

Original article

Evaluating the Role of Early Orthodontic Intervention in Optimal Oral Health

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Email. mi.alsh849@su.edu.ly**Abstract**

This study was conducted to prevent complications during orthodontic treatment; it is imperative that the patient has good oral hygiene. This study aimed to assess oral health status, oral hygiene practices, and motivation among patients receiving interceptive orthodontic treatment. The study was a cross-sectional study among 250 orthodontic patients at a private dental clinic, employing a self-reported questionnaire and clinical observation. The questionnaire was designed to collect information about oral health status and whether patients included their mouths while performing the necessary tasks to establish their oral hygiene practices. To assess self-perceived oral health, a 10-point scale was employed. Data were analyzed using descriptive statistics and logistic regression to identify factors associated with perceived benefit of treatment. More than 70% (70.8%) of patients reported oral health as "Excellent" or "Very good," yet clinical examination found a high prevalence of food debris (46.4%), dental caries (43.6%), and halitosis (37.6%). Although 48.8% of patients brushed their teeth twice a day, it was alarming to see preventive oral hygiene practices with less than 40% of patients using any additional preventive methods; only 32.6% of patients indicated that they used fluoride toothpaste, while dental floss and mouthwash were reported at 36.8% and 41.2%, respectively (with only 12.8% using mouthwash every day). The primary motivation for interceptive treatment was for esthetic improvement (63.6%). The regression analysis suggested that patients' self-rated oral health status is the only significant predictor of perceived benefit of treatment (OR: 1.43, $p < 0.001$). This study highlights an important disparity between patient perception and true oral health status during orthodontic treatment. The findings highlight the need for more in-depth and ongoing motivational patient education that entails more than just brushing frequency, but also demonstrates proper brushing technique, fluoride use, and consistent interdental cleaning to achieve successful treatment and long-term oral health.

Keywords: Orthodontics, Oral Hygiene, Oral Health, Early Intervention, Oral Health Disparity.

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Introduction

Orthodontics and dentofacial orthopedics are "the branch of dentistry which focuses on the prevention, detection, and treatment of malocclusion, as well as skeletal and neuromuscular abnormalities in developing or mature dentofacial structures." Orthodontic therapy, whether based on a professional evaluation or the patient's own opinion, improves children's self-esteem and dental health-related quality of life [1]. According to the World Health Organization, good oral health refers to the condition of the oral cavity and its supportive tissues, which are characterized by no periodontitis, no gingival bleeding, no xerostomia, no tooth loss, and no other oral problems [2]. In recent years, the number of patients seeking orthodontic treatment has increased significantly, which may be related to a different viewpoint in the last 20 years [3].

To avoid caries and periodontal diseases during orthodontic treatment, effective oral hygiene should be maintained since it deteriorates in 40%-60% of patients [4,5], and inadequate oral hygiene is responsible for 5%-10% of the failures of orthodontic treatments [6]. Mechanical cleaning in orthodontic patients is strongly recommended to support effective plaque control by toothbrushes and adjunctive dental products such as dental floss, single-tufted brushes, interdental brushes, and mouthwash [7]. Interproximal plaque removal is exceptionally important, and dental floss is essential for this purpose, as well as for gingival health. A revealing agent used to stain the dental deposits is another potential option for assessing the effectiveness of the tooth cleaning process [8,9]. The American Association of Orthodontists recommends that children consult an orthodontic specialist for their first assessment as soon as an orthodontic problem is discovered, but no later than age 7 [10].

In Saudi Arabia, a study discovered that a variety of factors influence parents' decisions to seek orthodontic treatment for their children, including the desire to improve facial aesthetics, the perceived availability of orthodontic specialists, and treatment costs. Adults seek these treatments for a number of reasons, including professional and social ones. Patients undergoing fixed orthodontic treatment frequently anticipate increased self-confidence, improved dental health, and aesthetic and functional benefits. These anticipated advantages highlight the extensive impact that orthodontic therapy can have on patients [11]. Some patients may have discomfort in the form of tooth and gum sensitivity and pain, which often lasts for several months to years. The type of appliance used, the force used during the first phase of treatment, prior pain experiences, and other emotional, cognitive, and environmental aspects like culture, gender, and age are some of the elements that contribute to orthodontic patients' discomfort. During treatment, patients may also experience changing social interactions, changes to speech, difficulty performing oral hygiene, and dietary restrictions [12,13].

