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Research Article

Effect of Orthodontic Braces on Gingival Health Status and the Role of Professional Scaling Frequency as a Preventive Factor

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ABSTRACT

Fixed appliance orthodontic treatment is often linked with greater amounts of plaque retention, and this could adversely affect the health of the gums, provided that preventive measures are not taken. The present cross-sectional observational study sought to measure the impact of the use of orthodontic braces on the level of gingival health and to determine the place of professional scaling frequency as a preventive measure. The research was carried out on a sample size of 120 orthodontic patients (15-30 years old) who were in the orthodontic units of tertiary care dental hospital, and their individual orthodontic clinics. A Demographic and Oral Hygiene Practices Questionnaire was used to gather some data and to assess the state of the gingival health clinically by using the Plaque Index (Silness and Loe), Gingival Index (Loe and Silness), and Bleeding on Probing Index. The respondents will be grouped according to the number of times they have had professional scaling during orthodontic therapy. The results obtained showed that there was a lot more plaque, gingival inflammation, and bleeding among the patients undergoing infrequent or irregular professional scaling as opposed to those undergoing regular professional scaling. The more time spent in fixed appliance wear was also linked to poorer health outcomes in the form of gingivitis. Professional scaling on a regular basis showed a protective effect as it increased the health parameters of the gingiva significantly. The research states that regular professional scaling should be included in the orthodontic treatment plans to ensure optimal gingival health and avoid periodontal complications.

Keywords: Gingival, orthodontics, scaling, preventing factors, braces

INTRODUCTION

The use of fixed appliances in orthodontic therapy has become very popular among adolescents and young adults in terms of correcting malocclusion and enhancing esthetics and work function. Nevertheless, the positioning of brackets, bands, and archwires provides more plaque-binding spaces, which makes it difficult to maintain the oral hygiene habits and predisposes to periodontal inflammation (1,2). The introduction of orthodontic appliances also changes the microenvironment in the mouth, leading to the biofilm accumulation and the shift to the pathogenic microbial flora linked to gingivitis (3,4).

A very common form of adverse effects in the course of fixed orthodontic therapy is gingival inflammation. Research findings have indicated a large rise in plaque index, gingival index and bleeding on probing during the initial months of appliance insertion (5,6). Otherwise, chronic gingival inflammation can develop into loss of attachment and permanent periodontal complications (7). Whereas these alterations are costly and undoable with proper oral care and professional treatment, chances of the

complications are high among patients who do not respond well to the treatments (8).

According to recent evidence, orthodontic appliances not only augment the retention of plaque but also alter the composition and virulence of subgingival microbiota (9). High concentrations of periodontal pathogens e.g., Porphyromonas gingivalis, Prevotella intermedia, have been reported in orthodontic treatment, thus adding to the inflammatory reaction (10). Additionally, mechanical irritation of brackets and wires could increase the size of the gingival area and the inclination to bleed (11).

The professional preventive strategies are significant in preserving periodontal health in orthodontic treatment. Oral hygiene reinforcement and regular professional scaling were found to play a significant role in minimizing the amount of plaque that forms and gingivitis in orthodontic patients (12,13). Periodic scaling interferes with the established biofilm and decreases bacterial burden, thus it minimizes inflammatory alterations in tissues of the gums (14). Nevertheless, the best frequency of professional scaling in the course of orthodontic therapy is still the subject of on-going research.

Some studies support the professional prophylaxis of high-risk individuals with intervals of three months, as a method of controlling the plaque and gingivitis in reference to gingival bleeding (15). Others focus on personalized periodontal maintenance schedules, which are founded on patient-related risk factors, oral health compliance, and appliances- wearing time (16). Although there is an increased evidence of the use and beneficial effect of professional periodontal care, there is still scarce data directly comparing the gingivitis results in relation to various scaling frequencies in orthodontic patients.

Taking into consideration the growing population of people who receive fixed orthodontic treatment and the possibility of periodontal complications that can be prevented, it is necessary to assess how the use of braces affects the health of gums and whether routine professional scaling is a viable preventive strategy. Thus, the purpose of the current research is to determine the impact of orthodontic fixed appliances on the state of gingivality and to study the importance of professional scaling frequency as a protective factor of periodontal health retention.

