Original research

A STUDY ON PERIODONTAL INDICES AND CONTRIBUTING FACTORS IN ORTHODONTIC PATIENTS AT THE UNIVERSITY OF MEDICINE AND PHARMACY, HUE UNIVERSITY

Phan Anh Chi[1], Truong Thi Cam Tien[1], Le Quang Long[1], Tran Thi Khanh Chi[1], Vo Thi Khanh Xuan[1], Tong The Tuan Vu[1]

[1]Faculty of Odonto-Stomatology, Hue University of Medecin and Pharmacy, Hue University, Vietnam.

ABSTRACT

Background: Orthodontic treatment using fixed appliances, such as braces, can complicate oral hygiene practices, particularly when effectively removing dental plaque. This increases the risk of developing or relapsing periodontal diseases, as braces create areas that are difficult to access, allowing plaque and bacteria to accumulate. Therefore, this study aims to investigate the periodontal status and evaluate the factors associated with periodontal health in students undergoing orthodontic treatment at the University of Medicine and Pharmacy, Hue University.

Methods: A cross-sectional study was conducted on students at the University of Medicine and Pharmacy, Hue University, undergoing orthodontic treatment with fixed appliances (braces).

Results: Among the study participants, 80.3% exhibited mild gingivitis, 9.1% showed moderate gingivitis, and 10.6% had no gingival inflammation. No cases of severe gingivitis were observed. The gingival index was significantly associated with the duration of orthodontic appliance use (p < 0.05).

Conclusion: To prevent periodontal issues, it is crucial to provide comprehensive guidance on oral hygiene practices for orthodontic patients, particularly during the initial phase of brace application.

Keywords: Orthodontic Treatment, Periodontal Health.

I. INTRODUCTION

Orthodontic treatment is widely recognized as a method to improve both masticatory function and aesthetics. However, using fixed orthodontic appliances, such as braces, presents challenges in maintaining adequate oral hygiene, particularly in removing dental plaque. This difficulty leads to an increased risk of plaque accumulation, which, in turn, may facilitate the development or recurrence of periodontal diseases.

Additionally, a study conducted by Liu et al. (2011) at Dalian Medical University reported that there was a significant increase in plaque index, gingival index, and probing depth within the first month after the application of braces, with peak values observed at three months post-treatment [1].

In Vietnam, a study by Ngo TL et al. (2021) revealed that up to 90% of patients undergoing orthodontic treatment exhibited gingival inflammation [2]. However, limited research has been conducted to evaluate periodontal health in university students. Therefore, the present study aims to investigate the periodontal status and assess factors influencing periodontal health in students undergoing orthodontic treatment at the University of Medicine and Pharmacy, Hue University. The study aims to evaluate periodontal indices and identify factors related to periodontal health in this cohort.

II. MATERIALS AND METHODS

2.1. Subjects

Students from the University of Medicine and Pharmacy, Hue University, are undergoing orthodontic treatment with fixed appliances (braces).

Inclusion criteria: Students undergoing orthodontic treatment with braces for more than 3 months voluntarily agree to participate.

Exclusion criteria: Students who smoke; Students with systemic diseases or acute conditions; Students currently on medication or taking antibiotics; Students who do not agree to participate in the study.

2.2. Study method

Descriptive cross-sectional study.

Sample size: 66 students, participants were selected using a consecutive sampling method based on predefined inclusion and exclusion criteria. Recruitment continued until the required sample size was reached.

2.3. Methodology

Obtain a list of all students from the University of Medicine and Pharmacy, Hue University, by class.

Survey and screen students wearing braces from each class.

Obtain consent for participation in the study:

- Agree to participate: Data collection will proceed by distributing the study questionnaire and instructing participants to fill it out.

- Decline to participate: Exclude from the study.

Conduct clinical evaluations of periodontal indices, including the Plaque Index (PlI) by Loe and Silness, Gingival Index (GI) by Loe and Silness, Probing Pocket Depth (PPD) according to Nield-Gehrig, and Sulcus Bleeding Index (SBI) by Muhlemann and Mazor (1958). Record the results in the study form.