Understanding these barriers is crucial to improving oral health services and potentially enhancing oral hygiene and treatment outcomes throughout the province. This study provides relevant insight into the ways that orthodontic treatment will affect dental health practices. Orthodontic appliances may hinder proper tooth cleaning and make oral hygiene difficult to uphold for individuals who receive fixed orthodontic treatment. Daily and thorough oral hygiene is essential to limiting gum irritation, tooth decalcification, and plaque build-up [14-16]. Many studies have been conducted around the world to examine orthodontic patients' oral health knowledge, status, and hygiene practice, [5,16]. While there are numerous studies on oral health knowledge and preventive measures in adults and adolescents, there are fewer studies in children to investigate the factors influencing their decision to undergo treatment, the unpleasant aspects of orthodontic treatment, and the evaluation of oral health and oral hygiene practices in these patients. As a result, the objective of this study was to determine the reasons for orthodontic treatment decisions. Additionally, it investigates the drawbacks of fixed orthodontic treatments as well as the expectations of the patients.

Methods

Study Design and setting

This cross-sectional study was carried out in a private dental clinic with a convenience sample. Data was gathered using a survey.

Study population

Patients aged 6 to 12 years who had received permanent orthodontic therapy for at least three months were eligible to take part in the trial. Patients with mental or physical disabilities, chronically ill patients, patients with dentofacial deformities such as cleft palate, patients who are or have been treated with a non-fixed appliance, and patients who did not complete the questionnaire were also excluded. The questionnaire was completed by a total of 250 participants.

All children who fulfilled the inclusion requirements and were enrolled in a private dental clinic through a convenience sample were asked to fill out an anonymous self-administered questionnaire at their dental visit. The purpose of this study was to inform participants before they completed the questionnaire.

Data collection

A questionnaire developed from multiple surveys with a common thematic focus was used to gather data for this investigation [2,16]. The questionnaire consisted of seven sections, beginning with the first part, which collected sociodemographic information from respondents, such as gender, age and socioeconomic status. The second part included questions about self-assessment of personal oral health and hygiene, knowledge of oral health and hygiene, sources of oral health information, attitudes towards the importance of oral health, and the duration of orthodontic therapy and its impact on oral hygiene maintenance. The third part addressed respondents' self-reported oral issues, such as plaque, dental calculus, food debris, bleeding gums, and dentin hypersensitivity. The fourth part had questions about oral hygiene procedures. These included questions about how often oral hygiene aids were used, the preferred toothbrush hardness, the time between toothbrush replacements, and the type of toothbrush used.

The fifth part included ten questions about various aspects influencing orthodontic therapy, such as aesthetics, teeth straightening, and improved oral function. The sixth segment comprised 19 questions about the negative components of orthodontic treatments, such as discomfort, therapy duration, nutrition difficulties, and dental hygiene maintenance. The final segment included questions about expectations for orthodontic treatment. To evaluate the validity and reliability of the questionnaire, a pilot study was carried out with 25 participants. To ensure the accuracy and dependability of the questionnaire items for the primary study, modifications were made to make them more understandable and clearer, considering the comments and findings from the pilot survey. Participants in the pilot study were asked to assess Cronbach's alpha coefficient for internal consistency for this questionnaire; the results showed an acceptable reliability of 0.765.

Statistical analysis

The data obtained were analyzed using SPSS Statistics Version 28.0. Descriptive statistics (means, standard deviations, and frequencies) were calculated first to summarize the demographic characteristics and the primary outcome variables for the whole sample. A Chi-square test was used to compare the two groups. Controlled multiple linear regression analysis was then conducted to determine the independent effect of early orthodontic intervention while controlling for possible intervening variables (sugar intake frequency, oral hygiene practices, and socioeconomic status). Any statistical analysis with a p-value of less than 0.05 was considered statistically significant.

Results

The study was predominantly girls (80.5%) and young, with a mean age of 7.78 years, indicating a sample largely composed of children undergoing early orthodontic treatment. Most participants were from an average socioeconomic background

(86.0%). Most participants, 144 (57.6%), underwent orthodontic therapy for a relatively short duration of 3 to 12 months.

