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AWARENESS AND KNOWLEDGE OF ORAL HYGIENE PROTOCOLS AND PERIODONTAL HEALTH AMONG ORTHODONTIC PATIENTS

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Abstract

Introduction: Maintaining good oral hygiene during orthodontic treatment, particularly with fixed orthodontic applience can be a challenge for most patients. Such appliances often create physical barriers that make it difficult to remove plaque effectively, which can lead to increased plaque buildup and a higher risk of periodontal diseases. Past studies have shown a clear link between orthodontic treatment and various periodontal issues, highlighting the need for diligent oral care during treatment.

Objectives: This study aims to understand how much orthodontic patients in the western province of Saudi Arabia know about oral hygiene and periodontal health. We want to see if there are differences in awareness and knowledge based on factors like age, gender, and how long the patients have had their braces.

Methodology: In this cross-sectional study, an online questionnaire was used to gather data from orthodontic patients. The participants were divided into two age groups: those under 18 and those 18 and older. Also observing the duration of wearing orthodontic applience, grouping them into those who had braces for less than six months and those who had them for more than six months. The questionnaire covered demographics, knowledge of periodontal disease, awareness of periodontal health, and attitudes towards orthodontic treatment. We used a structured scoring system to evaluate the responses and analyzed the data with SPSS software.

Results:

This study was evaluating the awareness and knowledge of oral hygiene protocols and periodontal health among 406 orthodontic patients. The average participant age was 28, with a notable 67.5% being female and a majority holding a bachelor's degree. While 92.9% brushed daily, only 41.6% accurately identified dental plaque as soft deposits, pointing to a significant knowledge gap regarding periodontal issues. Alarmingly, 63.1% reported no plaque presence despite indicators of gum disease, such as bad breath and tooth mobility, affecting many. A strong positive attitude towards oral hygiene was noted, yet only 11.1% demonstrated high awareness, highlighting the need for targeted educational

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interventions.

Conclusion:

The present study provides valuable insights into the knowledge of oral hygiene protocols and periodontal health among orthodontic patients in Saudi Arabia. While the findings indicate a proactive approach to maintaining oral hygiene, significant gaps in knowledge and awareness persist.

Keywords: Orthodontic treatment, oral hygiene awareness, periodontal health knowledge, fixed applience, patient education

Introduction

Orthodontics is a specialty of dentistry that manages the diagnosis of malocclusion, prevention, and correction of mispositioned teeth and jaws, as well as, altering facial growth[1] .The use of orthodontic appliances, such as fixed braces can present unique challenges for the maintenance of optimal oral hygiene. [2] These appliances can create physical barriers and obstruct access to certain areas of the dentition, potentially hindering the patient's ability to effectively remove plaque and debris through routine brushing and flossing. Also, any facial anomaly or misalignment of teeth is a significant factor in plaque accumulation. [3]

Several studies have shown a significant increase in the quantity of dental plaque and the occurrence of gingivitis in patients with fixed orthodontic appliances.[4] For this reason, special efforts are required for adequate oral hygiene during treatment, as their presence makes tooth cleaning more difficult.[5] Gingival enlargement may lead to the formation of an artificially deep pocket, which can progress to the loss of gingival attachment and gingival recession.[6]

Orthodontic treatment and periodontal disease have a noticeable correlation. Malocclusion promotes further plaque accumulation and can increase the risk of periodontal disease. It is crucial to maintain good oral health maintenance when correcting malocclusion. [7]

Some studies have suggested that certain malocclusions such as open or deep bites may contribute to periodontal diseases for example recession. However, other studies have not found any significant relation between periodontal health problems and malocclusion.[8]

A significant component to assess orthodontic treatment outcomes is the health of the periodontium. Periodontal issues are one of the most common side effects of orthodontic treatment.[9]

Fixed appliances may have a negative impact on the oral environment as it may promote plaque buildup. These appliances have shown to increase the difficulty of cleaning teeth demanding better oral hygiene measures. [10] Many patients are unaware of the significance of maintaining good oral hygiene and tend to ignore proper hygiene instructions. Therefore, patients must be motivated and taught the importance of maintaining proper oral hygiene during fixed orthodontic treatment. [11]

In a study codnucted by Priyadarsi et al., 2020 reported that the majority of subjects (52%) had a

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moderate level of awareness. There was a significant association between orthodontic patients' awareness of their periodontal health during fixed orthodontic treatment and their attitude scores (R^2 = 0.132; P = 0.023). [5]

Another study by Vignesh Kamath et al. in 2021 assessed the oral hygiene awareness among participants both during and after orthodontic treatment. The results revealed that 62% of patients did not follow oral hygiene instructions. Despite being given these instructions, most patients hesitated to practice them consistently. [11]

