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Original Article

Periodontal Health Knowledge among Patients with Fixed Orthodontic Appliance: A Hospital Based Cross-Sectional Study

Mahmoud F. El-Belkemy[1], Rasha W. Mostafa[1], Riham O. Ibrahim[1]

[1]Department of Periodontology, Faculty of Dentistry, Cairo University, Cairo, Egypt.

Email: mahmoud.elbelkemy@dentistry.cu.edu.eg

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Abstract

Aim: The study was aimed to assess the periodontal health knowledge among patients with fixed orthodontic appliance.

Subjects and Methods: A total of 314 eligible patients recruited from the orthodontic department and the paid section faculty of dentistry, Cairo University according to the inclusion and exclusion criteria. A full questionnaire was filled for each patient. This questionnaire included 4 sections which included a series of questions related to demographic characteristics of the individuals, questions about periodontal health knowledge of the individuals, questions related to subject's awareness toward periodontal health, and questions related to subject's attitude toward orthodontic treatment. Clinical examination was done for evaluation of periodontal health status which included Bleeding on probing (BOP), Plaque index (PI), Clinical attachment level (CAL), probing depth (PD), and number of teeth with gingival recession.

Results: The overall outcomes indicated that participants with very good knowledge were the largest portion with 151 participants (48.1%). Most participants had moderate awareness (153 participants, 48.7%) and positive attitude (247 participants, 78.7%) and only 67 participants (21.3%) showed negative attitude.

Conclusions: Egyptian orthodontic patients had well knowledge of periodontal health, and they were moderately to highly aware of it.

Keywords: Knowledge, Awareness, Attitude, Orthodontic, Periodontal health.

Introduction

The absence of clinically visible inflammation defines periodontal health. Clinical gingival health can be identified as an intact periodontium, without clinical attachment loss or bone loss, and can be presented on a reduced periodontium in either a non-periodontitis patient or a patient with a history of periodontitis who is counted periodontally stable **[1]**.

Gingival disorders which aren't caused by dental plaque biofilm are different from plaque induced gingivitis where gingival disorders are a collection of diseases that aren't caused by plaque and don't usually resolve if plaque is eliminated. These lesions could be the outcome of a systemic condition or they could be confined to the mouth. On the other hand, gingivitis produced by tooth plaque biofilm can present in a variety of ways, with both local predisposing factors and systemic modifying variables influencing the disease's intensity, course, and severity **[1]**.

Periodontal disease is characterized as "a gradual breakdown of the periodontal ligament and alveolar bone with increased probing depth, recession, or both caused by specific bacteria or groups of microorganisms"**[2]**.

Periodontal health is a significant component that can be used to assess orthodontic treatment outcomes **[3]**. Periodontal issues are said to be one of the most common orthodontic side effects **[4]**.

Orthodontic treatment can improve facial appearance and mastication by repositioning teeth **[5]**. Fixed orthodontic appliances have a negative impact on the oral environment because they can promote gingival inflammation by decreasing the plaque PH which favors the buildup of dental plaque biofilm **[6-8]** causing changes in the content, type, and ecology of oral bacteria making it difficult to maintain excellent oral hygiene **[5]**.

[7, 9] showed that teeth cleaning is more difficult for patients undergoing fixed orthodontic treatment, necessitating extra effort to maintain good oral hygiene. Furthermore, **[10]** showed that periodontal pathogens colonise orthodontic stainless steel brackets as early as 24 hours, implying that meticulous oral hygiene measures are required early and throughout the fixed orthodontic treatment to avoid over colonization by periodontal pathogens, which can lead to more virulent periodontal diseases.

Many people are unaware of the importance of maintaining good dental hygiene and fail to follow the proper instructions **[11]**. Thus, the patient's knowledge, motivation, participation, and attitude toward the treatment are the most important aspects in maintaining oral hygiene during fixed orthodontic appliance therapy **[12]**.

Little is known about periodontal health knowledge and awareness among orthodontic patients in Egypt. Therefore, the aim of this cross-sectional study was to assess the periodontal health knowledge among patients with fixed orthodontic appliance.

Subjects and Methods

1.1. Study design and setting:

The study is a cross-sectional survey investigating the periodontal health knowledge among patients with fixed orthodontic appliance attending the orthodontic department and the paid section faculty of dentistry, Cairo University, which is an open public facility, a tertiary healthcare and a referral center.

1.2. Study population:

A total sample of 314 adult patients was involved in the study. Subjects were recruited in a consecutive manner from the orthodontic department and the paid section at faculty of dentistry, Cairo University. Then periodontal examination was continued at the outpatient clinic, Department of orthodontic, Faculty of Dentistry, Cairo University.