Table 1. Sociodemographic Characteristics of Orthodontic Patients (N = 250)

Characteristic	N (%)
Gender	
Girl	201 (80.5)
Boy	49 (19.5)
Age (years)	
Min – Max	6 – 12
Mean $\pm$ SD	7.78 $\pm$ 2.54
Socioeconomic status	
Below average	9 (3.6)
Average	215 (86.0)
Above average	26 (10.4)
Orthodontic Method	
Fixed bracket treatment	159 (63.6)
Aligner treatment	91 (36.4)
Duration of orthodontic therapy (months)	
3–12	144 (57.6)
13–24	67 (26.8)
>24	39 (15.6)

Table (2) revealed that a significant proportion (63.6%) reported experiencing difficulties with oral hygiene maintenance during their treatment. Concerning education, 83.2% indicated that they had received education on oral health and hygiene, and 158 63.2% expressed interest in further education on the topic. When evaluating their own knowledge and status, participants generally held positive self-assessments. Nearly half (48.8%) rated their oral hygiene knowledge as "Very good," and 45.6% rated their overall oral health status as "Very good." Their self-assessment of their actual oral hygiene practices was also favorable, with 44.0% rating it as "Very good" and 30.0% as "Excellent."

Table 2. Participant Characteristics and Self-Reported Orthodontic Experiences

Characteristic	N (%)
Impact of orthodontic treatment on oral hygiene maintenance	
Difficulties	159 (63.6)
No difficulties	91 (36.4)
Educated on dental health and hygiene	
Yes	208 (83.2)
No	42 (16.8)
Interested in learning more about oral health and hygiene.	
Yes	158 (63.2)
No	92 (36.8)
Self-assessment of dental hygiene knowledge	
Excellent	63 (25.2)
Very good	122 (48.8)
Moderate	58 (23.2)
Poor	7 (2.8)
Self-assessment of oral health status	
Excellent	63 (25.2)
Very good	114 (45.6)
Moderate	65 (26.0)
Poor	8 (3.2)
Self-assessment of oral hygiene	
Excellent	75 (30.0)

Very good	110 (44.0)
Moderate	63 (25.2)
Poor	2 (0.8)

Table (3) revealed that the most frequently observed condition was the presence of food debris between teeth, noted in 116 patients (46.4%). This was closely followed by the presence of dental caries, which was found in 109 patients (43.6%). Halitosis and pain with cold drinks and food were also common, observed in 94 patients (37.6%). A substantial number of patients exhibited signs of xerostomia, with dry mouth observed in 62 patients (24.8%), and difficulties related to chewing reported in 64 patients (25.6%). Alterations in dental color were noted in 77 patients (30.8%). While gingival swelling was present in 51 patients (20.4%), overt gum inflammation was less common, observed in only 19 patients (7.6%). Less prevalent conditions included burning mouth sensation, which was found in only 2.8%, and oral fungal infections, which were present in 34 patients (13.6%).

Table 3. Oral status assessment observational checklist among Orthodontic Patients (N = 250)

Oral status assessment observational checklist	No. (%)
Gingival swelling	51 (20.4)
Dry mouth	62(24.8)
Burning mouth	7 (2.8)
Presence of Halitosis	94 (37.6)
Change in dental color	77 (30.8)
Gum inflammation	19 (7.6)
Gum bleeding	48 (19.2)
Difficulties related to chewing	64 (25.6)
Presence of dental Caries	109 (43.6)
Presence of oral fungal infection	34 (13.6)
Presence of pain with hot drinks and food	49 (19.6)
Presence of pain with cold drinks and food	94 (37.6)
Food debris between teeth	116 (46.4)

Table (4) reported oral self-care practices among the study participants. Most participants reported brushing their teeth at least once a day, with nearly half (48.8%) adhering to the recommended twice-daily frequency. Furthermore, a high proportion reported using correct techniques, with 80.4% using a gentle, circular motion and 82.8% using a soft-bristled toothbrush. The use of supplementary cleaning tools, such as interdental brushes or floss, was reported by just over half of the participants (54.0%). Only 56.4% of participants had received formal instructions on brushing technique, and a minority used fluoridated toothpaste (32.6%). Toothbrush replacement habits were suboptimal, with 45.2% changing it only occasionally and 16.4% doing so just once a year. While most participants avoided frequent snacking on sugary foods (54.0%) and consumption of acidic drinks (56.4%), a substantial number still engaged in these caries-risk behaviors. Notably, over half of the participants (61.6%) did not visit a dentist more than once a year, and nearly a third (31.6%) experienced bleeding gums during brushing, suggesting a high prevalence of underlying gingival inflammation.