In a related study, Maybodi et al. 2023 found that the average knowledge score about oral health among patients with fixed orthodontic appliances was 5±1.13 on a scale from 0 to 7, which is considered moderate. There was no significant correlation between knowledge and factors such as gender, age, treatment duration, and educational level, although these findings were not detailed in the study.[12]

Additionaly, a study conducted in 2023 by Mahjoub et al. reported that females had significantly higher levels of awareness and oral hygiene practice. This level of awareness also showed a consistent stepwise increase with age. Additionally, higher education levels, longer durations since obtaining the appliance, and receiving instructions from the orthodontist were associated with increased awareness and better oral hygiene practices. [10]

Furthermore, a study by Marusamy et al. 2024 found that patients' attitudes towards fixed orthodontic treatment were significantly influenced by their consistency in attending dental checkups (p value = 0.02).[7]

Poor oral hygiene during the course of orthodontic treatment has been associated with an increased risk of plaque accumulation, the development of gingivitis, and the potential onset of other periodontal problems. The accumulation of plaque can lead to inflammation of the gingival tissues (gingivitis) and, if left untreated, may progress to more advanced forms of periodontal disease. [10]

Evaluating the level of awareness and knowledge among orthodontic patients regarding the importance of maintaining optimal oral hygiene during treatment is crucial. This assessment can provide valuable insights to guide the development of targeted educational interventions and behavioral strategies aimed at promoting better oral hygiene practices among this patient population. By empowering patients with the necessary knowledge and skills, the risk of plaque-induced periodontal complications can be mitigated, thereby enhancing the overall success and long-term stability of orthodontic treatment outcomes

Objectives:

This research aims to assess the awareness of orthodontic patients about proper oral hygiene practices and to asses their level of knowledge on periodontal health. Seeking to determine whether factors such as age, gender, and the duration of appliance use influence this awareness and knowledge.

Methodology

Study Design:

This research will employ a cross-sectional study conducted between July 2024 - December 2024 to assess the awareness and knowledge of oral hygiene protocols and periodontal health among

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orthodontic patients. The study conducted as an online questionnaire via google form among orthodontic patients. The online questionnaire distributed in both private and public orthodontic clinics.

Subject: Participants, recruitment and sampling procedure:

The study's population consists of patients wearing fixed orthodontic appliances, residing in the western province of Saudi Arabia. Participants are divided into two age groups: those below 18 years old and those 18 years and older. Both female and male patients are included in the study to ensure a comprehensive understanding of the awareness and knowledge of oral hygiene protocols and periodontal health across different demographics.

To further refine the sample, participants are also categorized based on the duration they have been wearing their orthodontic appliances: those who have had their appliances for less than 6 months and those who have had them for more than 6 months. This categorization aims to assess any differences in awareness and knowledge related to the length of time they have been undergoing orthodontic treatment.

Sample size:

Participants are recruited from various orthodontic clinics and dental hospitals in the western province, ensuring a diverse and representative sample. A random sampling technique adopted in the present study. Noting that population is approximatly 10,000 orthodontic patients in the Jeddah region, and a confidence level of 95%, a margin of error of 5%, and a response distribution of 50%, the recommended sample size calculated is 384.

$$n = \frac{1.96^2 \cdot 0.5 \cdot (1 - 0.5)}{0.05^2} = 384.16$$

Inclusion and Exclusion criteria:

Female and male patients wearing orthodontic appliance from all social classes are included. The age was divided into two groups (less than 18 years old and more than 18 years old). Also, the duration of treatment ranged from less than 6 months to more than 6 months. Patients not undergoing orthodontic treatment and patients with advanced periodontitis as well as craniofacial deformities such as cleft lip and palate were excluded from the study.

Method for data collection, instrument and score system:

A structured questionnaire used as a study tool, to collect the data adopted from previous similar articles [3,9,13] , via Google forms which distributed to patients in waiting rooms in both private and public orthodontic clinics.

The questionnaire applied in the study included the following segments:

The 1st segment of the survey had an multiple of inquiries concerning the respondents' demographic

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data, such as age, length of orthodontic treatment, gender, and the patient's present oral health practices (such as brushing frequency and use of auxiliary tools).

In the 2nd part of the survey six questions about a person's knowledge of periodontal disease were included. Responses were provided as multiple choices, with only one correct answer. For these questions, a score of 0 was assigned for an incorrect response and a score of 1 for a correct answer. These assessments divided the periodontal health knowledge into three categories: low (average score 0-1), acceptable (average score 2-3), very good (average score 4-5), and outstanding (scoring 6).