1.3. Study Eligibility criteria:

1.3.1. Inclusion criteria were as follows:

- Patients whose age is 15-35 years old.
- Patients with upper and lower fixed orthodontic appliances.
- The duration of orthodontic treatment is 12 ±8 months.
- Provide informed consent.

1.3.2. Exclusion criteria were as follows:

- Individuals with chronic systemic diseases such as diabetes, endocrine and haematological Pathologies
- Patients having problem in opening their mouth or undergoing intermaxillary fixation where oral examination will not be possible.
- Pregnant women
- Patients diagnosed with psychiatric problems or intoxicated with alcohol or drugs.
- Patients with congenital disorders or craniofacial anomalies such as cleft lip and palate.
- Patients with advanced (sever) periodontitis.

1.4. Sample size:

This power analysis used percentage of patients with correct answers for all knowledge questions as the primary outcome. Based upon the results of **[13]**, the percentage of patients with correct answers for all related questions = 8%. Using alpha (α) level of (5%), acceptable margin of error = 3%; the minimum estimated sample size was 314 subjects. Sample size calculation was performed using Epi Info 7.2.2.2

1.5. Variables and Data Collection:

The medical history was taken, thorough oral examination was done and a full questionnaire was filled for each patient. Before filling the questionnaire, the aim of the study was explained to the patient and the patient's acceptance to participate in the survey was received. The questionnaire was filling through a face-to-face personal interview with the patient using simple, short, easily comprehended questions.

The interview questions were prepared in English and translated into Arabic and then reversed by a certified translator to ensure accuracy. All the interviews were done by the same Investigator **(El-Belkemy)**

Clinical examination done on a dental unit using the light of the unit, mirror and UNC 15

periodontal probe which is 15mm long probe with markings at each millimeter and colour coded at 5th, 10th, and 15th mm. Periodontal status evaluated which included Bleeding on probing (BOP), Plaque index (PI), Clinical attachment level (CAL), probing depth (PD), and number of teeth with gingival recession. Maxillary right lateral incisor, maxillary right first premolar, maxillary right first molar, mandibular left lateral incisor, mandibular left first premolar and mandibular left first molar were considered the six representative teeth chosen for this purpose which called (Ramfjord teeth). The adjacent tooth scored when any of these preselected teeth was missing. The average score of each tooth calculated by dividing the total score of each tooth surface by the number of surfaces examined **[14]**.

1.6. Predictors

The questionnaire which was applied in the study included the following:

The 1st section of the questionnaire included a series of questions related to demographic characteristics of the individuals; age, duration of fixed orthodontic treatment, gender, and the patient's current oral health behaviour (frequency of tooth brushing, and auxiliary aids) **[15, 16]**.

The 2nd section of the questionnaire included six questions about periodontal knowledge of the individuals **(1ry outcome) [15, 16]** and answers were given in the form of multiple choices, with only one correct answer. These questions were scored as 0 if the answer was incorrect and as 1 if the answer was correct. According to these scores, Periodontal health knowledge categorized as poor with average score 0-1, good with average score 2-3, very good with average score 4-5 and excellent with score 6 **[13]**.

The 3rd section of the questionnaire included ten questions related to subject's awareness toward periodontal health **(2ry outcome) [15, 16]** that was scored as 0 if the answer was "I don't know" and as 1 if the answer was "yes" or "no". The levels of awareness were determined according to the scores. High level of awareness with average score 8-10, moderate level with average score 5-7, low level with average score 1-4, and no awareness with score 0 **[13]**.

The 4th section of the questionnaire included ten questions related to subject's attitude toward orthodontic treatment and periodontal health **(2ry outcome) [15, 16]** that was scored as 0 if the answer was negative and as 1 if the answer was positive. The subject's attitude was determined according to the scores. Negative attitude with average score 0-5 and positive attitude with average score 6-10 **[13]**.

1.7. Clinical Periodontal parameters

Bleeding on probing (BOP): Gingival bleeding was assessed by gentle probing of the orifice of the gingival crevice. A BOP score was assessed as the proportion (%) of bleeding sites (dichotomous yes/no) when stimulated by a standardized manual UNC 15 [1]periodontal probe with a controlled (~25 g) force inserted into the bottom of the gingival sulcus/pocket at six sites on all present teeth. If bleeding occurred within 10 seconds a positive finding was recorded **[1]**. Patients with an intact periodontium or reduced periodontium without a history of periodontitis are defined healthy if bleeding sites < 10%, localized gingivitis if bleeding sites 10%-30%, and generalized gingivitis if bleeding sites > 30% **[1]**.