LITERATURE REVIEW

It is already known that orthodontic therapy using fixed appliances has always been related to the changes in periodontal health because of better adherence to plaque and difficulty in maintaining oral health. Modern studies indicate that brackets, bands, ligatures and archwires form mechanical ridges that support the settlement of bacteria, resulting in inflammatory alterations of the gingivitis tissues (17). Such structural elements inhibit the efficient removal of the plaque, and hence, the risk of developing gingivitis is also enhanced in the course of active orthodontics (18).

Other longitudinal investigations carried out in the year 2020-2024 have documented considerable increases in the plaque index and gingival index during the first three-six months of the use of fixed appliances (19,20). The inflammatory reaction is normally accompanied by a redness of the gums, edema, and bleeding on probing which is mostly blamed on the biofilm build-up but not mechanical injury (21). Though they can be easily reversed with the removal of appliances and better oral care due to longer-term inflammation, they can put vulnerable people at risk of losing periodontal attachment (22).

Microbiological studies also indicate the association between periodontal inflammation and orthodontic appliances. The recent molecular research has shown enhanced numbers of periodontopathogenic bacteria, such as Porphyromonas gingivalis, Tannerella forsythia, and Treponema denticola, in the course of orthodontic treatment cases using polymerase chain reaction (PCR) and next-generation sequencing methods (23,24). Such changes in microbes help to increase the host inflammatory response, leading to greater gingival bleeding and pocket depth levels (25).

Along with microbial parameters, patient-related variables including age, oral hygiene adherence, nutrition, and appliance wear time have a significant effect on periodontal outcomes that occur during orthodontic treatment (26). Younger patients tend to

show enhanced gingival recovery because they have renewed resilience of tissue, and a lengthy period of appliances has been associated with continuing gingival inflammation (27). Thus, the prevention measures should be planned with both appliance-related and patient-related risks in mind.

Routine scaling and polishing as a form of professional periodontal maintenance are a vital aspect in managing the amount of plaque during orthodontic treatment. It has been demonstrated through clinical trials that patients that are undergoing professional prophylaxis after every three months have had very low plaque scores and inflammation of the gums than patients who make irregular or less frequent visits (28). Consistent scaling breaks down the mature biofilm, decreases the number of bacteria and also increases the efficacy of the daily oral hygiene practices (29).

New systematic reviews reinforce the role of the supportive periodontal therapy as an addition to the orthodontic treatment, especially in patients with poor oral hygiene (30). There is an indication that risk-based individualized maintenance schedules are more effective in enhancing periodontal stability as compared to regular periodontal recall schedules (31). Further, oral hygiene instructions that are reinforced plus professional scaling have shown some synergistic effects in decreasing gingival bleeding and overall periodontal health (32).

Even though there is already an established relationship between orthodontic appliances and gingivitis, few studies have directly compared gingivitis health variables in different levels of professional scaling. Some researchers support scaling every quarter as the most efficient preventive method (33), but others suggest customizing maintenance periods according to the levels of plaque control as well as clinical responsiveness (34). Therefore, the study should be extended to elaborate on the best preventive measure to use in keeping the gums healthy during orthodontics treatment.

To conclude, it has been shown by the existing literature that fixed orthodontic appliances have a substantial effect on gingival health due to the mechanical retention of plaque and microbiological alterations. Professional scaling and supportive periodontal therapy seem to alleviate these negative effects, but the agreement on the most appropriate frequency of scaling is still not established. Thus, it is clinically significant and essential to assess the frequency of professional scaling on the health of the gums of orthodontic patients to create evidence-based prevention regimes.

METHODOLOGY

The study was a cross-sectional observational study done to determine the impact of orthodontic fixed appliances on the condition of the gingiva and to determine the importance of the frequency of professional scaling as a preventive measure. It was conducted within the Orthodontic Departments of selected tertiary care dental hospitals and a number of private orthodontic clinics in a span of six months. The sample size included patients who were receiving conventional fixed orthodontic appliance therapy. The sample size used was 120 patients, as it was calculated with a 95 percent confidence level and an approximate medium effect size with reference to the earlier studies that assessed the changes in the gingiva during orthodontic treatment. Non-probability consecutive sampling strategy was used, whereby patients who qualified for the study and who visited the clinics within the study period were asked to join the study.