As for the 3rd segment of the survey ten questions about the subjects' awareness of periodontal health (2ry outcome) were included. A response of "I don't know" was worth 0 points, while a response of "yes" or "no" was worth 1 point. The scores were used to calculate the awareness levels. Average scores for awareness are as follows: 5–10 for high awareness, 2-4 for moderate awareness, 0-1 for poor awareness

Lastly in the 4th and final section of the survey ten items about the subjects' attitudes regarding orthodontic treatment and periodontal health (2ry outcome) were included. Responses were scored as 0 if they were negative and as 1 if they were favorable. The scores were used to gauge the subject's attitude. Positive attitudes have an average score of 7–10, whereas negative attitudes have an average score of 0–6.

Data Analysis:

Descriptive statistics used to elaborate the dataset. Chi-square tests were employed to assess the differences comparing categorical variables for the awareness levels between age groups or gender. The Statistical Package for the Social Sciences (SPSS) software program used to analyze the data after they were entered into a personal computer using the Microsoft Excel program.

Results:

Table (1) displays various demographic parameters of the participants with a total number of (406). Participants have a mean age of 28 years, a majority of whom are between 19 to 25 years of age (42.9%), which demonstrates a likely smaller age gap (more than 17 years and less than 27 years) than most previous studies reported, and thus represents a younger demographic that may indicate a higher orthodontic treatment prevalence among this age group. It is likely that there is some skew towards females as 67.5% of the sample represents females. Most have obtained higher education (bachelor's degree 55.2% of the respondents), suggesting the possibility of association between high educational levels and awareness or access of orthodontic services. Additionally, the data reveals that 92.9 % of participants brush their teeth daily, and an even larger segment (47.5 %) of the population brush their teeth twice a day, implying the green light among participants of oral hygiene. Auxiliary aids were widely applied, 80.5% participants used additional oral hygiene devices, indicating an effort to protect oral health regardless of age in these cases including people with orthodontic treatments.

Table (1): Sociodemographic characteristics of participants (n=406)

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Parameter		No.	Percent (%)
Age (Mean:28.0, STD:11.0)	10 to 15 years	19	4.7
	15 to 18 years	29	7.1
	19 to 25	174	42.9
	26 to 29	81	20.0
	30 or more	103	25.4
Gender	Female	274	67.5
	Male	132	32.5
Residential region	Northern region	8	2.0
	Southern region	29	7.1
	Central region	141	34.7
	Eastern region	14	3.4
	Western region	214	52.7
Level of education	Middle school	11	2.7
	High school	50	12.3
	College student	100	24.6
	Bachelor	224	55.2
	Post-graduate student	21	5.2
Duration of orthodontic appliances use	Less than 6 months	92	22.7
	More than 6 months	314	77.3
Do you brush your teeth daily?	No	29	7.1
	Yes	377	92.9
How many times do you brush your teeth daily?	Once	99	24.4
	Twice	193	47.5
	Three or more times	68	16.7
	Irregularly	46	11.3
Type of toothbrush? *	Orthodontic brush	173	42.6
	Ordinary brush	252	62.1
Do you use any auxiliary aids for oral hygiene?	No	79	19.5
	Yes	327	80.5
What type of auxiliary aids you use? *	Dental floss	207	50.9
	Toothpick	60	14.8
	Mouthwash	191	47.0
	Water floss	29	7.1
	Interdental brush	199	49.0
	Others	5	1.2
	None	7	1.7
Do you clean your tongue?	No	102	25.1
	Yes	304	74.9

Results may overlap

As shown in figure 1, Trends in dental plaque awareness presented in the figure are insightful in the data presented for a sample of 406 individuals. In particular, the greater majority of 41.7 % (169 people) stated dental plaque as soft deposits on teeth, which shows quite a high level of knowledge. Conversely

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26.4% (107 individuals) portrayed hard deposits which means there is less understanding with respect to this issue of dental plaque. Some awareness, however, of some sort was shown with a notable 10.8% (44 individuals) noting staining on teeth as a component of plaque. Additionally, 21.2 per cent (86 people) claimed to have no knowledge at all.

Figure (1): Illustrates dental plaque among participants.