Plaque index (PI): Teeth in each quadrant dried with a blast of air, and presence of visible dental plaque and supragingival calculus recorded. Each of the four surfaces of the teeth (buccal, lingual, mesial and distal) gave a score from 0-3. The scores from the four areas of the tooth added and divided by four in order to give the plaque index for the tooth with the scores 0,1,2,3 **[17]**.

[1] Sedradent, Qasr Al-Ainy, Cairo, Egypt.

Clinical attachment level (CAL): The loss of clinical attachment was measured from the CEJ to the bottom of the gingival sulcus. Each tooth was probed using UNC 15 periodontal probe with a light force not exceeding .25 newton (25 gram force) at six points: mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual force **[18]**.

Probing depth (PD): It was measured from the gingival margin to the bottom of the gingival sulcus. The UNC 15 periodontal probe was inserted parallel to the long axis of the tooth using light force **[18]**.

Number of teeth with Gingival Recession was recorded. Gingival Recession Depth (RD) is the distance from the CEJ of the tooth to the most apical extension of the gingival margin **[18].**

1.8. Statistical methods

Descriptive statistics were presented as frequency and percentages for qualitative data and as mean with standard deviation, median, 95% confidence interval (95% CI) for quantitative data. Chi-square test was used to compare qualitative data. Quantitative data were checked for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. Comparisons between two groups, independent student t-test were utilized. For multiple group comparisons, one-way ANOVA test with Turkey post-hoc test for pairwise comparisons in case of significance. All testes were two-tailed and significance level was set at level of $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS®[2]

[2] Version 26. SPSS Inc., IBM Corporation, Armonk, NY, USA.

Results

1. Descriptive statistics:

1.1 Demographic data:

1.1.1 Age structure

The mean age of participants was 23.36 ± 4.57 years and median of 22.5 years with 95% confidence interval ranging from 22.85 to 23.68 years. The minimum age of participants was 15 years and the maximum reached 35 as shown in table (1). Age structure for participants between 15-20 years included 99 participants representing 31.5% of the total study sample, 21-25 years were 116 participants (36.9%), from 26-30 years were 76 participants (24.2%) and finally from 31-35 years were 23 in number or 7.3% as shown in table (1)

1.1.2 Duration of appliance

The average appliance duration in the participating cohort was 13.32 ± 4.48 months, with median of 12 months and 95% CI between 12.82 and 13.82 months. The minimum and maximum durations were 12 months and 20 months respectively as shown in table (1).

1.1.3 Gender

Gender distribution in the participating sample had 121 male participants accounting for 38.5% of total participants, and 193 females accounting for the remaining 61.5% as shown in table (1).

1.1.4. Frequency of brushing

There were 89 participants with irregular tooth brushing which accounted for 28.3% of total participants. Participants using the brush once daily

were 72 with percentage of 22.9%. 103 participants used the toothbrush twice daily and 50 others used it for 3 times daily or more, which accounted for 32.8% and 15.9% respectively as shown in table (1)

1.1.5. Auxiliary aids:

Almost half of participants (148 individual representing 47.1%) did not use any auxiliary aids. The most common auxiliary aid was the toothpicks

(66 participant, 21%) followed by orthodontic brush (54 participants, 17.2%), followed by dental floss (28 participants, 8.9%) and finally mouthwash (18 participant, 5.7%) as shown in table (1).

Table (1): Demographic data

Age (in years)	**Mean**	**SD**	**95% CI**	**Median**	**Minimum**	**Maximum**
	23.36	4.57	22.85 –23.86	22.5	15	35
	Sub-group		**Number**		**Percentage**	
Age group	15-20 years		99		31.5 %	
	21-25 years		116		36.9 %	
	26-30 years		76		24.2 %	
Duration (in months)	**Mean**	**SD**	**95% CI**	**Median**	**Minimum**	**Maximum**
	13.32	4.48	12.82- 13.82	12.00	12.00	20.00
	Sub-group		**Number**		**Percentage**	
Gender	Male		121		38.5 %	
	Female		193		61.5 %	
	Sub-group		**Number**		**Percentage**	
Frequency of brushing	Irregular		89		28.3 %	
	1 time		72		22.9 %	
	2 times		103		32.8 %	
	3 times or more		50		15.9 %	
	Sub-group		**Number**		**Percentage**	
Auxiliary aids	No		148		47.1 %	
	Toothpicks		66		21.0 %	
	Orthodontic brush		54		17.2 %	
	Dental floss		28		8.9 %	
	Mouthwash		18		5.7 %	

1.2 Periodontal health Knowledge (primary outcome)

Participants with poor knowledge constituted the least portion of participants (27 participants, 8.6%). good knowledge was present in 95 participant (30.3%), very good was the largest portion with 151 participants (48.1%) and finally excellent knowledge was evident in 41 participants (13.1%) as shown in table (2).

