and the use of interdental brushes, and 30% of the patients used mouthwash.[29] In this study, 22.5%

of the patients with OT used dental floss, 60.6% used interdental brushes, and 4.2% used toothpicks during OT. In comparison, 22.5% of all orthodontic patients used dental floss, 38.0% used interdental brushes, and 7.04% used toothpicks during OT.

Conventional orthodontic brackets have many retention areas that impede proper hygiene, thus leading to more significant plaque build-up. However, the approximal plaque index and gingival bleeding index did not differ during OT.[30] In another study, 91% of the participants brushed their teeth twice a day.[26] The plaque index of the participants was 0.72, the percentage of patients with bleeding on probing was 59%, and the percentage of patients with a periodontal pocket 4-5 mm was 47.8%. Another study revealed that the plaque index increased beginning in the first month after OT, and the gingival index increased beginning in the third month.[15] For all orthodontic patients to adequately maintain oral hygiene, the physician should repeat the oral hygiene instructions during the first three sessions at least to motivate the patients.[31] Marincak *et al*.[11] showed that the plaque index increases with orthodontic treatment and that the oral microbiota becomes dysbiotic against periodontopathogens. This study found no differences in plaque index, gingival index, bleeding on probing, and gingival recession between patients with OT and PT.

When Bollen *et al*.[32] compared the results of the articles included in their systematic review, there were very different opinions about the effect of orthodontic treatment on clinical attachment levels.[32] Three hundred and thirty-five fixed patients with OT had a clinical attachment loss of 0.11 mm. Existing evidence from longitudinal clinical studies suggests that orthodontic treatment with fixed appliances has little to no clinically relevant effect on periodontal clinical attachment levels. [33] Similarly, OT was associated with a mean clinical attachment loss of 0.11 mm, which was neither statistically nor clinically significant in another study. The findings suggest that orthodontic treatment might have little or no clinically relevant detrimental effect on patients' clinical attachment levels. [34] Due to the difficulties in maintaining adequate oral hygiene during treatment, 10% of post-orthodontic patients experienced clinical attachment loss more frequently than did patients in the no-treatment group.[35] There is a difference in clinical attachment level between patients with OT and PT in this study.

Manual toothbrushes with hard bristles remove plaque better but may also cause more soft tissue trauma than brushes with softer bristles.[36] One study included two hundred orthodontic patients, 57% of whom used a medium-hardness toothbrush.[37] In another study, 16% of the participants used medium-hardness toothbrushes.[38] Atassi and Awartani.[16] reported that 60% of orthodontic patients use medium brushes. In this study, 62.9% of the patients with OT and 67.1% of the post-orthodontic patients used a medium-hardness toothbrush during OT.

The modified Stillman's technique, Bass method, and Ramfjord's approach are the tooth brushing procedures most frequently used among orthodontic patients.[39] With respect to the brushing technique, the results showed that 38% of patients followed a combination of circular, horizontal, and vertical brushing movements, whereas 30% used vertical motions, and the remaining reported using horizontal and circular movements.[29] The evaluation of brushing techniques revealed that four (8%) patients used a circular movement, 21 (42%) used a horizontal movement, and 13 (26%) of the patients used a vertical movement in one direction in another study.[16] During OT, 56.3% of the participants whose treatment was ongoing and 50.7% of the participants whose treatment ended brushed their teeth from the tooth-gingiva junction to the incisal/occlusal part of the tooth.

The majority of patients attend regular monthly appointments in their orthodontic treatments.[29] While the rate of visits to the dentist before orthodontic treatment is usually 24%, this rate was 37% when the treatment started in this study.[27] On the other hand, in another study, most participants reported that they only went to the orthodontist when they had a problem.[40] In this study, 65.7% of the participants with OT responded once every six months, while only 48.6% of the post-orthodontic participants in general. While 81.4% of the participants currently undergoing OT reported visiting the orthodontist once every 6 months, only 78.9% post-orthodontic patients gave the same response during OT.

This study has several limitations. Firstly, although the sample size was aimed for at least 142 individuals as determined through power calculation, larger sample sizes could yield more robust results. Secondly, participants were recruited from a single institution, potentially limiting the generalizability of findings to the broader population. These limitations should be acknowledged and considered in future research endeavors.

Conclusion

This study examined the overall impact of OT on the oral health of patients with OT and PT, shedding light on the relationships among various factors. The results indicated that OT generally does not alter patients' oral hygiene habits but significantly impacts attachment levels or treatment in light of the consequences that may occur due to loss of clinical attachment. This study emphasizes the importance of orthodontists referring these patients to periodontists for oral hygiene practices, motivation, and what to do in case of clinical attachment loss.

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Ortodontik tedavi sırasında ve sonrasında hastaların ağız hijyeni alışkanlıklarının ve periodontal durumlarının değerlendirilmesi

Özet

Amaç: Bu çalışma ile ortodontik tedavi görmekte olan veya tedavisini tamamlamış bireylerde ağız hijyeni uygulamaları ile periodontal sağlık ve hastalık durumu arasındaki ilişkinin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: Sabit ortodontik tedavi görmekte olan veya tamamlamış 142 katılımcının periodontal durumları klinik indeksleri incelenerek tespit edilmiştir ve kapsamlı bir anket ile oral hijyen alışkanlıkları hakkında bilgi sahibi

olunmuştur. Sistemik olarak sağlıklı, sabit ortodontik tedavi gören veya tamamlanmış hastalar çalışmaya dahil edilmiştir. Gruplar arasında periodontal durumların ölçümlerini karşılaştırmak için istatistiksel analizlerde ki-kare ve t-testleri kullanılmıştır.

Bulgular: Ortodontik tedavisi devam eden (OT) ve postortodontik tedavi (PT) zamanında olan gruplar arasında ağız hijyeni alışkanlıkları, periodontal indeksler veya periodontal durum açısından istatistiksel olarak anlamlı farklılık olmadığı bulunmuştur (p>0.05). Bunun yanında OT ve PT arasında ataşman seviyesi, diş hekimi ziyaret sıklığı ve ziyaret nedenleri açısından istatistiksel olarak anlamlı farklılık kaydedilmiştir (p<0.05). Katılımcılar genel olarak benzer ağız hijyeni farkındalığı ve alışkanlığı gösterirken, OT sırasında diş fırçalama sürelerinde ve diş hekimi tavsiyelerine uymada farklılıklar ortaya çıkmıştır.

Sonuç: Bu çalışma OT'nin ağız sağlığı üzerindeki etkisini araştırmış ve ağız hijyeni alışkanlıklarını değiştirmediğini ancak klinik ataşman seviyelerini etkilediğini bulmuştur. Ortodontistler, hastalarını ağız hijyeni alışkanlığı kazandırmak ve klinik ataşman kaybını önlemek için periodontologlara yönlendirmelidirler.

Anahtar Kelimeler: Ağız hijyeni; anket; gingivitis; ortodonti