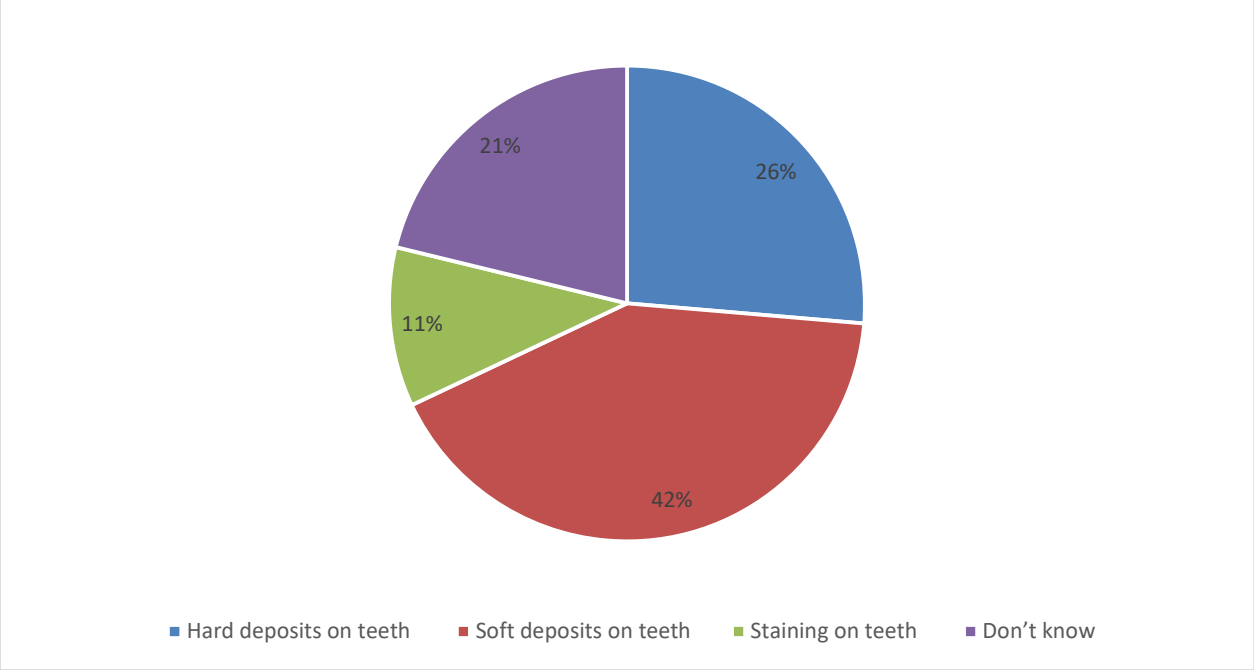

Table 2 displays data of orthodontic patients' knowledge about oral hygiene protocol and periodontal health. The results show a big variance in the level of awareness with a sample size of 406. Almost half

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were right: Nearly 41.6 percent got the answer right that dental plaque is soft deposits on teeth, while a worrying 21.2 percent were unsure. In addition, the link to gum disease makes dental plaque a potential health issue for nearly half (49.3%) of Americans who identify it as such. Even more worryingly perhaps, whereas 82.5 per cent of participants admitted that brushing and flossing daily was important in preventing the disease, a large section of participants was unaware of key aspects such as the signs of gum inflammation.

Table (2): Parameters related to knowledge about oral hygiene protocols and periodontal health among orthodontic patients (n=406).

Parameter		***No.***	***Percent (%)***
What is dental plaque?	Hard deposits on teeth	107	26.4
	Soft deposits on teeth	169	41.6
	Staining on teeth	44	10.8
	Don't know	86	21.2
How can dental plaque harm oral health?	Discoloration of teeth	115	28.3
	Gum disease	200	49.3
	Malformation of teeth	44	10.8
	Don't know	47	11.6
What can gum bleeding indicate?	Gum recession	22	5.4
	Healthy gums	11	2.7
	Inflamed gums	352	86.7
	All above	2	.5
	Don't know	19	4.7
How can you prevent gum disease?	By brushing and flossing	335	82.5
	By having a soft diet	26	6.4
	By taking vitamin C only	11	2.7
	Don't know	34	8.4
What is the principal cause of bad breath?	Eating onion/garlic	16	3.9
	Lung disease	4	1.0
	Poor oral hygiene	373	91.9
	Smoking	13	3.2
What is the outcome of progressed gum disease?	Bad breath	86	21.2
	Red gums	76	18.7
	Tooth mobility	168	41.4
	Don't know	76	18.7

As shown in figure (2), The sample of 406 individuals who had the data obtained from their progress on their gum disease reveals important information regarding mechanisms of how hard it is to get rid of the pocket producing periodontal disease. Bad breath was suffered by 86 participants, or a major 21.2% of the sample. Additionally, 76 people, or 18.7%, identified red gums. The alarming part is that it involved incidence of tooth mobility, which 168 respondents reported and formed 41.4% of the respondents. In addition, 76 people (18.7%) reported uncertainty about their symptoms.

Figure (2): Illustrates the outcome of progressed gum disease among participants.