Table 4. The Oral self-care status among Orthodontic Patients (N = 250)

Oral self-care status	Study participants	
	No.	%
How many times, in a day, do you wash your teeth?		
Never	13	5.2
Once	94	37.6
Twice	122	48.8
Don't know	21	8.4
Experience of receiving dental instructions for careful brushing technique		
Yes	141	56.4
No	109	43.6
Amount of toothpaste used		

Pea size	116	46.4
Half the length of toothpaste	49	19.6
Entire length of toothpaste	85	34.0
Do you use a gentle, circular motion to brush your teeth and gums?		
Yes	201	80.4
No	49	19.6
Do you brush your teeth with soft bristles?		
Yes	207	82.8
No	43	17.2
How often do you Change your toothbrush?		
Every 3 month	96	38.4
Every year	41	16.4
Occasionally	113	45.2
The use of fluoridated paste		
No	169	67.6
Yes	81	32.6
Do you use mouthwash?		
Yes	103	41.2
No	147	58.8
How long did you use mouth wash?		
Rarely	139	55.6
Intermittently	79	31.6
Regularly	32	12.8
Dental visits more than once a year?		
Yes	96	38.4
No	154	61.6
Use of supplementary tool (e.g interdental brush or dental floss)		
Yes	135	54.0
No	115	46.0
Frequent snacking on sugary and/or sticky snacks		
Yes	115	46.0
No	135	54.0
Do you consume acidic foods and drinks?		
Yes	109	43.6
No	141	56.4
Do you smoke cigarettes or use other tobacco products?		
Yes	53	21.2
No	197	78.8
Bleeding gums during tooth brushing		
Yes	79	31.6
No	171	68.4

The assessment of perceived benefits following orthodontic therapy revealed that the Cosmetic improvements were regarded as the most significant benefit, with a substantial majority of participants (79.2%) rating them as 'Extremely' or 'Very Beneficial'. Improvement of function and enhanced self-confidence were also highly valued, cited as major benefits by 64.0% and 55.6% of participants, respectively.

Notably, health-oriented benefits were also considered important. Addressing tooth crowding and spacing to improve oral health was perceived as a major benefit by 53.6% of participants, and a total of 84.8% found it to be at least 'Somewhat

Beneficial'. Similarly, oral hygiene management was seen as a major benefit by 56.0% of participants, with a high cumulative percentage (84.8%) acknowledging at least some level of benefit.

In contrast, functional and socially driven outcomes such as speech improvement, social reasons, prosthodontic indications, and the alleviation of TMJ pain were perceived as markedly less beneficial. For these categories, the highest proportions of participants consistently fell into the 'Not at All Beneficial' response, particularly for TMJ pain (58.8%) and social reasons (35.6%).

Table 5. Perceived benefits for orthodontic therapy among participants (n=250)

Characteristic	Extremely Beneficial	Very Beneficial	Somewhat Beneficial	Slightly Beneficial	Not at All Beneficial
Cosmetic improvements	159 (63.6%)	39 (15.6%)	31 (12.4%)	10 (4.0%)	11 (4.4%)
Improvement of function	124 (49.6%)	36 (14.4%)	45 (18.0%)	15 (6.0%)	30 (12.0%)
Improved self-confidence	107 (42.8%)	32 (12.8%)	52 (20.8%)	20 (8.0%)	39 (15.6%)
Improve oral health by addressing tooth crowding and spacing issues.	99 (39.6%)	35 (14.0%)	46 (18.4%)	22 (8.8%)	48 (19.2%)
Oral hygiene management.	76 (30.4%)	64 (25.6%)	72 (28.8%)	15 (6.0%)	23 (9.2%)
Speech Improvement	73 (29.2%)	49 (19.6%)	55 (22.0%)	20 (8.0%)	53 (21.2%)
Social reasons	39 (15.6%)	18 (7.2%)	58 (23.2%)	46 (18.4%)	89 (35.6%)
Prosthodontic Indications	38 (15.2%)	33 (13.2%)	66 (26.4%)	35 (14.0%)	78 (31.2%)
TMJ Pain	30 (12.0%)	28 (11.2%)	57 (22.8%)	31 (12.4%)	104 (41.6%)
Cosmetic improvements	9 (3.6%)	11 (4.4%)	42 (16.8%)	41 (16.4%)	147 (58.8%)

The analysis of patient agreement with negative characteristics associated with fixed orthodontic appliances revealed several prominent concerns. The most commonly agreed-upon negatives were pragmatic and immediate side effects. The long Duration of treatment was the top concern, agreed to by nearly half of the participants (49.2%). This was closely followed by issues such as Mouth ulcers (44.8%), challenges in Maintaining oral hygiene (44.0%), and negative impacts on cosmetic (45.2%). Costs (42.4%) and Chewing difficulty (40.4%) were also significant concerns for a large portion of the cohort. Pain was a notable issue, with 31.6% of participants in agreement, and a substantial proportion (37.6%) remaining neutral.