1.3 Awareness toward orthodontic treatment and periodontal health (secondary outcome)

Most participants had moderate awareness (153 participants, 48.7%), followed by high awareness (110 participants, 35%). No participant showed a complete lack of awareness and only 51 participants (16.2%) had low awareness as shown in table (2).

1.4 Attitude toward orthodontic treatment and periodontal health (secondary outcome)

Most participants had positive attitude (247 participants, 78.7%) and only 67 participant (21.3%) showed negative attitude as shown in table (2).

Table (2): Descriptive statistics of periodontal health knowledge, awareness, and attitude

	Sub-group	**Number**	**Percentage**
Periodontal health Knowledge	Poor	27	8.6 %
	Good	95	30.3 %
	Very good	151	48.1 %
	Excellent	41	13.1 %
	Sub-group	**Number**	**Percentage**
Awareness	No	0	0.0 %
	Low	51	16.2 %
	Moderate	153	48.7 %
	High	110	35.0 %
	Sub-group	**Number**	**Percentage**
Attitude	Positive	247	78.7 %
	Negative	67	21.3 %

1.5 Clinical Periodontal Parameters:

1.5.1 Bleeding on probing

Only 3 participants (1%) had bleeding on probing less than 10% of sites. About one third of participants (104 participant, 33.1%) had bleeding on probing at 10-30% of sites and the majority of participants showed bleeding on probing at more than 30% of sites (207 participants, 65.9%) as shown in table (3).

1.5.2 Other periodontal parameters

Other periodontal parameters showed that the mean plaque index score was 1.57 ± 0.76 with median of 2 and 05% CI of 1.48 – 1.65. Clinical attachment level (CAL) had mean of 0.22 ± 0.63 mm with median of 0 and CI of 0.15 – 0.29. Regarding probing depth, the mean was 1.86 ± 0.83 mm with median of 2 and CI of 1.74 – 1.95. Finally, the average number of teeth with recession was 0.22 ± 0.70 with median of 0 and CI 0.14 – 0.29 as shown in table (3).

Table (3): Descriptive statistics of clinical periodontal parameters

	Sub-group	**Number**	**Percentage**
Bleeding on probing	< 10%	3	1.0
	10-30%	104	33.1
	> 30%	207	65.9

	Mean	**SD**	**95% CI**	**Median**	**Minimum**	**Maximum**
Plaque index (score)	1.57	0.76	1.48 – 1.65	2.00	0	3.00
Clinical attachment level (mm)	0.22	0.63	0.15 – 0.29	0	0	3.00
Probing depth (mm)	1.86	0.83	1.74 – 1.95	2.00	1	4.00
No. of teeth with recession	0.22	0.70	0.14 – 0.29	0	0	4.00

2 Association

2.1 Association between periodontal health knowledge and Demographic data

The comparison of age distribution among different knowledge categories was not statistically significant. Same was observed with duration of appliance use and gender distribution. Regarding the frequency of tooth brushing, there was a statistically significant difference between different knowledge categories as most participants with poor knowledge did not use the tooth brush regularly (51.9%) while in the very good category, 68.2% used tooth brush 2 times and in the excellent category, all participants used the brush 3 times or more as shown in table. Similarly, the use of auxiliary aids showed a statistically significant comparison, as the poor knowledge group used more mouthwash than other groups (29.6%) and the

very good group used toothpicks the most (25.8%) as shown in table (4).

Table (4): Comparison between different knowledge categories regarding demographic data

Demographic data \ Knowledge		Poor N= 27	Good N= 95	Very good N= 151	Excellent N= 41	p-value
Age in years [Mean (SD)]		24.81 (4.24)	23.39 (4.70)	23.34 (4.45)	22.37 (4.85)	0.197
Appliance duration in months [Mean (SD)]		13.11 (4.25)	13.29 (4.76)	13.48 (4.45)	12.93 (4.19)	0.902
Gender [No (%)]	Male	7 (25.9)	40 (42.1)	61 (40.4)	13 (31.7)	0.341
	Female	20 (74.1)	55 (57.9)	90 (59.6)	28 (68.3)	
Frequency of brushing [No (%)]	Irregular	14 (51.9)	52 (54.7)	23 (15.2)	0 (0)	<0.001*
	1 time	13 (48.1)	43 (45.3)	16 (10.6)	0 (0)	
	2 times	0 (0)	0 (0)	103 (68.2)	0 (0)	
	3 or more	0 (0)	0 (0)	9 (6.0)	41 (100.0)	
Auxiliary aids [No (%)]	None	12 (44.4)	37 (38.9)	77 (51.0)	22 (53.7)	0.029*
	Dental floss	4 (14.8)	9 (9.5)	9 (6.0)	6 (14.60)	
	Ortho brush	8 (29.6)	23 (24.2)	18 (11.9)	5 (12.2)	
	Mouthwash	0 (0)	9 (9.5)	8 (5.3)	1 (2.4)	
	Toothpicks	3 (11.1)	17 (17.9)	39 (25.8)	7 (17.1)	