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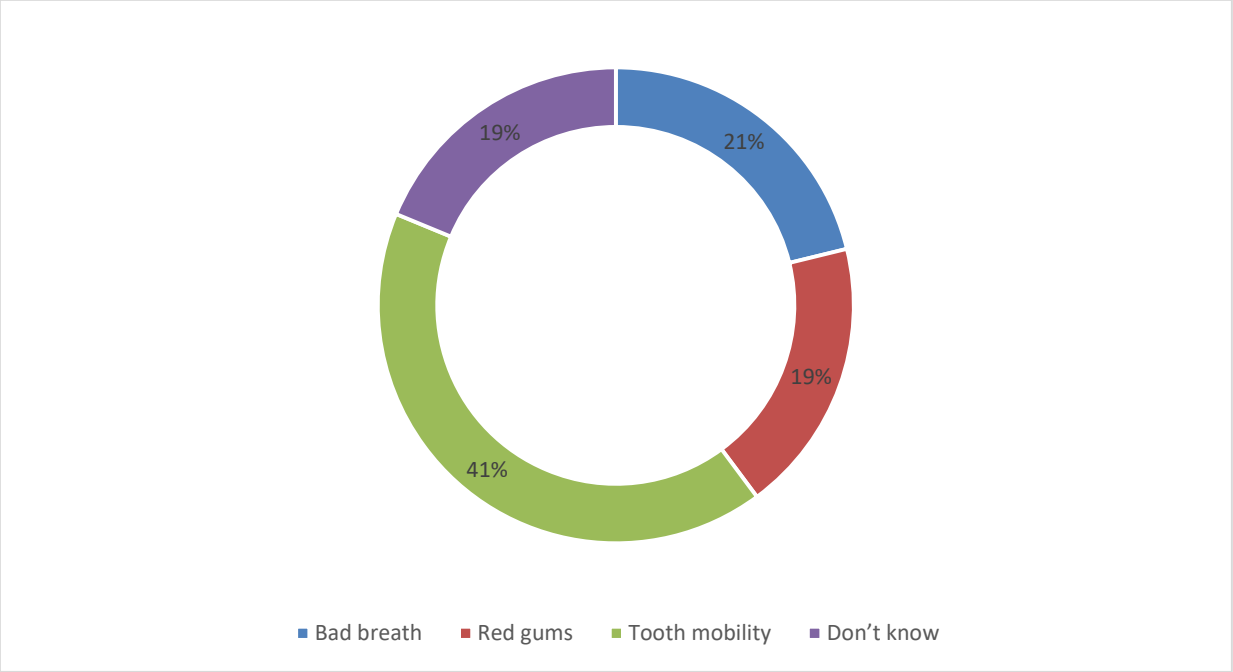

In table 3 (which evaluates awareness of the oral hygiene protocols and periodontal health of a large cohort of 406 orthodontic patients), several critical aspects of these patients' periodontal status can be illuminated. Notably, 63.1% of participants reported no plaque while only 22.2% of those who believed they had plaque (plus the 14.8% 'not sure') indicates a need for more educational interventions. Already, 61.1% state having no dental calculus and 20.7% stating they have and 18.2% being uncertain due to the awareness gaps created is a combined figure that is expected to lead to a compromised long term oral health. The high proportion of those reporting no gum recession (67.0%), and minimal bleeding (75.4%) are laudable, yet the high percentages of affirmative responses to stains, periodontal pockets and oral discomfort are cause for immediate concern.

Table (3): participants' awareness about oral hygiene protocols and periodontal health among orthodontic patients (n=406).

Parameter		***No.***	***Percent (%)***
1) Do your teeth have dental plaque?	No	256	63.1
	Yes	90	22.2
	Don't Know	60	14.8
2) Do your teeth have dental calculus?	No	248	61.1
	Yes	84	20.7
	Don't Know	74	18.2
3) Do you have stains on your teeth?	No	233	57.4
	Yes	136	33.5
	Don't Know	37	9.1
4) Do your gums show recession?	No	272	67.0
	Yes	85	20.9
	Don't Know	49	12.1

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5) Do you suffer from periodontal pockets?	No	270	66.5
	Yes	37	9.1
	Don't Know	99	24.4
6) Do you have bad breath?	No	318	78.3
	Yes	51	12.6
	Don't Know	37	9.1
7) Do you have pain from gums?	No	346	85.2
	Yes	53	13.1
	Don't Know	7	1.7
8) Do you have gums enlargement?	No	362	89.2
	Yes	30	7.4
	Don't Know	14	3.4
9) Do you have bleeding from your gums?	No	306	75.4
	Yes	92	22.7
	Don't Know	8	2.0
10) Do you suffer from gingival irritation?	No	329	81.0
	Yes	54	13.3
	Don't Know	23	5.7

Table 4 provides an interesting data that shed light on the attitudes of the orthodontic patients towards the oral hygiene protocols and periodontal health (406 participants). But a 76.8% of respondents confessed that orthodontic appliances are prone to plaque accumulation, which causes a major concern for the practitioners as well as the patients. Also, an overwhelming 89.7 percent responded that, as new orthodontic brackets are added, the process of brushing becomes much more difficult, underscoring the importance to provide more targeted oral hygiene education to the patient that is receiving orthodontic care. Of particular significance is that 74.9 per cent of patients hold the opinion that fixed orthodontic appliances may trigger the aetiology of periodontal disease, stressing the need for monitoring and intervention prior and during treatment. Respondents also showed knowledge in preventive measures: 90.1% believed that gum disease is most preventable and 83.7% agree with the importance of regular dental visits to maintain oral health.