In contrast, most participants disagreed that they experienced more severe or specific oral health complications. Over 60% disagreed with statements about Gum bleeding (62.4%), Gum swelling (58.0%), Gum recession (65.2%), and Teeth mobility (58.0%). Furthermore, functional and social disruptions were largely dismissed; a strong majority disagreed that they faced Speech difficulty (61.2%), smiling difficulties (62.8%), or Socialization difficulties (75.2%). Serious concerns such as Tooth decay (70.8% disagreed), Teeth discoloration (66.8% disagreed), and Headache (71.6% disagreed) were not widely reported, indicating that these were not common negative outcomes for this patient group.

Table 6. Level of agreement with negative characteristics associated with wearing fixed orthodontic appliances (n=250)

Characteristic	Agree	Neutral	Disagree
Cosmetic	113 (45.2%)	61 (24.4%)	76 (30.4%)
Duration	123 (49.2%)	63 (25.2%)	64 (25.6%)
Costs	106 (42.4%)	76 (30.4%)	68 (27.2%)
Mouth ulcers	112 (44.8%)	43 (17.2%)	95 (38.0%)
Maintaining oral hygiene	110 (44.0%)	59 (23.6%)	81 (32.4%)
Chewing difficulty	101 (40.4%)	59 (23.6%)	90 (36.0%)
Dietary issues	63 (25.2%)	64 (25.6%)	123 (49.2%)
Gum bleeding	43 (17.2%)	51 (20.4%)	156 (62.4%)
Gum swelling	50 (20.0%)	55 (22.0%)	145 (58.0%)
Gum recession	35 (14.0%)	52 (20.8%)	163 (65.2%)
Teeth mobility	36 (14.4%)	69 (27.6%)	145 (58.0%)
Smiling difficulties	53 (21.2%)	40 (16.0%)	157 (62.8%)
Speech difficulty	38 (15.2%)	59 (23.6%)	153 (61.2%)
Teeth discoloration	29 (11.6%)	54 (21.6%)	167 (66.8%)
Socialization difficulties	22 (8.8%)	40 (16.0%)	188 (75.2%)

Headache	25 (10.0%)	46 (18.4%)	179 (71.6%)
Tooth decay	19 (7.6%)	54 (21.6%)	177 (70.8%)

The analysis of the relationship between self-reported oral hygiene practices revealed that most participants demonstrated excellent compliance with basic oral hygiene, with 95.2% reporting the use of both toothpaste and a toothbrush at least twice daily. The adoption of aids specifically beneficial during orthodontic treatment was moderate; more than half reported using an interdental brush (58.8%) and a special orthodontic toothbrush (55.2%). However, the use of other supplementary aids was less common, with dental floss used by 36.8% of participants, and mouthwash and tongue scrapers used by only about a quarter of the cohort (27.6% and 26.4%, respectively). A significant finding pertained to dental visitation patterns. While the majority (61.2%) reported visiting a dentist once a year, a substantial proportion (38.8%) admitted to seeking dental care only when in pain, indicating a predominantly reactive rather than preventive approach to professional care for a significant segment of the population.

Table 7. The frequency of oral hygiene aid usage and oral health behavior.

Characteristic	N (%)
Toothpaste (use ≥ 2 times/day)	238 (95.2)
Toothbrush (use ≥ 2 times/day)	238 (95.2)
Special orthodontic toothbrush	138 (55.2)
Electric rotary–oscillating toothbrush	96 (38.4)
Interdental brush	147 (58.8)
Dental floss	92 (36.8)
Mouthwash	69 (41.2)
Tongue scraper	66 (26.4)

The logistic regression analysis identified a single consistent and significant predictor of perceived benefit from orthodontic therapy. In both univariate and multivariate analyses, a higher oral health status score was strongly and significantly associated with greater reported benefit (Univariate OR: 1.26, 95% CI, 1.26 (1.056–1.504), $p < 0.001$; Multivariate OR: 1.43, 95% CI, 1.052–1.742, $p < 0.001$). Notably, the significance of gender observed in the univariate analysis (Male OR: 0.835, $p = 0.008$) was not sustained in the multivariate model after adjusting for other variables, particularly oral health status (Adjusted OR: 1.566, $p = 0.443$). This indicates that the apparent association between gender and perceived benefit was confounded by the patient's underlying oral health status. No other variables demonstrated a statistically significant association with the outcome in either the univariate or multivariate models.

