

Changes in Gingiva with Fixed Orthodontic Appliance: A Clinico-microbiological Study

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Abstract

Background: While undergoing fixed orthodontic therapy, gingiva shows various inflammatory changes with time, such as gingival bleeding and enlargement. Presenting serious clinical concerns. As Fixed Orthodontic Appliance (FOA) interferes with patients' oral hygiene practice, and it aids into furthermore plaque retention, the FOA patients are prone to develop inflammatory diseases of the gingiva. The aims of the study was to evaluate the impact of fixed orthodontic therapy on the patients' periodontal health as well as to test whether orthodontic mechano-therapy could alter the sub-gingival plaque biofilm to a pathogenic flora from a non-pathogenic one, conducive enough for the pathosis. **Materials and Methods:** 70 subjects were included in the study including 50 subjects undergoing fixed orthodontic therapy (referred to as "case") and 20 subjects yet not received brackets (referred to as "control"). Gingival bleeding on probing and *Porphyromona gingivalis* count were measured before the placement of bracket and after 3 months for "cases;" and same were assessed for "controls" at same interval; and both set of data were compared. **Results:** bleeding tendency and *P. gingivalis* count were significantly increased in case population; while that remained unchanged for controls. **Conclusion:** fixed orthodontic therapy favors periodontal disease by plaque retention and subsequent change in sub-gingival microbial flora.

Keywords: Fixed orthodontic appliance, Gingiva, Bleeding, *Porphyromona gingivalis*.

INTRODUCTION

While undergoing fixed orthodontic therapy, gingiva shows various inflammatory changes with time, such as gingival bleeding and enlargement. presenting serious clinical concern. As Fixed Orthodontic Appliance (FOA) interferes with patients' oral hygiene practice, and it adds to furthermore plaque retention, the FOA patients are prone to develop periodontal disease.^[1-4]

As the plaque represents the prime factor for the development of periodontal disease, the virulence and quantity of plaque microbiota have been related to the disease process by many a researchers. According to Marsh (1997), a change in plaque microbial ecology shifts resident bacteria toward pathogens that elicits gingival immune-inflammatory response and the subsequent pathogenesis.^[5]

The change in microbial flora and subsequent change of periodontal condition after placing the orthodontic brackets became a topic of interest since the late 1980s. Boyd (1992)

reported that as many as half of young adults develop significant gingivitis while treated with fixed therapy.^[6] Four factors were pointed by Attack (1996) for periodontal disease following orthodontic therapy, including (1) mechanical trauma from the appliances, (2) chemical irritation from cement used to fix the brackets, (3) food impaction, and (4) plaque retention.^[7] Peti (1997) established the increase in motile rods and spirochetes and reduction of Gram-positive cocci following fixed therapy.^[8]

Sallum (2004) concluded that those periodontal pathogens increased during orthodontic therapy, again reduced after removal of brackets and professional prophylaxis.^[9] Ristic

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(2007) opined that orthodontic therapy transitionally worsen periodontal health, but no lasting damage to deeper tissues occurred.^[10] Van Gastel (2011) suggested that microbial composition and periodontal parameters only partially normalize, 3 months following appliance removal.^[11] Spoorthi (2011) commented that orthodontic therapy not only hampers oral hygiene maintenance, thereby increasing the plaque retention but also creates an environment conducive for a shift of microbial flora from aerobic to anaerobic one.^[12]

The aims of the study was to evaluate the impact of fixed orthodontic therapy on the patients' periodontal health as well as to test whether orthodontic mechano-therapy could alter the sub-gingival plaque biofilm to a pathogenic flora from a non-pathogenic one, conducive enough for the pathosis.

The study was undertaken with objectives to find the changes, if any, in gingival bleeding on probing, among patients undergoing fixed orthodontic therapy, assessed at the beginning of therapy and after 3 months; and to assess the changes, if any, in *Porphyromona gingivalis* by count of colony-forming units in culture of subgingival plaque of patients receiving fixed therapy assessed at beginning of therapy and 3 months later.

MATERIALS AND METHODS

This study was conducted at the Dept. of Orthodontics and Dentofacial Orthopedics at Guru Nanak Institute of Dental Science and Research, Panihati, Kolkata 700114, West Bengal; from January 2015 to December 2015. The periodontal examination with a collection of sample was performed at Department of Periodontics, and the microbiological assay took place at Department of Microbiology of the same.

People, attending to the Department of Orthodontics, for the correction of malocclusion with crowding of upper and lower anterior segment, were subjected to fixed orthodontic therapy, and also qualifying the entry and exclusion criteria, were included in the study. Fifty subjects, who had been planned to begin the therapy immediately and hence received the brackets, were defined as "Case;" while another 20, who had been planned to begin the therapy 3 months later and hence got the brackets after 3 months, were classified as "Controls." So total sample size was 70, including 50 cases and 20 controls.