Data compilation, analysis, and report writing.

2.4. Statistical analysis

All data were entered using Microsoft Excel 2019 and analyzed with SPSS version 20.0.

III. RESULTS

3.1. General characteristics of study participants

The general characteristics of the study participants are summarized in Table 1, showing variations in gender, field of study, year of study, and the duration of orthodontic appliance use. The proportion of female participants and those in the 4th, 5th, and 6th years of study was relatively high. In terms of field of study, approximately one-third of the participants were studying dentistry. The highest proportion of participants wore braces for 6 to 12 months (48.5%).

Table 1: General Characteristics of Study Participants

Characteristics		n	(%)
Gender	Male	20	30.3
	Female	46	69.7
Major	Dental students	23	34.8
	Others	43	65.2
Year	1, 2, 3	14	21.2
	4, 5, 6	52	78.8
Duration of Braces Treatment (months)	3 - 6	9	13.6
	6 - 12	32	48.5
	> 12	25	37.9
Sum		66	100

3.2. Characteristics of gingival inflammation in study participants

Table 2: Characteristics of Gingival inflammation in study participants

Gingivitis	n	%
Nomal	7	10.6
Mild Gingivitis	53	80.3
Moderate Gingivitis	6	9.1
Severe Gingivitis	0	0
Sum	66	100

The results from Table 2 indicate that none of the participants exhibited severe gingivitis. The majority of participants (80.3%) had mild gingivitis, while a smaller proportion had normal gingiva (10.6%) and moderate gingivitis (9.1%).

3.3. Association between periodontal status and risk factors in students undergoing orthodontic treatment with braces

Table 3: Association between periodontal status and risk factors in students undergoing orthodontic treatment with braces

Index		PlI	GI	PPD	SBI
Duration of Braces Treatment (month)	3 - 6	0.63 ± 0.27	0.19 ± 0.17	1.62 ± 0.27	0.14 ± 0.10
	6 - 12	0.77 ± 0.44	0.47 ± 0.40	1.39 ± 0.50	0.27 ± 0.23
	> 12	0.57 ± 0.32	0.25 ± 0.19	1.45 ± 0.35	0.11 ± 0.11
p (Kruskal - Wallis Test)		0.142	0.044	0.564	0.033
Brushing Frequency (time/day)	1	0.95 ± 0.57	0.65 ± 0.25	1.52 ± 0.27	0.46 ± 0.22
	2	0.66 ± 0.38	0.35 ± 0.17	1.44 ± 0.44	0.18 ± 0.06
	≥ 3	0.65 ± 0.30	0.23 ± 0.13	1.42 ± 0.44	0.12 ± 0.07
p (Kruskal - Wallis Test)		0.497	0.142	0.979	0.02
Tooth brushing duration (min)	< 1	0.89 ± 0.44	0.67 ± 0.32	1.70 ± 0.24	0.43 ± 0.21
	1 - 3	0.66 ± 0.35	0.33 ± 0.16	1.42 ± 0.46	0.18 ± 0.10
	> 3	0.62 ± 0.32	0.27 ± 0.13	1.36 ± 0.40	0.11 ± 0.04
p (Kruskal - Wallis Test)		0.368	0.136	0.205	0.048
Toothbrush replacement time	Every 3-4 months	0.65 ± 0.17	0.30 ± 0.16	1.35 ± 0.42	0.15 ± 0.09
	Worn-out Bristles	0.75 ± 0.31	0.46 ± 0.18	1.67 ± 0.35	0.28 ± 0.11
p (Mann - Whitney U Test)		0.556	0.02	0.004	0.023
Brushing technique	Vertical	0.78 ± 0.26	0.43 ± 0.13	1.49 ± 0.32	0.22 ± 0.13
	Horizontal	0.63 ± 0.35	0.31 ± 0.17	1.53 ± 0.35	0.19 ± 0.13
	Circular	0.68 ± 0.27	0.35 ± 0.28	1.39 ± 0.59	0.16 ± 0.08
	Bass technique	0.54 ± 0.25	0.28 ± 0.11	1.24 ± 0.53	0.13 ± 0.08
p (Kruskal - Wallis Test)		0.404	0.202	0.34	0.973