Groups of patients aged 15 and 30 years old and those who had been making use of fixed orthodontic appliances for at least three months and were systemically sound were incorporated into the study. Those with systemic disease that impairs periodontal health, those who had undergone antibiotics or anti-inflammatory drugs in the past three months, smokers, and those who already had some periodontal disease before their orthodontic treatment were excluded. The privacy and confidentiality of the patient information were greatly upheld during the research process.

The Demographic and Oral Hygiene Practices Questionnaire was a structured questionnaire that was used to collect the data based on the following criteria: age, gender, orthodontic treatment duration, oral hygiene behavior, like the frequency of brushing and use of interdental aids, and frequency of professional scaling during the

period of orthodontic treatment. The clinical examination was performed with sufficient light with the help of a mouth mirror and a periodontal probe of the necessary caliber. The periodontal indices which included Plaque Index (Silness and Loe, 1964) to indicate the amount of plaque present at the gingival margin, Gingival Index (Loe and Silness, 1963) to determine the severity of gingival inflammation basing on the color, edema and bleeding and finally Bleeding on Probing Index (Ainamo and Bay, 1975) to show how well the gingival responds to probing were used to determine the state of the gingivals. The respondents were divided into three groups based on the frequency of their reporting on the professional scaling every three months (regular scaling), every six months, and irregular or symptomatic visits only.

To achieve reliability and consistency, the principal investigator was calibrated before the data were collected. 10 participants underwent testing twice after 1 week, and intra-examiner reliability was measured by using Cohen's Kappa, and a coefficient of more than 0.80 was considered fine. All clinical observations were documented on an assessment form based on standardization after observing every infection control measure. The data collected were input into SPSS version 25.0, where they were analyzed. Mean, standard deviation, frequencies and percentages were estimated. The independent samples t-tests were used to compare the gingival parameters across genders as well as among regular and irregular scaling groups, and one-way ANOVA was utilized to determine the differences across the categories of scaling frequency. Pearson correlation analysis was conducted to identify the correlation between the orthodontic treatment duration and the parameter of gingival health, and multiple linear regression analysis was done to identify the significant predictors of gingival inflammation. The p-value was considered statistically significant.

RESULTS

Table 1. Demographic Characteristics of Study Participants (n = 120)

Variable	Category	n	%
Age (years)	Mean ± SD	—	21.4 ± 4.2
	15–20	48	40.0
	21–25	42	35.0
	26–30	30	25.0
Gender	Male	52	43.3
	Female	68	56.7
Duration of Braces Wear	< 6 months	34	28.3
	6–12 months	46	38.3
	> 12 months	40	33.3

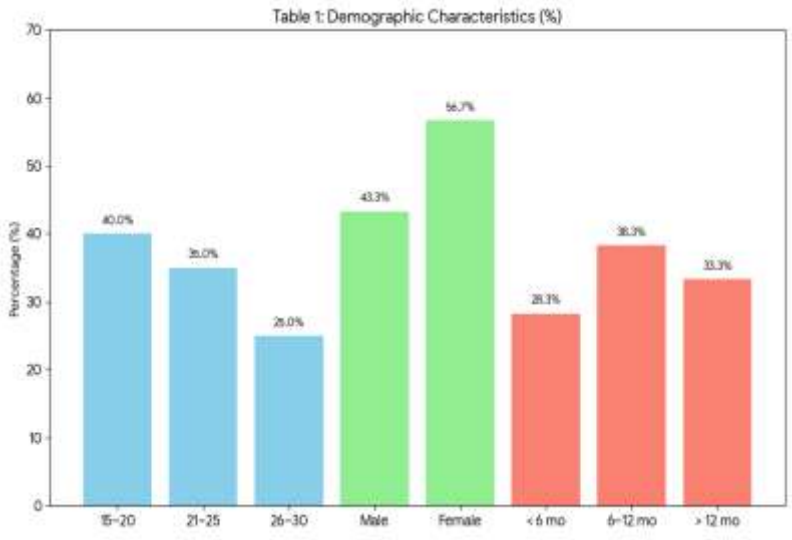

Table 2. Frequency of Professional Scaling During Orthodontic Treatment

Scaling Frequency	n	%
Every 3 months (Regular)	44	36.7
Every 6 months	38	31.7
Irregular / Only When Needed	38	31.7
Total	120	100