*Statistically significant

2.2 Association between periodontal health knowledge and clinical parameters

For the comparison between different knowledge categories, there was a statistically significant difference in bleeding on probing BOP as the poor knowledge group showed the highest percentage of BOP more than 30% sites (74.1% of this group). For excellent knowledge group (61%) showed more than 30% BOP while (4.9%) showed less than 10% BOP. For the other clinical outcomes, there was no statistically significant difference in plague index, CAL, probing depth nor number of teeth with recession table (5).

Table (5): Comparison between different knowledge categories regarding clinical parameters

Clinical parameters \ Knowledge		Poor N= 27	Good N= 95	Very good N= 151	Excellent N= 41	p-value
Bleeding on probing [No (%)]	< 10%	1 (3.7)	0 (0)	0 (0)	2 (4.9)	0.042*
	10-30%	6 (22.2)	30 (31.6)	54 (35.8)	14 (34.1)	
	> 30%	20 (74.1)	65 (68.4)	97 (64.2)	25 (61.0)	
Plaque index (score) [Mean (SD)]		1.67 (0.88)	1.61 (0.82)	1.57 (0.69)	1.39 (0.83)	0.400
Clinical attachment level (mm) [Mean (SD)]		0.41 (0.89)	0.26 (0.75)	0.17 (0.53)	0.17 (0.44)	0.266
Probing depth (mm) [Mean (SD)]		2.00 (1.04)	1.92 (0.83)	1.83 (0.79)	1.73 (0.84)	0.498
Teeth with recession [Mean (SD)]		0.41 (1.05)	0.27 (0.84)	0.15 (0.54)	0.20 (0.51)	0.262

*Statistically significant

Discussion

Periodontal diseases are considered a wide variety of chronic inflammatory conditions of the gingiva, bone and periodontal ligament. Periodontal disease begins with gingivitis, the inflammation which is localized to the gingiva that is initiated by bacteria in the microbial biofilm. Periodontitis occurs when untreated gingivitis progresses to the bone and ligament **[19, 20]** cited in **(Kinane, Stathopoulou [21]**.

Orthodontic treatment is becoming increasingly popular among adults as the public's desire for a better appearance grows. The connection between different disciplines becomes even more vital as adult orthodontic patients may also have restorative and periodontal needs. Orthodontics may be an important aspect of treatment for many periodontal patients who have pathological tooth migration or other abnormalities **[22]**.

Several studies showed that patients with fixed orthodontic appliances have a significant quantity of dental plaque which may cause increase of the incidence of gingivitis and progressively periodontitis **[23, 24]**.

It's crucial to show people how to wash their teeth properly and how often they should do so. They must be taught how to use the proper toothbrushes, interdental, and orthodontic brushes,

as well as auxilliary equipment for maintaining oral hygiene **[25]**. Patients should essentially be informed about the obligation of maintaining good dental hygiene before starting orthodontic treatment **[26]**.

The harmful effect of orthodontic treatment on the periodontium is multifactorial which may be bacterial, chemical, mechanical, allergic, or factors related to orthodontic tooth movement. So, the periodontal health knowledge, awareness, and attitude of the orthodontic patient toward the treatment are key elements in maintaining oral hygiene and decreasing harmful risks **[3]**.

Little is known about periodontal health knowledge and awareness among orthodontic patients in Egypt. Therefore, the aim of this cross-sectional study was to assess the periodontal health knowledge among patients with fixed orthodontic appliance.

Gender distribution in the participating sample in our study interestingly revealed contribution of 121 male participants accounting for (38.5%) of total participants, and 193 females accounting for the remaining (61.5%). This is in accordance with a study conducted by **[27]** who reported that females seeking orthodontic treatment were nearly twice as likely as males, **[28]** in which female patients accounted for (60.9%), **[29]** found the female percentage was (67%), and **[30]** was 1:3 males to females' ratio for the sample of treated patients. These finding reflects the fact that females are more concerned with their aesthetics, hence they showed greater attendance to have their dentition maintained and checked, and were thus more represented in the sample.

