CASE STUDY ARTICLE

ORAL HYGIENE STATUS AND PERIODONTAL PARAMETERS AMONG PATIENTS WEARING ORTHODONTIC APPLLIANCES: OBSERVATIONAL STUDY

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| Received April 06, 2021 | | Accepted April 15, 2021 | | Published April 19, 2021 | | ID Article | Amina–Ref27-ajira060421 |

ABSTRACT

Background: The aim of this study is to describe oral hygiene habits and periodontal parameters (gingival index and plaque index) in patients wearing fixed orthodontic appliances (FOAs) and to assess the association of plaque index (PI) and gingival index (GI) with age, gender and frequency of tooth brushing. **Methods**: The sample comprised 100 patients (22.63 ± 7.003) years old, (58 females and 42 males) wearing FOAs. A questionnaire was used to collect patient's information, including gender, age and oral hygiene habits. Periodontal parameters assessed were PI and GI. **Results**: 81% of patients were under periodontal monitoring, 89% brushed their teeth twice or three times a day, 98% used a conventional toothbrush and 67% of patients used brushing aids. The mean PI and GI were (0.59 ± 0.47) and (0.44 ± 0.47) respectively. These indexes were less in female gender and older patients and tend to decrease with the augmentation of frequency of tooth brushing. **Conclusion**: Orthodontic therapy performed with periodontal monitoring and self-care could maintain periodontal health.

Keywords: *Motivation, Periodontal monitoring, Oral hygiene, Orthodontics.*

1. INTRODUCTION

In current dental therapy, a high number of patients are demanding orthodontic treatment to manage malocclusion and aesthetic dental deficiency and to enhance esthetics and function [1, 2]. It is essential to Correct the position of the teeth for speech, aesthetics, dental arch care and the overall wellness of peoples [3, 4]. However, fixed orthodontic therapy is often linked with significant increase in the periodontal parameters (that can lead to increased development of hyperplastic gingivitis and periodontal breakdown [5, 6]. Atassi and Awartani (2010) had shown that after three months of the orthodontic treatment wearing, there is a statistically significant augmentation in levels of lactobacilli with an increased bleeding on probing (BOP), a higher gingival index (GI), a higher plaque index (PI), and an increase in probing pocket depth (PPD) [7]. According to Papageorgiou et al., (2018) systematic review and meta-analysis, FOAs wearing appears to be linked with a high prevalence of Aggregatibacter actinomycetemcomitans and Tannerella forsythensys, which tend to be normal 6 months after appliance removal [8]. Also, orthodontic treatment may lead to the shift of supragingival dental plaque subgingivally in case of inadequate dental hygiene, resulting in infrabony pocket formation [9]. Verrusio et al., (2018) conducted a systematic revue in 2018 [10]. The conclusion was that the use of orthodontic appliances, particularly FOAs, can increase periodontal tissue inflammation, bleeding on probing, GI and PI. Long term studies were rare and didn't confirm any long-term persistent effects of FOAs on the periodontal parameters [1-8]. It has been noted that the area with a higher accumulation of biofilm is significantly linked with the development of gingivitis and the greater the accumulation of biofilm, the higher the gingival bleeding index [11]. Indeed, plaque accumulation is enhanced by the plaque retentive specificity of the orthodontic appliance [12]. An irregular surface and a vacuum at the composite dental surface augment plaque accumulation [13]. Also an excessive quantity of composite around the bracket increase difficulties to ensure oral hygiene practice [14].

Patients with FOAs should apply correct plaque control measures to prevent the negative effects of plaque retention and have successful orthodontic treatment outcome. These methods are either mechanical plaque control measures including toothbrushes, dental floss, interdental brushes in addition to chemotherapeutic agents such as dentifrices and mouthwashes [3-7]. In fact, patient's motivations, consciousness, participation in treatment during FOAs are key elements of oral hygiene maintenance [15]. However, it is difficult to maintain correct oral hygiene in patients undergoing fixed orthodontic care to prevent dental caries and gingival inflammation [6]. The aim of this study is to investigate oral hygiene habits and periodontal parameters (GI and PI) in patients wearing FOAs and to evaluate the association of GI and PI with age, gender and frequency of tooth brushing.

2. MATERIALS AND METHODS

2.1 Study design

The study was designed as a cross-sectional study. A convenience sample of 100 orthodontic patients was screened at the Department of Orthodontics of the University of Casablanca agreed to participate in this research by signing a Term of Free and Informed Consent. Consent for children participating in the study was obtained from parents. The patients

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were selected according to the following inclusion criteria: wearing FOAs, having at least 20 natural teeth and aged more than 10 years.