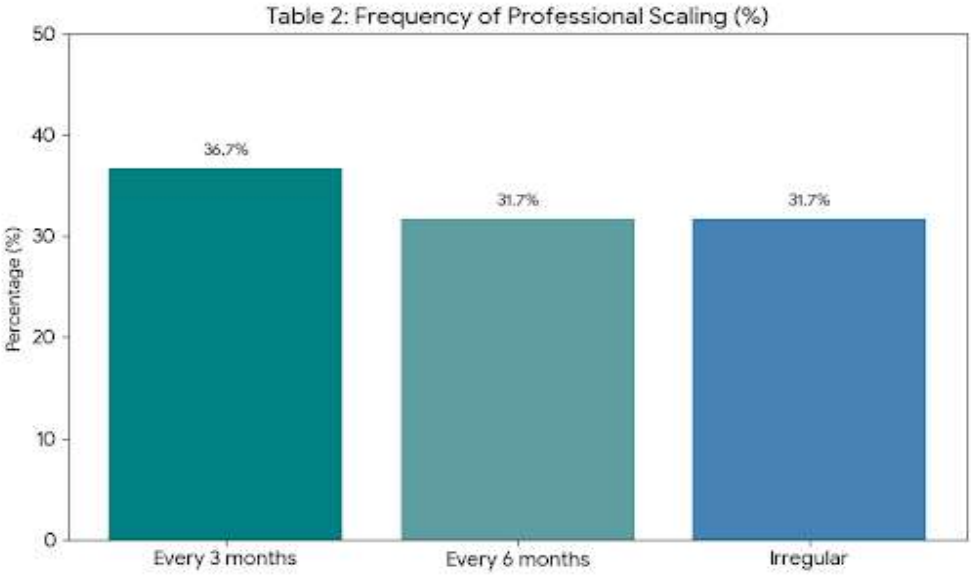

Table 3. Descriptive Statistics of Gingival Health Parameters

Variable	Minimum	Maximum	Mean	Std. Deviation
Plaque Index	0.6	2.8	1.82	0.51
Gingival Index	0.5	2.6	1.65	0.48
Bleeding on Probing (%)	5	65	32.4	14.7

Table 4. Comparison of Gingival Index According to Scaling Frequency (One-Way ANOVA)

Scaling Frequency	Mean Gingival Index	Std. Deviation
Every 3 months	1.28	0.32
Every 6 months	1.67	0.41
Irregular	2.02	0.37