On behalf of using tooth brushes, our study apparently showed a calculation of 100% of participants education of good oral hygiene behaviour translated in term of frequency of brushing, where 103 participants (32.8 %) used tooth brushes twice daily, 89 participants (28%) followed irregular brushing, 72 participants (22.9%) brushed once / day, and 50 participants (15.9%) used tooth brushes three times / day. This is in accordance with **[31]** and **[32]** who found (100%) of their participants were using tooth brushes to clean their teeth. A similar finding was reported by **Alhaija and coworkers** who stated that oral hygiene behavior of orthodontic subjects was good leaving only (6%) experiencing no brushing **[30]**. However, **[33]** assessed the oral hygiene of fixed orthodontic patients in Saudi Arabia and found that (40%) had fair oral hygiene and (60%) had poor oral hygiene. The disparity in the reported percentages in the later study, could be attributed to cultural differences, a lack of oral health services, or a diverse population.

As regard the auxillary aids, almost half of the participants (148 individuals representing 47.1%) did not use auxillary aids. Comparable results were reported by **Al-harbi and co-workers, 2018** with (67%) usage of oral hygiene auxilliary aids. **[34]** in their study announced (78.35%) participants using auxillary aids. On the country, a high of 100% participants versus alow of 25% participants were reported using auxillary aids in studies conducted by **[31]** and **[35]** respectively. It is worth to be mentioned that in our study the most common auxiliary aid was the toothpicks (66 participants, 21%) followed by orthodontic brush (54 participants, 17.2%), followed by dental floss (28 participants, 8.9%) and finally mouthwash (18 participants, 5.7%).

The patient's knowledge, motivation, cooperation, and attitude toward treatment are key elements in maintaining oral hygiene during fixed orthodontic treatment **[12]**. In 2010 Elanchezhiyan stated that oral hygiene may be neglected owing to a lack of knowledge or ignorance on the part of patients **[11]**.

The present study showed that, the majority of the participants have good and very good knowledge, moderate and high level of awareness, and positive attitude. Good knowledge was present in (95 participants, 30.3%), and very good had the

largest portion with (151 participants, 48.1%). Most participants had moderate awareness (153 participants, 48.7%), followed by high awareness (110 participants, 35%). Positive attitude was reported in (247 participants, 78.7%). Our results agreed with knowledge of oral health among Nigerian patients with fixed orthodontic appliances which were evaluated by **[28]** and they stated that (93.5%) of the subjects showed good oral health awareness. **[30]** investigated the periodontal health knowledge and awareness among subjects with fixed orthodontic appliance, and they announced a moderate level of periodontal health awareness among participants. **[36]** directed a study in India which aimed to report on periodontal health awareness among orthodontic patients and the majority of subjects were included in the moderate level of awareness (52%). On the country **[35]** found about half of Indian patients were unaware of periodontal health. **[30]** reported poor knowledge of (84%) participants, who did not know what plaque is, (95%) did not know what does it cause, and only 24subjects (8%) correctly answered all related questions ,however most of their participants had a good level of knowledge regarding the role of oral hygiene in preventing gum disease. They also reported a negative attitude among orthodontic subjects. The fact that, periodontal health knowledge among orthodontic patients, awareness and their attitude toward the periodontal health vary among different populations, could be explained by the disparities found in culture, in socioeconomic level, in educational background, and in the availability of orthodontic services **[37, 38]**.

Despite the fact that the participants in our study appeared to practice adequate oral hygiene, clinical examination revealed that the majority of participants (207 participants, 65.9%) showed bleeding on probing BOP at more than 30% of sites. About one third of participants (104 participant, 33.1%) had BOP less than 30% of sites and only 3 participants (1%) had BOP less than 10% of sites. This agrees with **[30]** who demonstrated that, clinical examination revealed that most of the patients had developed generalized moderate gingivitis despite of good oral hygiene reported by them, and **[29]** who stated that the majority of the participants showed increased bleeding from gums, indicating that orthodontic treatment have impact on maintenance of oral hygiene. **In 2015 Ajayi and Azodo** reported that (30.4%) of the patients showed swollen / bleeding gum occasionally after the onset of orthodontic treatment **[28]**.

Clinical periodontal parameters in our study showed that the mean probing depth for all participating orthodontic patients was 1.86 ± 0.83 mm with median of 2 mm. Plaque-retentive nature of orthodontic appliances, causes plaque accumulation at the gingival margins contributing to gingival inflammation and ecologic changes in the pathogenicity of microbiota progressing to periodontal pockets. This was in agreement with **[24]** who showed that patients undergoing orthodontic treatment had increased plaque accumulation and probing depth, resulting in periodontal tissue destruction. Additionally, **[30]** reported that the mean of the probing depth was 1.23 ± 0.02 mm , and the probing depth was greater in subjects who used fixed appliance for more than 18 months with a mean 1.30 ± 0.04 mm.