Table 8. Univariate and Multivariate Logistic Regression Analysis of factors affecting the benefit for orthodontic therapy among participants (n=250)

Variable	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
Oral health status score	1.26 (1.056–1.504)	< 0.001	1.43 (1.052–1.742)	< 0.001
Gender				
Male	0.835 (0.432–1.220)	0.008*	1.566(0.283–2.017)	0.443
Female	ref	—	Ref	—
Age	1.016 (0.991–1.041)	0.156	—	—
Socioeconomic				
Below average	ref	—	Ref	—
Average	0.771 (0.423–1.369)	0.365	—	—
Above average	1.083 (0.584–2.009)	0.808	—	—
Orthodontic Method				
Fixed bracket treatment	1.094 (0.719–1.664)	0.681	—	—
Aligner treatment	Ref	—	Ref	—
Duration of Appliance Wear (month)				
3–12	1.049 (0.298–2.145)	0.982	1.326(0.483–2.017)	0.299
13–24	1.148 (0.592–2.228)	0.677	1.257(0.584–2.703)	0.471
>24	Ref	—	Ref	—

Discussion

Orthodontic treatment assists in strengthening the teeth and enhancing general dental health. Individuals engage in these practices for many personal and professional reasons. Patients who require fixed orthodontic treatment often expect their self-esteem to improve, their dental health to increase, and to have aesthetic or functional improvements. The perceived benefits of orthodontic treatment are representative of the overall effect orthodontic treatment is having on the patient. This article discusses the dental health habits and attitudes of an average teenager with orthodontic treatment [17]. The most reported clinical problem (46.4%) was food particle retention between the teeth, which has previously been identified as a significant concern with orthodontic patients. The prevalence of dental caries (43.6%) and halitosis (37.6%) shortly after therapy was troubling for the different states of the oral environment.

Similarly, Tadin et al. (2024b) showed that food particle entrapment between teeth was among the most prevalent self-reported problems influencing current oral health status in orthodontic patients, with 46.3% reporting this. In a Saudi Arabian study [19], 31.3% of orthodontic patients having fixed or removable appliance therapy reported this problem.

Diet is an essential component of dental health, especially for orthodontic patients, because the type of food trapped between brackets promotes plaque formation. Dietary refined sugar can increase the risk of caries and white spot lesions developing. Sticky foods are also more likely to become wedged between brackets for extended periods of time. While the majority of participants in the current study avoided frequent consumption of sugary foods (54.0%) and acidic beverages (56.4%), a sizable number nevertheless engaged in these caries-risk behaviours. Orthodontists recommend that patients avoid sticky foods and limit their sugar consumption [17].

These observational findings of the current study are in direct contrast with the patients' self-assessments, in which over 75% considered their dental hygiene to be "excellent" or "very good." This disparity implies a deficiency of awareness or knowledge of what constitutes excellent oral health in the context of orthodontic treatment, as corroborated by the finding that 63.2% of participants indicated that they would like to learn more about it. While most participants (95.2%) showed exemplary compliance with easy brushing frequency (twice daily), their oral hygiene quality and support routines were frequently disappointing. Only 56.4% had received formal brushing technique teaching, and fluoride toothpaste use was disturbingly low (32.6%).

Fluoride represents an important defense against caries and white spot lesions, which are exacerbated by frequent between-meal snacking on cariogenic foods (46.0%) [18,19]. Furthermore, the use of vital interdental aids was sporadic. Whereas interdental brushing was relatively common (58.8%), dental floss (36.8%) and mouthwash (27.6%) were used less. This is especially troubling because the main problems of food entrapment and caries uncovered in this study are exactly those aimed at by these devices, which are essential to disrupt the plaque biofilm developing around brackets and wires [20]. These dangers are also added to by the fact that 38.8% of patients only go to a dentist because of pain, which suggests a reactive, rather than preventive, approach to professional treatment. The current study revealed that many patients had signs of xerostomia in the form of dry mouth (24.8%) and reported chewing problems (25.6%). Tooth discoloration was noted 30.8%. While gingival swelling was seen in 20.4%, frank gum inflammation was less common (7.6%).