Table (4): participants' attitude about oral hygiene protocols and periodontal health among orthodontic patients (n=406).

Parameter		***No.***	***Percent (%)***
1) Does the orthodontic appliance increase plaque accumulation?	No	94	23.2
	Yes	312	76.8
2) Does the orthodontic brackets make brushing more difficult?	No	42	10.3
	Yes	364	89.7
3) Can the fixed orthodontic appliance initiate periodontal diseases?	No	102	25.1
	Yes	304	74.9
4) Can a fixed orthodontic appliance cause mild pain?	No	60	14.8
	Yes	346	85.2
5) Is gum disease mostly preventable?	No	40	9.9
	Yes	366	90.1
6) Can regular dental visits prevent gum diseases?	No	66	16.3

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	Yes	340	83.7
7) Is it important to follow the clinician's oral hygiene instructions?	No	23	5.7
	Yes	383	94.3
8) Do you follow the clinician's oral hygiene instructions?	No	46	11.3
	Yes	360	88.7
9) Do you think bad oral hygiene affects your general health?	No	43	10.6
	Yes	363	89.4
10) Are straight teeth easier to clean?	No	36	8.9
	Yes	370	91.1

Table 5 shows the distribution of knowledge levels concerning the oral hygiene protocol and periodontal health among orthodontic patients. Of the 406 respondents, 42.9% had very good knowledge about these important health practices and this is commendable. In addition, 18 percent were outstandingly knowledgeable, a lesser but major category showing extensive knowledge. However, acceptable understanding of oral health principles was obtained from 36.7%. Interestingly, we found that 2.5% displayed low knowledge.

Table (5): Shows knowledge about oral hygiene protocols and periodontal health among orthodontic patients score results.

	Frequency	**Percent**
Outstanding knowledge	73	18.0
Very good knowledge	174	42.9
Acceptable knowledge	149	36.7
Low knowledge	10	2.5
Total	406	100.0

The contents of Table 6 show the level of awareness of orthodontic patients regarding oral hygiene protocols and periodontal health. Only 11.1% of the 406 participants had high awareness, a small percentage that understood all components. Moderate awareness, that is, partial knowledge that needs reinforcement, was reported by a massive 30.8%. Unsurprisingly, 58.1% were poor aware.

Table (6): Shows awareness about oral hygiene protocols and periodontal health among orthodontic patients score results.

	Frequency	**Percent**
High awareness	45	11.1
Moderate awareness	125	30.8
Poor awareness	236	58.1
Total	406	100.0

Table 7 shows the attitude of orthodontic patients on oral hygiene protocols and periodontal health. It was found that 90.1% of the participants had an attitude that was positive towards the recognition of the need to keep good oral hygiene and periodontal care. It seems that this is a good basis for making adherence to oral health practices easier. But 9.9 percent of respondents had negative attitudes.

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Table (7): Shows attitude about oral hygiene protocols and periodontal health among orthodontic patients score results.

	Frequency	**Percent**
Positive attitudes	366	90.1
Negative attitudes	40	9.9
Total	406	100.0

Table (8) shows that knowledge about oral hygiene protocols and periodontal health has statistically significant relation to age (P value=0.0001), educational level (P value=0.0001), duration of orthodontic appliance use (P value=0.015). It also shows statistically insignificant relation to sex, residential region, and whether participants are brushing teeth daily.

Table (8): Relation between knowledge about oral hygiene protocols and periodontal health and sociodemographic characteristics.

Parameters		***Knowledge level***		***Total (N=406)***	***P value****
		Acceptable or low knowledge	**Outstanding or very good**		
Age	18 or less	30	18	48	0.0001
		18.9%	7.3%	11.8%	
	More than 18	129	229	358	
		81.1%	92.7%	88.2%	
Sex	Female	100	174	274	0.113
		62.9%	70.4%	67.5%	
	Male	59	73	132	
		37.1%	29.6%	32.5%	
Residential region	Northern region	3	5	8	0.268
		1.9%	2.0%	2.0%	
	Southern region	14	15	29	
		8.8%	6.1%	7.1%	
	Central region	63	78	141	
		39.6%	31.6%	34.7%	
	Eastern region	6	8	14	
		3.8%	3.2%	3.4%	
	Western region	73	141	214	
		45.9%	57.1%	52.7%	
Educational level	Middle school	7	4	11	0.0001
		4.4%	1.6%	2.7%	
	High school	31	19	50	
		19.5%	7.7%	12.3%	
	College student	42	58	100	
		26.4%	23.5%	24.6%	
	Bachelor	76	148	224	
		47.8%	59.9%	55.2%	

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	Post-graduate student	3	18	21	
		1.9%	7.3%	5.2%	
Duration of orthodontic appliances use	Less than 6 months	46	46	92	0.015
		28.9%	18.6%	22.7%	
	More than 6 months	113	201	314	
		71.1%	81.4%	77.3%	
Do you brush your teeth daily?	No	12	17	29	0.800
		7.5%	6.9%	7.1%	
	Yes	147	230	377	
		92.5%	93.1%	92.9%	

P value was considered significant if ≤ 0.05.