Regarding gingival recession, the average number of teeth with recession was 0.22 ± 0.70 with median of 0. In a study conducted by **[30]**, they demonstrated that, the mean for GR among orthodontic patients was 0.06 ± 0.02. The tendency of gingival margin migration could be attributed to brushing trauma, thin biotype and axial inclination of tooth alignment. **[39]** reported that treatment duration, age, gender, or race, had no effect on the development of recessions throughout treatment.

The association of age distribution, appliance duration**,** and gender distribution versus different knowledge categories was not statistically significant. Remarkably, the frequency of tooth brushing, showed a statistically significant differences compared to different knowledge categories where most participants with poor knowledge (51.9%) did not use the tooth brush

regularly while those in the very good category (68.2%), used tooth brush twice and were consequently in the excellent category, all participants used the brush three times or more. Similarly, the use of auxiliary aids showed a statistically significant comparison, as the poor knowledge group (0%) used less mouthwash than other groups and that was expected because the patient's knowledge is a vital factor in maintaining oral hygiene during having fixed orthodontic appliance **[12]**.

For the association between different knowledge categories and clinical parameters, there was a statistically significant difference in bleeding on probing BOP as the poor knowledge group showed the highest percentage of BOP of more than 30% sites (74.1% of this group). For excellent knowledge group (61%) showed more than 30% BOP while (4.9%) showed less than 10% BOP. For the other clinical outcomes, there was no statistically significant difference in plague index, CAL, probing depth nor number of teeth with recession.

The distribution of demographic data among different awareness and different attitude groups showed statistically significant differences regarding frequency of brushing The low and moderate awareness groups comprised mainly of irregular brushers (51% and 41.2% respectively) while the high awareness group had participants who either use the brush twice daily (54.5%) or 3 times or more (45.5%). The negative attitude group presented no participants using the toothbrush more than once per day, in contrast to the positive attitude group with (41.7%) participants using the toothbrush twice daily. Justification could rely on the statement affirming that patient's awareness and attitude toward treatment are significant parameters that affect oral hygiene maintenance during fixed orthodontic treatment **[12]**.

Generally, periodontists and orthodontists do not assign the same degree of need to treat clinical periodontal situations before orthodontic treatment. Orthodontists perform limited periodontal screening. However, dentists frequently see patients for periodontal damage following orthodontic treatment.

Orthodontists through their long-term treatment procedure have the responsibility to educate their patients about periodontal health and to promote proper oral health behaviour with emphasis on the prevention of periodontal disease. However, self-directed educational material such as a leaflet is an inexpensive and practical way of targeting large sections of population to consider health change.

Conclusion

- Periodontal health knowledge among Egyptian orthodontic patients was good and very good, while the periodontal health awareness among Egyptian orthodontic patients was moderate and high.
- Orthodontic patients showed a positive attitude toward periodontal health.
- Both periodontists and orthodontists should be aware of each other's work and work together in clinical practice to provide the best possible treatment for their patients.

Recommendations

Further studies are needed with larger sample size to investigate the association among the Egyptian population at different locations in Egypt, as the subjects were recruited from a single orthodontic practice.

This survey highlights the need to strengthen academic and continuing education with general dentists as well as orthodontists and periodontists to cover basic and applied clinical concepts.

Conflict of Interest:

The authors declare no conflict of interest.

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This study protocol was approved by the ethical committee of the faculty of dentistry- Cairo university on the 8th of June 2020, approval number:PER1-1-1.

Questionnaire form

[15, 16]

Periodontal health knowledge among patients with fixed orthodontic appliance. A hospital based Cross-sectional study.

A) Demographic characteristics and oral hygiene practices.

- Age:……..(Yrs)
- Sex : ( ) Male ( ) Female

1-From when have you been wearing your orthodontic appliance? ..... (months)
منذ متى وأنت ترتدي جهاز تقويم الأسنان الخاص بك؟

2- Do you brush your teeth? (yes) (no)
If yes ……
هل تقوم بتنظيف اسنانك؟

3-How many times do you brush your teeth daily? ( )irregular ( ) 1 ( ) 2 ( ) ≥3
كم مرة تنظف اسنانك في اليوم الواحد؟

4-What is the type of your brush? ( ) Ortho-brush ( ) Ordinary brush
ما هو نوع الفرشاة الخاصة بك؟

5-Do you use any auxiliary aids in oral hygiene practice? (yes) (no)
If yes …….
هل تستخدم أي مساعدات في ممارسة نظافة الفم؟

6-Which type of auxiliary aids do you use? ( ) Dental floss ( ) ID brush ( ) MW ( ) T. pick
ما نوع الوسائل المساعدة التي تستخدمها؟

7- Do you clean your tongue? (yes) (no)
هل تقوم بتنظيف اللسان؟

B) The knowledge of periodontal health.