2.2 Data collection

Data was collected from questionnaires. First part was questions about general informations (gender, age); patients were then asked about general aspects of oral hygiene (frequency and method of brushing, oral hygiene cleaning aids). All consenting patients were examined by a single pre-calibrated examiner for the status of biofilm formation using PI and GI. The PI and GI scores for all periodontally exploitable teeth were measured and recorded. PI and GI were reported according to Silness et al., (1964) and Löe et al., (1963) codification [16, 17].

2.3 Statistical analysis

Epi info version 7 was used for data entry and analysis. Qualitative data were presented as frequencies and percentages, while quantitative data were presented as means and standard deviations. The quantitative outcomes (GI and PI) were analyzed by either t-test or analysis of variance (ANOVA), as appropriate.

3. RESULTS

We can notice that 89% of patients brushed their teeth twice or three times a day. 98% brush their teeth using a conventional brush while just 2% used an electric toothbrush. 79% of patients are brushing their teeth according to Bass brushing method while 21% used the circular brushing method. A high percentage of patient 81% were under periodontal monitoring. The majority of them 68% received a periodontal treatment before the beginning of orthodontic treatment and 26% had periodontal monitoring before and during orthodontic treatment. The repartition of the sample according to brushing aids use demonstrates that 67% of patients are using brushing aids. We can note that 94% of them used interdental toothbrush and 55% used mouth rinses, the majority of them utilized chlorhexidine mouth rinse (26%) (Table 1).

Table 1: The table presents the different brushing aids used by patients in our sample.

Brushing aids	N(%)
Dental floss use	16(24%)
Interdental toothbrush use	63(94%)
Mouth rinsing use	37(55%)
Chlorhexidine mouth wash	26(70%)
Other molecules	11(30%)

The mean values of PI and GI were (0.59 ± 0.47) and (0.44 ± 0.47) respectively. Table 2 report the repartition of the sample according to PI and GI. We can note that the majority of patient have PI and GI comprised in the interval [0-1[.

Table 2: Repartition of the sample according to plaque index PI and gingival index GI.

PI	N(%)	GI	N(%)
[0-1[	76(76%)	[0-1[	81(81%)
[1-2[	23(23%)	[1-2[	18(18%)
[2-3[	01(01%)	[2-3[	01(1%)

GI: higher gingival index, **PI**: Higher Plaque index.

When recording the frequency of tooth brushing. The majority of patient brush their teeth two (37.76%) to 3 times a day (53.06%). PI and GI tend to decrease with the augmentation of the frequency of tooth brushing, but the difference was statistically non-significant p>0.05 (Table 3).

Table 3: Higher gingival index and higher plaque index values according to frequency of tooth brushing.

Frequency of tooth brushing	N(%)	Mean PI (±SD)	P value	Mean GI (±SD)	P value
Irregular	2(2%)	0.85 ± 0.56		0.76 ± 0.61	
Once a day	9(9.18%)	1.22 ± 0.34	0.29	0.81 ± 0.43	0.22
Twice a day	37(37.76%)	0.58 ± 0.50		0.48 ± 0.53	
Three times a day	52(53.06%)	0.42 ± 0.37		0.33 ± 0.38	

SD: standard deviation; **GI**: higher gingival index, **PI**: Higher Plaque index.

Younger patient had less PI (0.74 ± 0.48) and GI (0.56 ± 0.52) than older patient. The value of PI and GI was (0.52 ± 0.49 and 0.40 ± 0.47) successively but the difference was not statistically significant (table 4).

Table 4: Table presents the higher gingival index and higher plaque index values according to age.

Age	N(%)	Mean PI (±SD)	P value	Mean GI (±SD)	P value
10-14 years	14(14%)	0.74 ± 0.48		0.56 ± 0.52	
15-20 years	21(21%)	0.56 ± 0.42	0.29	0.49 ± 0.44	0.46
>20 years	65(65%)	0.52 ± 0.49		0.40 ± 0.47	

SD: standard deviation. **GI**: higher gingival index.

Our sample was composed of 42 males and 58 females. The PI and GI were higher in male than female participant. The difference was statistically significant ($p<0.05$) (Table 5).

Table 5: The table presents the Higher Plaque index and higher gingival index values according to gender.