The results from Table 3 indicate that the Plaque Index (PlI), Gingival Index (GI), and Sulcus Bleeding Index (SBI) tend to increase within the first 12 months of wearing braces but decrease in the group with more than 12 months of appliance use. The Probing Pocket Depth (PPD) index was highest in the 3-6 month group, decreased between 6-12 months, and then increased again in the group with over 12 months of wear. The average values for all indices were highest in the group brushing once a day, gradually decreasing in the group brushing twice daily, and lowest in those brushing at least three times daily. The highest mean values for all indices were observed in the group brushing

for less than one minute. The lowest mean values for GI, PPD, and SBI were found in the group brushing for more than three minutes. For PlI, the lowest mean value was found in the group brushing for 1 - 3 minutes. The average values for all indices were higher in the group that replaced toothbrushes when the bristles were worn out than in those that replaced their toothbrushes every 3 - 6 months. Statistically significant differences were observed in the GI and SBI indices with $p < 0.05$. There were no statistically significant differences in the mean periodontal index values among the different brushing techniques.

IV. DISCUSSION

The cross-sectional study was conducted on 66 students wearing orthodontic braces at the University of Medicine and Pharmacy, Hue University. The results in Table 1 show that 30.3% of the participants were male, and 69.7% were female. This result is consistent with the gender distribution in previous orthodontic studies by Elham et al. (2018), where the male-to-female ratio was 1:3 [3]. Female patients tend to undergo orthodontic treatment more frequently than male patients. However, the rate of malocclusion between males and females is similar, indicating that the difference in the number of male and female orthodontic patients is not due to malocclusion prevalence but rather factors such as aesthetics and psychological reasons [4]. Women are generally more concerned with their appearance and social interactions, making them more likely to accept advice from healthcare professionals about the aesthetic and long-term oral health benefits of orthodontic treatment.

According to the results from Table 1, the group of participants wearing braces for 6 - 12 months had the highest proportion (48.5%). This result differs from the study by Ngo TL et al. (2021), where the highest proportion was seen in patients who had been undergoing treatment for more than 12 months (69.4%) [2]. Our study's variable duration of appliance use was randomized, leading to an unequal distribution of participants among groups and differences from previous studies.

The results from Table 2 show that the highest proportion of participants (80.3%) had mild gingivitis, while 10.6% had no gingival

inflammation, and 9.1% had moderate gingivitis, with no cases of severe gingivitis. These findings align with Kirtana Gopalasamy's study (2020), where over 84% of orthodontic patients exhibited gingivitis [5]. The high prevalence of gingivitis is due to the presence of fixed appliances, which create areas that promote plaque accumulation and complicate oral hygiene [6]. Many clinical studies have reported that maintaining oral hygiene is challenging due to braces, archwires, and bands, which can lead to plaque buildup and gingival inflammation [7, 8]. Plaque has been established as the primary cause of gingivitis development. Clinical studies indicate that without plaque, orthodontic forces and tooth movement do not lead to gingival inflammation. After the fixed appliance placement, most patients experience gingivitis, typically temporary and not resulting in attachment loss [9]. Additionally, fixed appliances may cause direct damage to periodontal tissues due to the archwires, brackets, and hooks exerting pressure on the gingiva. Moreover, excessive force to move teeth and abnormal masticatory pressures (when the bite is disturbed) can cause periodontal damage [10].