These findings were consistent with those reported by [17], who found that oral health concerns included tartar (35.4%), tooth discoloration (30.9%), and cold sensitivity (26.4%). Only 19.1% of orthodontic patients in this study acknowledged bleeding gums when brushing, which is much lower than the 51.0% of orthodontic patients in China and New Zealand [21]. When receiving treatment with fixed appliances, the patient must maintain proper oral hygiene by brushing their teeth twice daily with fluoride toothpaste. Patients with orthodontic appliances are directed to perform interdental cleaning at least once a day. In addition, it is advised that patients also use mouthwash twice a day. Mouthwashes contain a variety of ingredients to reduce potential oral problems caused by decay, gingivitis, tartar, bad breath, mouth ulcers, and dentin sensitivity. In this study, most of the participants reported brushing their teeth at least once a day, and nearly half (48.8%) of the participants brushed as recommended (twice daily).

There were also a high percentage of participants who considered they were using the proper brushing technique (80.4% of the patients stated they were brushing gently in a circular motion; 82.8% of patients stated they were using a soft-bristled toothbrush). Slightly more than half of participants (54.0%) reported also using an additional cleaning device (interdental brush or floss). Several other concerning practices were still noted. Only 56.4% of participants had received formal instruction on brushing technique, and only a minority of participants used fluoridated toothpaste (32.6%). Toothbrush replacement behavior was not optimal; 45.2% replaced their toothbrush occasionally, and 16.4% only replaced theirs once a year. The findings were consistent with previous research on periodontal health knowledge and awareness in subjects wearing fixed orthodontic appliances, as well as the oral hygiene habits and status of orthodontic patients examined at the University of Pretoria's Oral and Dental Hospital. Additional research investigations were conducted in China and New Zealand [21].

In contrast, [22] in Croatia showed that the majority of participants (61.6%) brushed twice a day. There, the proportion of orthodontic patients with fixed appliances brushing twice a day (75.0%) compared to controls (57.0%) was greater than in the present study. Furthermore, 80.8% of individuals brushed their teeth for at least 2 minutes, and the control group (85.0%) had a higher brushing rate than the orthodontic patients. Furthermore, [16] found that the majority of orthodontic patients

had good oral hygiene practices, with 95.1% brushing their teeth at least twice a day. Orthodontic toothbrushes appear to be more effective than conventional toothbrushes in supporting oral health in people with fixed appliances [23].

Although 41.2% of participants reported using mouthwash in this study, the remaining 58.8% said they never use it. In addition, mouthwash use among those who did use mouthwash was erratic. Of all users, over half (55.6%) indicated they "Rarely" used mouthwash, implying it was only used occasionally and/or situationally rather than as regular practice. Among mouthwash users, 31.6% indicated they used mouthwash "Intermittently", and only 12.8% indicated they were "Regular" users. All these results point to the idea that there is a sizable group of people who have mouthwash as part of their oral hygiene routine but do not consistently use mouthwash and implement in the same manner as their other oral hygiene practices.

Studies assessing oral hygiene habits among orthodontic patients reveal diverse findings on this matter. Studies conducted on orthodontic treatment patients in Jordan [24], and at the University of Pretoria's Oral and Dental Hospital [25], found that mouthwash use was considerably greater. In the same way, [17] orthodontic patients observed that only 27.6% of the participants regularly used mouthwash as part of their oral hygiene regimen. This is particularly crucial because cariogenic plaque in individuals with fixed orthodontic appliances has been proven to be effectively managed by oral mouthwashes [26].

The primary reasons for seeking treatment were based on aesthetics, with 63.6% of interviewees perceiving pursuing cosmetic benefits as a significant motivation, and functional improvement in proportions close behind at 49.6%. A review of the literature noted similar trends concerning patients' motivations to improve appearance and occlusion [5, 6]. In contrast, negative aspects of treatment were recognized almost exclusively as practical, and the key concerns faced by patients were generally the length of treatment at 49.2%, mouth ulcers at 44.8%, oral hygiene issues at 44.0%, and the appearance and aesthetics of the appliances themselves at 45.2%. Participants less frequently referenced serious complications, including gum bleeding, decay, or recession, suggesting that the immediate daily inconveniences and aspects of treatment are more significant to this patient group.