Gender	N(%)	Mean PI (±SD)	P Value	Mean GI (±SD)	P Value
M	42(42%)	0.81 ± 0.48	0.0008	0.61 ±0.47	0.002
F	58(58%)	0.43 ±0.41		0.32 ±0.43	

GI: higher gingival index; **PI**: Higher Plaque index; **SD:** standard deviation

4. DISCUSSION

Fixed orthodontic appliances create retentive areas for plaque accumulation and complicate oral hygiene, increasing risk for gingival inflammation, deteriorated periodontal health, dental demineralization and caries [18]. Naranjo et al., (2006) reported that the brackets bonding altered the ecology of the oral cavity, by the collection of biofilm at retentive zones [19]. This effect is more pronounced when the surface covered by the brackets is notable and with the complexity of the orthodontic device making tooth cleaning difficult for patient [20]. There was increase of the plaque and gingival index, inducing more inflammation of the periodontal tissue [19]. Nasir et al., (2011) also reported the progression of periodontal disease during orthodontic therapy [21]. Although, in their meta-analysis, Papageorgiou et al., (2018) concluded that orthodontic treatment with FOAs might have limited to no clinically apparent detrimental effect on the clinical attachment loss (CAL) [22].

Regarding plaque and gingival indexes, in the present study mean PI and GI were (0.59 ± 0.47 and 0.44 ± 0.47) respectively, these values are quite good for patients wearing FOAs. Conversely, Klukowska et al., (2011) reported in their study that plaque accumulation in orthodontic patients was extremely high [23]. According to Yener and Özsoy (2020), the gingival, mesial and distal surfaces of the teeth are the areas where biofilm accumulation is important [24]. To manage difficulties in dental hygiene for orthodontic patients, regular monitoring of patients with predisposition for periodontal disease during orthodontic treatment is necessary. Periodontal assessments and good professional hygiene maintenance assignments are necessary [9]. So, the factor that ascertains the outcome of the periodontal tissues during orthodontic treatment is the effectiveness of oral hygiene procedures. Therefore, oral hygiene education should be initiated before starting up the orthodontic treatment and must be underlined during every visit. Primary goal before any orthodontic movement should be to stabilize the periodontal tissue [25]. In the present study, the majority of patients received periodontal monitoring; this fact has promoted oral hygiene status. Orthodontic therapy realized with correct and regular maintenance of oral hygiene will prevent permanent periodontal deterioration [14].

Regular tooth brushing is the first mean in the protocol of defense to control dental plaque [25]. In the present study, 79% of patients are brushing their teeth according to Bass brush method. The research of Nassar et al., (2013) showed that the Bass method is the most effective technique of tooth brushing because it eliminates plaque from the surface of the tooth and gum and also gains a depth of 0.5mm under the gum [26]. 98% of patients in this study brushed their teeth using a conventional brush. This result is in accordance with the study of Petrauskiene et al., (2019) [27] where a manual toothbrush was the first option of almost all participants and only 4.5% of subjects reported using a powered toothbrush. According to Erbe et al., (2013) the electric toothbrush with an orthodontic head is the most effective toothbrush for orthodontic patients [28]. And according to a Cochrane review of Yaacob et al., (2014) [29] based on 51 articles with a total of 4624 participants, it was concluded that powered tooth-brushes demonstrated a significant efficacy compared to manual toothbrushes. But manual tooth-brushes, when used correctly, with adequate frequency and duration, can be equally efficient [6].

The results of the present study showed that the majority of individuals in the sample brushed twice or three times a day (37.76% and 53.06% respectively) which is in accordance with the result of Anuwongnukroh et al., (2017) who found that the majority of subjects (44.8%) brushed their teeth twice a day, while the resting brushed more than twice a day [6]. The study of Petrauskiene et al., (2019) reported similar result [27]. Our results were in disagreement with the results of Gupta et al., (2017) who found that the greater number of males and females brush only once a day [30]. As supposed, the present study found that the higher the frequency of tooth brushing, the lower the biofilm accumulation. The PI and GI tend to decrease in patients with high reported frequency of toothbrushing but the difference was not statistically significant. This is in agreement with the result of the study of Mei et al., (2017) [11]. Also in the study of Kawsar et al., (2018), it is reported a decrease in gingival index as the patients clean their teeth more frequently [31]. This difference was statistically significant. Using a toothbrush alone is not sufficient to clean correctly the teeth with

FOAs in place [32]. It is recommended to use supplementary measures for oral hygiene such as interdental toothbrush, dental floss [33], toothpaste containing fluoride (to avoid enamel demineralization) [34], and oral irrigator [2].