Table (9) shows that awareness about oral hygiene protocols and periodontal health has statistically significant relation to sex (P value=0.037), residential region (P value=0.020), duration of orthodontic appliance use (P value=0.012). It also shows statistically insignificant relation to age, educational level, and whether participants are brushing teeth daily.

Table (9): Awareness about oral hygiene protocols and periodontal health in association with sociodemographic characteristics.

Parameters		***Awareness level***		***Total (N=406)***	***P value****
		High or moderate awareness	**Poor awareness**		
Age	18 or less	21	27	48	0.779
		12.4%	11.4%	11.8%	
	More than 18	149	209	358	
		87.6%	88.6%	88.2%	
Sex	Female	105	169	274	0.037
		61.8%	71.6%	67.5%	
	Male	65	67	132	
		38.2%	28.4%	32.5%	
Residential region	Northern region	6	2	8	0.020
		3.5%	0.8%	2.0%	
	Southern region	18	11	29	
		10.6%	4.7%	7.1%	
	Central region	58	83	141	
		34.1%	35.2%	34.7%	
	Eastern region	8	6	14	
		4.7%	2.5%	3.4%	
	Western region	80	134	214	
		47.1%	56.8%	52.7%	
Educational level	Middle school	6	5	11	0.256
		3.5%	2.1%	2.7%	
	High school	21	29	50	

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		12.4%	12.3%	12.3%	
	College student	33	67	100	
		19.4%	28.4%	24.6%	
	Bachelor	102	122	224	
		60.0%	51.7%	55.2%	
	Post-graduate student	8	13	21	
		4.7%	5.5%	5.2%	
Duration of orthodontic appliances use	Less than 6 months	49	43	92	0.012
		28.8%	18.2%	22.7%	
	More than 6 months	121	193	314	
		71.2%	81.8%	77.3%	
Do you brush your teeth daily?	No	17	12	29	0.058
		10.0%	5.1%	7.1%	
	Yes	153	224	377	
		90.0%	94.9%	92.9%	

****P value was considered significant if ≤ 0.05.***

Table (10) shows that knowledge about oral hygiene protocols and periodontal health has statistically significant relation to age (P value=0.0001), sex (P value=0.033), and educational level (P value=0.032). It also shows statistically insignificant relation to residential region, duration of orthodontic appliance use, and whether participants are brushing teeth daily.

Table (10): Attitude about oral hygiene protocols and periodontal health in association with sociodemographic characteristics.

Parameters		***Attitude level***		***Total (N=406)***	***P value****
		Negative attitudes	***Positive attitudes***		
Age	18 or less	12	36	48	0.0001
		30.0%	9.8%	11.8%	
	More than 18	28	330	358	
		70.0%	90.2%	88.2%	
Sex	Female	21	253	274	0.033
		52.5%	69.1%	67.5%	
	Male	19	113	132	
		47.5%	30.9%	32.5%	
Residential region	Northern region	0	8	8	0.584
		0.0%	2.2%	2.0%	
	Southern region	3	26	29	
		7.5%	7.1%	7.1%	
	Central region	18	123	141	
		45.0%	33.6%	34.7%	
	Eastern region	1	13	14	
		2.5%	3.6%	3.4%	
	Western region	18	196	214	

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		45.0%	53.6%	52.7%	
Educational level	Middle school	4	7	11	0.032
		10.0%	1.9%	2.7%	
	High school	7	43	50	
		17.5%	11.7%	12.3%	
	College student	9	91	100	
		22.5%	24.9%	24.6%	
	Bachelor	18	206	224	
		45.0%	56.3%	55.2%	
	Post-graduate student	2	19	21	
		5.0%	5.2%	5.2%	
Duration of orthodontic appliances use	Less than 6 months	10	82	92	0.710
		25.0%	22.4%	22.7%	
	More than 6 months	30	284	314	
		75.0%	77.6%	77.3%	
Do you brush your teeth daily?	No	2	27	29	0.579
		5.0%	7.4%	7.1%	
	Yes	38	339	377	
		95.0%	92.6%	92.9%	

P value was considered significant if ≤ 0.05.

Discussion:

The objective of the present study was to examine study design of knowledge about oral hygiene protocols and periodontal health among orthodontic patients in the western province of Saudi Arabia. It provides important insights into the awareness and practice of these patients and the urgent need for better educational interventions. Results showed that a large majority of the participants claimed to practice daily brushing of the teeth and auxiliary dental hygiene devices use, but that there is a worrying gap in their knowledge about dental plaque and its effects on periodontal health. In this discussion, we will carefully contrast these findings with existing literature and explain this under the broad picture of the awareness on oral hygiene amongst orthodontic patients.