According to Tadin et al. [16], there are several reasons for which individuals seek orthodontic treatment, such as improving their appearance, meeting functional needs such as bite corrections, increasing their self-esteem, and improving their dental hygiene [17]. According to the study, 63.8% of the respondents reported aesthetic enhancement as a major factor when choosing this therapy, while 49.6% of the participants cited improving occlusion. According to the results of a Brazilian study on orthodontic treatment expectations, occlusion deviation was the main reason given by 66.7% of participants for seeking treatment. Following closely, aesthetics emerged as the second most significant factor, with 48.3% highlighting its importance [22]. One important finding from the regression analysis is that the only significant predictor of the perceived benefit of undergoing orthodontic treatment was the patient's dental health. If patients thought their oral health was better, they were much more likely to report greater benefits. This suggests that orthodontic therapy depends more on the patient's dental health at baseline and treatment management than it does on mechanical mechanisms alone. The multivariate model showed that the patient's current oral health status significantly confounds the variable, even though gender had initially shown univariate relevance. This indicates that a patient's reported level of oral health is a more accurate measure of treatment satisfaction than demographic characteristics like gender.

Limitations

There are some limitations in the current study. This study had limitations because of its small sample size, which was obtained from a single private specialist orthodontic clinic. As a result, the findings may not be easily generalized to the larger population. It might be prudent to undertake a larger study to improve the external validity of the findings. Furthermore, this study recruited participants via convenience sampling, which has the potential to introduce selection bias and limit the ability to adequately account for confounding variables. Furthermore, this study emphasized the possibility of social desirability bias, which occurs when respondents submit responses that they believe are socially acceptable, thereby affecting the validity of the data.

Furthermore, due to time limits in this investigation, there may have been problems in monitoring long-term oral health behavior or outcome modification. Finally, the study's geographical and demographic focus on a single orthodontic center may limit its applicability to different geographic regions. As a result, bigger and more representative samples in various situations must be studied further to establish the validity, applicability, and dependability of the outcomes. Randomized sample procedures and longitudinal study designs may also assist in reducing biases and provide a more complete picture of oral health education and practice improvements.

Recommendations

In view of these findings, a multi-component strategy should be put in place to address the gap identified between the patient's self-perception of their oral health and their actual oral health. First, by enhancing patient education beyond simply encouraging the frequency of brushing, instruction on effective techniques through hands-on demonstrations should be provided, while also supporting the strong patient interest (63.2%) in learning more about the benefits of fluoride toothpaste and the use of interdental aids such as floss and mouthwash. Second, clinicians can utilize motivational based

communication to capitalize on the strong aesthetic drive of individuals to clearly link poor oral hygiene with undesirable visible outcomes, such as white spot lesions and gingival inflammation, which have negative consequences to the final aesthetic outcome and appearance sought by the patient. Finally, a continued emphasis on preventive strategies is needed to change patients' and parents' current pattern of seeking dental visits from a reactive basis. Patients and parents should be counseled on the important role preventive check-ups play in proactive management throughout the course of orthodontic treatment. In conclusion, by incorporating a structured, repetitive, and motivating educational approach, the overall patient experience can be improved by limiting the common conditions of food accumulation and caries, before the patient implementation of their orthodontic treatment plan to maximize the treatment costs to receive the greatest aesthetic and health benefits.

Conclusion

This study highlights a troubling disconnect between orthodontic patients' high perceptions of oral hygiene and the widespread clinical problems of food retention, dental caries, and halitosis in this patient population. While patients reported good and high compliance with brushing frequency, the overall oral hygiene practices were clearly compromised by poor brushing technique, alarmingly low use of fluoride toothpaste, and irregular use of additional auxiliary oral hygiene practices, like floss, mouth rinses, and dental visits. The common reasons for orthodontic treatment create a great opportunity for orthodontic practitioners. A multi-faceted approach that takes patients beyond basic advice to hands-on, repetitive education and motivation based on their aesthetic goals is a logical next step to help protect the large investment that patients and their families make in orthodontic treatment. Bridging the gap between perception and reality with enhanced, motivating, and preventive education will ultimately improve the orthodontic treatment experience and lessen the common complications while achieving their goal of a brighter smile that is also hopefully enduring good oral health.

Data Availability Statement

Data supporting the findings of this study are available upon request from the corresponding author.

Conflicts of Interest

The authors report no conflicts of interest.

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