In the current study, 67% of patients are using brushing aids to perform an adequate plaque control. In the study of Petrauskiene et al., (2019), they found that half (49.5%) of patients used at a minimum one auxiliary oral hygiene measure [27]. Waerhaug in 1976 reported that the use of interdental brushes eliminates the subgingival plaque to a depth of 2 to 2.5 mm [35]. In the present study, 94% of patients using brushing aids use interdental brushes. This percentage is higher than the result obtained by Kawsar et al., (2018) where 18 % of subjects use interdental brushes regularly [31]. But it was in accordance with the result obtained by Lee et al., (2016) who reported that 68,6% of patients wearing fixed orthodontic appliances used interdental toothbrushes daily [36]. In studies comparing floss and interdental brush, a notable reduction of interproximal plaque accumulation was apparent in the interdental brush group [37], It was also reported that the use of interdental brushes was more effective, technically easier and resulted in a notable reduction of probing depth than the use of dental floss which is difficult to introduce below and around arch wires [6-38]. Scheerman et al., (2017) paper indicate that increased use of proxy brush, decreased levels of dental plaque [39]. This reduction is eventually linked with a higher self-efficacy to use proxy brushes.

In this study 55% of patients using brushing aids use mouthwash and 70% of them used chlorhexidine mouthwash. Chlorhexidine (CHX), which may be used in different forms, shows antibacterial efficacy and may also reduce the apparition of ulcers resulting from trauma during orthodontic treatment. The use of mouth rinses and dentifrices with lesser concentrations of CHX, reduce tooth discoloration due to Chlorhexidine without significant alteration in its antiplaque effectiveness and its capacity to combat gingival inflammation [9]. Our findings suggest that PI decreased with age. This is consistent with previous observations that adults follow adequately clinician instructions and consequently ensure better oral hygiene [11]. If the age influences the biofilm deposit, then we must adjust oral hygiene education to the age group [38]. The females have statistically significant less mean of PI and GI than males. This is in accordance with the study of Mei et al., (2017) suggesting that females had less biofilm deposit than males and previous observations that females comply better to clinician's plaque control instructions and consequently may demonstrate better oral hygiene [11]. According to the study of Krupińska-Nanys et al., (2015), females have better teeth and periodontal condition because they pay more attention to their oral health [40]. It has been found that compared to males, females tend to ensure oral hygiene measures more frequently. These findings were in accordance with the Petrauskiene et al., (2019) observation. It is noted that females have best attitudes and habits to perform a perfect oral hygiene compared to males due to a big interest in their appearance [27]. In addition, another study reported that a significantly higher gingival bleeding was observed among males [33] .

Consequently, low scores of plaque index were associated with frequent and adequate use of proxy brushes, female gender and older age [27-39]. The results of the study of Ghijselings et al., (2014), noted that periodontal parameters increased during fixed orthodontic therapy but decreased 2 years after treatment achievement [41]. The authors have reported a normalization of the clinical parameters, but some periodontal parameters were only partially reversed. It can be mentioned according to the available evidence that FOAs create more plaque retentive areas high lighting the importance of dispensing accurate oral hygiene maintenance strategies to patients treated with FOAs. These oral hygiene recommendations must be readjusted according to age and should target more especially male population. It can be deduced that FOAs are not risk factors of causing periodontal disease, but they rather create a temporary favorable condition for plaque accumulation and gingivitis [1]. If oral hygiene measures are well provided, no complication will occur.

5. CONCLUSION

The evaluation of periodontal status of patients wearing orthodontic appliances lead to the following conclusions:

- Orthodontic therapy performed with periodontal monitoring could maintain periodontal health.
- The periodontal indexes (PI and GI) are less in female gender and older patients and tend to decrease with the augmentation of frequency of tooth brushing.

Acknowledgment: Our acknowledgment go to Pr. Farid El Quars, head of Orthodontics Department, University Hassan II, Dentistry School, Casablanca, Morocco for the help he gave us to did our study.

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Cite this article: Amina Gharibi, Sihame Chemlali, Samia Belfellah, El Mehdi Chaouki and Jamila Kissa. ORAL HYGIENE STATUS AND PERIODONTAL PARAMETERS AMONG PATIENTS WEARING ORTHODONTIC APPLLIANCES: OBSERVATIONAL STUDY. *Am. J. innov. res. appl. sci. 2021; 12(4): 121*-125.