The demographic profile of our study participants (predominantly young adults in whom a greater than expected proportion of females was represented) corresponds with the findings of other reports of increased prevalence of orthodontic treatment in younger populations. For example, in the longitudinal evaluation of oral health in orthodontic patient, Abozaid and Amer [14] had reported similar trend, where fixed appliances pose a challenge in maintaining optimal oral hygiene. The finding of this study that 92.9 percent of the respondents practice daily tooth brushing accords with Ajayi's research which also shows that orthodontic patients are highly tooth brushing [15]. Nevertheless, the current study's discovery that only 41.7% could accurately define dental plaque as soft deposits is a very crucial point that should be addressed to improve in patient education, as also indicated by Mahjoub et al., who found that orthodontic patients in Makkah are not aware in terms of oral hygiene as mentioned by other studies [16].

Results of the study indicate that while most of the participants were aware of the health related to plaque, and (for example) the link between plaque and gum disease, a worrying 21.2% simply did not know what plaque is. This is consistent with work by Li et al. who found that orthodontic patients

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commonly struggle in understanding the nature of dental biofilm and their management [17]. Moreover it observed the current study in which 74.9% of patients who were connected with the fixed appliances had the increased risk of periodontal disease, pointing out that the awareness of the possible disadvantages in orthodontic treatment is growing. Haider et al. corroborate this, stating that patients who receive orthodontic treatment need more periodontal interaction than usual because plaque materials accumulate deeper probing and as a result [18].

Additionally, in agreement with previous studies, the participants confirm that in addition to brushing becoming more and more difficult with each additional orthodontic bracket, it requires increased effort. Specifically, Anuwongnukroh et al. pointed out that fixed appliances pose a particular challenge in keeping oral hygiene, with resulting higher plaque accumulation and the potential for periodontal problems [19]. The finding of current study that 90.1% of participants recognized the preventability of gum disease reinforces the need for continuous education and reinforcement of good oral hygiene practices, which has been highlighted by the studies of Pinto et al., that emphasized the need for regular monitoring and adjustment to oral care routines during orthodontic treatment [20].

The study presented a statistical analysis, which suggests significant correlations between oral hygiene knowledge with variables of age, educational level and duration of orthodontic appliance use. This finding is in accordance with the research of Tadin who highlighted demographic factors as key factors that influence oral hygiene behavior in adult orthodontic patients [21]. Results from the current study, found that 11.1% of participants had high awareness of oral hygiene protocols, indicate an urgent call for targeted educational endeavors that aim to fill the identified knowledge gap in specific demographic groups. This is consistent with the conclusion presented by Cantekin et al. who recommended that comprehensive educational programs be developed to educate orthodontic patients on oral hygiene practice [22].

Although we observed relatively positive views to oral health in the study, with 90.1 % of subjects reporting positive beliefs concerning good oral hygiene practices, the results suggested that a substantial part of population lacks the needed knowledge about proper oral hygiene routines. In the investigation of attitudes and knowledge by Buthelezi and Madiba, it was pointed out that many orthodontic patients find it difficult to shift their positive attitude to effective oral hygiene behaviors [23]. The finding in the current study supporting an obligatory involvement of the orthodontist in spreading oral hygiene education strengthens the necessity of the orthodontist to take the responsibility to educate patients about proper oral hygiene measures concurred by Khurshid et al. [24].

Additional limitations of the present study must be mentioned. Self-reported data may also introduce bias, as participants may underestimate or overestimate their oral hygiene practices. Moreover, since the design is cross sectional, no causal relationships can be drawn between the knowledge and oral hygiene practices. Future longitudinal studies are needed to determine the long term effect of educational intervention on oral hygiene behaviour on patient orthodontic patients. Additionally, due to the focus of the study in a limited area, the applicability of these findings to other populations may be limited.

Conclusion:

The findings of the present study serve to illuminate the knowledge of oral hygiene protocol and periodontal health on Saudi orthodontic patients. However, the findings suggest a pro-active approach to mouth hygiene, but so many knowledge and awareness gaps remain. These results emphasize how urgently orthodontic patients require targeted educational interventions to overcome understanding of the consequences of plaque accumulation and understanding how to ensure good oral hygiene practice. Enhanced understanding provides an orthodontic patient the ability to better manage the periodontal

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component of the oral cavity during treatment resulting in increased success of orthodontic intervention.

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Ethical approval:
An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

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The authors declare no conflict of interest.

Informed consent:
Written informed consent was acquired from each individual study participant.

Data and materials availability:
All data associated with this study are present in the paper.

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