ANOVA Results: $F = 24.63$, $p < 0.001$

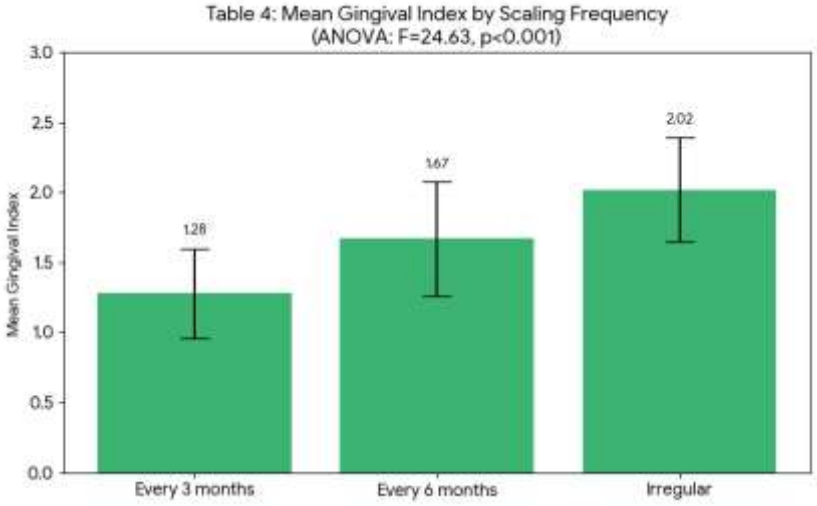

Table 5. Association between Scaling Frequency and Bleeding on Probing

Scaling Frequency	Mild (<20%)	Moderate (20–40%)	Severe (>40%)	Total
Every 3 months	28 (63.6%)	12 (27.3%)	4 (9.1%)	44
Every 6 months	10 (26.3%)	20 (52.6%)	8 (21.1%)	38
Irregular	6 (15.8%)	18 (47.4%)	14 (36.8%)	38

Chi-square: $\chi^2 = 21.47$, df = 4, p = 0.001

Table 6. Independent Samples t-Test: Gingival Index by Gender

Gender	n	Mean	Std. Deviation	Std. Error Mean
Male	52	1.71	0.49	0.068
Female	68	1.6	0.47	0.057

t(118) = 1.29, p = 0.199

Table 7. Correlation Between Duration of Braces Wear and Gingival Health Parameters

Variables	Plaque Index	Gingival Index	Bleeding on Probing
Duration of Braces Wear (months)	r = 0.42*	r = 0.48*	r = 0.45*

*p < 0.001

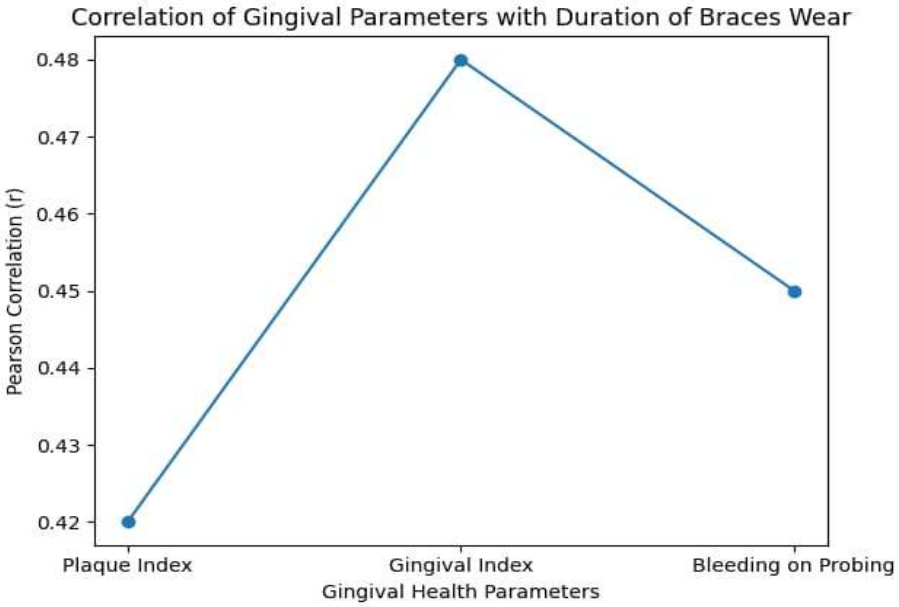

Table 8. Multiple Linear Regression Analysis: Predictors of Gingival Index

Predictor	B	Std. Error	Beta	t	Sig.
Constant	0.72	0.18	—	4.0	0.0
Duration of Braces Wear	0.03	0.007	0.36	4.29	0.0
Scaling Frequency	-0.41	0.08	-0.44	-5.12	0.0
Oral Hygiene Score	0.29	0.09	0.25	3.22	0.002

Table 9. Plaque Index According to Scaling Regularity

Scaling Group	n	Mean Plaque Index	Std. Deviation
Regular (Every 3 months)	44	1.38	0.34
Irregular	38	2.12	0.39

t(80) = -8.74, p < 0.001

DISCUSSION

This was a cross-sectional research that examined the effects of fixed orthodontic appliances on the gingival health status and the preventive effect of professional frequency of scaling. The results show that fixed appliances have a great influence on the periodontal parameters, and this is expressed by the increased level of plaque, gingival inflammation and bleeding on probing among the subjects with irregular or less frequent professional periodontal maintenance. These findings are consistent with what other studies have proposed concerning the orthodontic appliances, which cause an increase in the number of surfaces that trap plaque, thereby increasing the presence of the supragingival biofilm and localized gingival inflammation (35,36).