The results from Table 3 indicate a relationship between the severity of gingivitis and gingival bleeding and the duration of wearing braces. This finding is consistent with studies by Ngo TL et al. (2021) and Nguyen MT et al. (2022), where the Gingival Index (GI) and Plaque Index (PLI) tend to increase within the first 12 months of wearing braces but decrease after 12 months of appliance use [2, 11]. In the early stages of treatment, indices are generally higher due to new factors, such as the forces from the braces and archwires on the teeth and gums, which may cause mild gingivitis or gingival bleeding. During the 6-12 month period, gingival inflammation and bleeding tend to be higher as long-term appliance use increases plaque accumulation, which can lead to gingivitis if oral care is not maintained correctly. The continuous changes in archwires and the forces acting on the teeth can also make the gums more prone to irritation and bleeding. After 12 months, patients generally become more accustomed to proper oral care, and the periodontal tissues have had time to adapt to the tooth movements, reducing inflammatory responses and bleeding.

Regarding Table 3, there was a correlation between the frequency of gingival bleeding and the number of times teeth were brushed daily. All indices were highest in the group brushing once a day and decreased progressively as the frequency of brushing increased. This indicates that oral hygiene plays a significant role in periodontal health. These findings are consistent with the study by Ngo TL (2021) on 62 orthodontic patients, where the highest values for the GI, PLI, SBI, and PPD were observed in the group brushing once a day, with values decreasing in the group brushing twice a day, and the lowest in those brushing three times a day [2]. A study by Scheerman et al. (2017) on 116 orthodontic patients found that plaque levels significantly decreased with increased tooth brushing frequency [12]. This can be explained by the fact that brushing once daily is insufficient to remove plaque, allowing bacteria to accumulate effectively. Brushing more frequently helps eliminate plaque and bacteria causing periodontal disease, reducing the risk of gingivitis and improving periodontal indices.

In Table 3, all indices were highest in the group brushing for less than 1 minute and decreased as brushing time increased. These results align with Bellamkonda Pavani et al. (2023), who demonstrated that plaque removal effectiveness increases with brushing duration, with plaque removal rates improving as brushing time increases from 30 seconds to 180 seconds [13]. There is an inverse relationship between gingival bleeding and the duration of each brushing session. Longer brushing times allow better plaque removal from hard-to-reach areas, such as the gingival margins and interdental spaces, reducing inflammation and gingival bleeding. Additionally, thorough brushing helps improve blood circulation, contributing to healthier gums and reducing bleeding.

According to the results in Table 3, the average values for all four indices (PlI, GI, PPD, SBI) were higher in the group replacing toothbrushes when the bristles were worn out, compared to the group replacing their toothbrushes every 3-4 months. A statistically significant correlation was found between the Plaque Index, Probing Pocket Depth, and Sulcus Bleeding Index with toothbrush replacement frequency. Kreifeldt JG, Hill PH, Calisti LJ (1980) found that worn-out toothbrushes are less effective at removing plaque than new ones, as the bristles gradually taper and reduce their ability to remove plaque [14]. According to Darby (2010), worn bristles reduce the toothbrush's ability to reach into the gingival sulcus and interdental spaces, significantly diminishing its cleaning effectiveness [15]. Pradeep S Tangade et al. (2013) reported increased plaque indices in the group using toothbrushes that were not replaced after 70 and 100 days [16]. These findings align with the American Dental Association (ADA) recommendations to replace toothbrushes every 3-4 months [17].

V. CONCLUSION

In patients undergoing orthodontic treatment with braces, Gingival Index, and Sulcus Bleeding Index tend to increase during the first 12 months of wearing braces, but decrease in those who have worn braces for more than 12 months, there was a statistically significant difference. Brushing frequency and duration significantly affected the Sulcus Bleeding Index, with the lowest bleeding index observed in participants who brushed at least three times per day and spent more than three minutes brushing. The average values of the Gingival Index, Probing Pocket Depth, and Sulcus Bleeding Index were higher in the group that replaced their toothbrush when the bristles were worn compared to the group that replaced their toothbrush every 3-4 months, there was a statistically significant difference.

Ethical approval

This study was approved by the Ethics Committee of the University of Medicine and Pharmacy, Hue University. All participants were fully informed about the purpose and procedures of the study. Written informed consent was obtained prior to participation.

Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

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