1- What is the dental plaque? ( ) Soft deposits on teeth ( ) Hard deposits on teeth
( ) Staining on teeth ( ) Don't know
ما هو جير الاسنان؟

2-by what way can dental plaque harm the oral health? ( ) Malformation of teeth ( ) Discoloration of teeth

( ) Gum disease ( ) Don't know

ما هي الطريقة التي يمكن أن يضر بها جير الأسنان بصحة الفم؟

3-What can gum bleeding indicate? ( ) Healthy gum ( ) Inflamed gum

( ) Gum recession ( ) Don't know

ماذا يمكن ان يشير نزيف اللثة؟

4-by what way can you prevent gum disease? ( ) By brushing and flossing ( ) By having soft diet

( )By taking vitamin C only ( ) Don't know

بأي طريقة يمكنك منع أمراض اللثة؟

5- What is the principle cause for bad breath? ( )Smoking ( )Poor oral hygiene

( )Lung disease ( )Onion/garlic food product

ما هو السبب الرئيسي لرائحة الفم الكريهة؟

6- What is the outcome of progressed gum disease? ( ) Red gingiva ( )Bad breath

( )Tooth mobility ( ) Don't know

ما هي نتيجة مرض اللثة المتقدم؟

C) The awareness.

1-Do your teeth have dental plaque? ( ) No ( ) Yes ( ) Don't know

هل لديك جيرعلى اسنانك ؟

2-do your teeth have dental calculus? ( ) No ( ) Yes ( ) Don't know

هل لديك جير متصلب على اسنانك ؟

3- Do your teeth have stains? ( ) No ( ) Yes ( ) Don't know

هل لديك صبغة على أسنانك؟

4- Do your gingiva show recession? ( ) No ( ) Yes ( ) Don't know

هل لديك انحصار في اللثة؟

5- Do you suffer from periodontal pockets? ( ) No ( ) Yes ( ) Don't know

هل تعاني من الجيوب اللثوية؟

6- Do you have bad breath? ( ) No ( ) Yes ( ) Don't know

هل لديك رائحة فم الكريهة؟

7-Do your gingiva feel pain? ( ) No ( ) Yes ( ) Don't know

هل تعانين من ألم اللثة؟

8- Do your gingiva show enlargement? ( ) No ( ) Yes ( ) Don't know

هل لديك تضخم في اللثة؟

9- Do your gingiva bleeds? ( ) No ( ) Yes ( ) Don't know

هل تعاني من نزيف اللثة؟

10-do you suffer from gingival irritation? ( ) No ( ) Yes ( ) Don't know

هل تعاني من تهيج اللثة؟

D) The attitude

1-Does the fixed orthodontic appliance increase plaque accumulation? ( )yes ( )no

هل يزيد جهاز تقويم الأسنان الثابت من تراكم الجير؟

2-Do orthodontic brackets make brushing more difficult? ( )yes ( )no

هل يزيد جهاز تقويم الأسنان الثابت من صعوبة تنظيف الاسنان؟

3-Does the fixed orthodontic appliance may initiate periodontal diseases? ( )yes ( )no

هل يمكن لجهاز تقويم الأسنان الثابت أن يتسبب في أمراض اللثة؟

4-Does the fixed orthodontic appliance may cause mild pain? ( )yes ( )no

هل يسبب جهاز تقويم الأسنان الثابت آلامًا خفيفة؟

5- Is gum disease mostly preventable? ( )yes ( )no

هل أمراض اللثة يمكن تجنبها في الغالب؟

6- Can regular dental visits prevent gum diseases? ( )yes ( )no

هل يمكن لزيارات الأسنان المنتظمة أن تمنع أمراض اللثة؟

7-Is it important to follow the instructions of the clinician about oral hygiene? ( )yes ( )no

هل من المهم اتباع تعليمات الطبيب حول نظافة الفم؟

8-are you follow the instructions of the clinician about oral hygiene? ( )yes ( )no

هل تتبع تعليمات الطبيب حول نظافة الفم؟

9-Do you think bad oral hygiene affects your general health? ( )yes ( )no

هل تعتقد أن نظافة الفم السيئة تؤثر على صحتك العامة؟

10-are straight teeth easier to clean? ( )yes ( )no

هل تنظيف الأسنان المستقيمة أسهل؟

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