One of the major etiologic causes of gingivitis in orthodontic therapy is the presence of plaque (37). It hinders effective mechanical plaque control due to the presence of brackets, bands, and archwires, especially in the places adjacent to bonded attachments, which could be the reason for the higher mean plaque and gingival indices in patients with a long period of appliance use or inconsistent scaling (38,39). These results support the clinical significance of targeted plaque management interventions in the course of treatment in order to reduce periodontal tissue reactions.

Further, the findings showed considerable associations between the length of fixed orthodontic treatment and poor gingivitis. This observation goes hand in hand with longitudinal information that prolonged use of orthodontic devices can lead to increased inflammatory alterations in the absence of consistent application of effective biofilm control measures (40,41). It is also worth noting that, in the regression analysis, the frequency and duration of professional scaling were used as important predictors of gingivitis inflammation, which also suggests the interaction between iatrogenic and maintenance factors in the development of periodontal diseases.

In the present research, it was also established that routine professional scaling was also linked to much superior periodontal results as compared to intermittent or random prophylaxis. This observation is in line with interventional studies that show that frequent periodontal maintenance, such as debridement and reinforcement of oral hygiene education, results in significant changes in the accumulation of plaque and gingival bleeding in orthodontic patients (42,43). This supportive periodontal treatment would probably break up mature biofilm and promote better patient self-care by reducing the amount of bacteria and improving the health of the tissue of the gingiva.

The patients with irregular scaling had the greatest levels of gingivitis and bleeding as compared to other patients. These findings support the argument that insufficient periodontal care is a factor in chronic gingivitis and it could result in a higher level of periodontal destruction in case it is not treated (44). In this regard, personalized preventive measures, including professional scaling at the right time, will enhance the outcome of the treatment and minimise/no iatrogenic periodontal risk.

Although it has been reported that supportive periodontal therapy in orthodontic treatment sessions yields positive results (45), it has not been clearly defined or confirmed what the ideal period of scaling is to have the best positive impact on periodontal health. Other studies support the idea of increased professional service, especially among those patients who have been shown to have poor compliance with oral health or high baseline inflammatory measures (46). The literature, as a whole, justifies the need to use risk-based approach in periodontal maintenance as opposed to a fixed-frequency system, and individualized care planning based on individual clinical responses.

The current results indicate the significance of incorporation of periodontal maintenance in orthodontic care regimes. The clinical implications comprise the need to ensure close working relationships of orthodontists and dental hygienists in the terms of checking the condition of the gingiva, reinforcing the oral care procedures and arranging the professional prophylaxis on a regular basis to reduce the number of periodontal complications related to fixed appliances. Through a more holistic, preventative oriented treatment approach, practitioners would be able to achieve a better periodontal outcome among orthodontic patients.

CONCLUSION

This paper concluded that fixed orthodontic devices have a considerable impact on the health of the gingiva, resulting in the exponential presence of plaque, gingival inflammation, and bleeding on probing, especially in patients receiving inconsistent professional scaling. Professional scaling has been demonstrated to be a valuable tool for mitigating these negative effects when performed regularly, and thus it is extremely important as a prevention measure in ensuring the level of periodontal health in the face of orthodontic therapy.

Future Suggestions

The next step in the research should be longitudinal studies on a larger scale to determine the causal relations and the optimal frequency of professional scaling. Moreover, periodontal maintenance protocols should be considered to be personalized and in accordance with risk factors and adherence to oral health in order to further reduce the periodontal complications during orthodontic treatment.

Limitations

The limitations of this study are that it is a cross-sectional study; hence, it cannot be used to make causal inferences, and that it uses self-reported scaling frequency that can result in recall bias. Further studies, preferably through randomized controlled trials with standardized intervals of prophylaxis and objective measures of adherence, could enhance the evidence on the most effective periodontal maintenance model during orthodontic treatment.

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