The entry criteria for the study

- Malocclusion with crowded upper and lower anterior segment up to 2–4 mm
- Voluntary enrollment of the subjects after signing informed consent
- Fair periodontal health of the subjects.

The exclusion criteria of the study

- h/o Systemic illness
- h/o oral/per-enteral antibiotic within last 3 months
- h/o extraction of any permanent tooth except the third molar.

The periodontal examination and bacteriological assay were performed at the beginning of study, i.e., just prior to placement of brackets (T_0), and after 3 months of placement of bracket (T_1) of every subject of both groups. No attrition of sample size was found at the end of the study.

3 index teeth were selected for microbiological and periodontal examination, including right maxillary second premolars, right mandibular second premolars, and right maxillary lateral incisors.

Gingival bleeding on probing was examined on those index teeth using standard tools and protocols.

The subgingival plaque was collected as microbiological sample using two sterile paper points (ISO 45) held parallel to the vertical axis of the tooth and inserted up to the deepest mesio-vestibular point of sulcus and kept for 60 s. Then, the paper points were dipped into reduced Brain-Heart Infusion broth and send to Department of Microbiology. Nitrogen gas was blown continuously with adequate safety measure to ensure minimal oxygen exposure. After suspension on vortex, serial dilution of 10^{-2} , 10^{-3} , and 10^{-4} were prepared of the samples. BG agar as specified by De Hunt *et al.*^[16] was employed as selective growth media for *P. gingivalis*. After the incubation was done, the colonies were counted by the method recommended by Aneja.^[17] Gram stain was also done additionally (Figures 1 and 2).

RESULTS

Seventy subjects, consisting of 50 cases and 20 controls, were included in the study. The data, thus obtained, were entered in Microsoft Excel spreadsheet and thereafter analyzed. "Fisher *t*-test" was applied to determine the non-random relation between the variables. ($P < 0.05$: Significant, $P < 0.01$: Highly significant, $P > 0.05$: non-significant). Qualitative data, such as Bleeding on gingival probing was tested for Pearson's Chi-square goodness of fit, i.e., dependence.

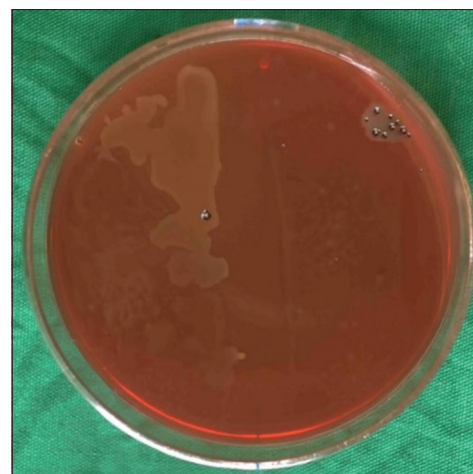


Figure 1: Colonies of *Porphyromona gingivalis* on Columbia agar with Vit-K and sheep blood

Table 1 compares gingival bleeding on probing of the study population at T_0 and T_1 . It shows, there was significant bleeding in the index teeth of the FOA patients at the end of 3 months study.

Table 2 indicates a significant increase in colony count of *P. gingivalis*, after 3 months in the case group.

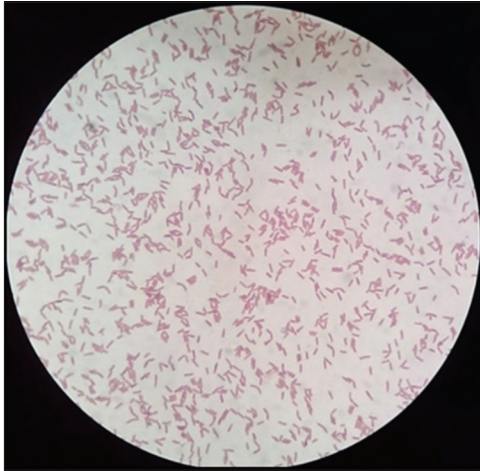


Figure 2: Photo micrograph ($\times 1000$) of gram staining of *Porphyromona gingivalis*

Table 1: Gingival bleeding on probing before and after placement of brackets among case and control population

T_0	Case	Control	χ^2	P-value
Maxillary second premolar				
Present	15	8	0.6475	Non-significant
Absent	35	12		
Mandibular second premolar				
Present	17	10	1.5435	Non-significant
Absent	33	10		
Maxillary lateral incisor				
Present	14	5	0.0650	Non-significant
Absent	36	15		
T_1				
Maxillary second premolar				
Present	47	11	15.2974	<0.0001
Absent	3	9		
Mandibular second premolar				
Present	47	12	12.4684	<0.0005
Absent	3	8		
Maxillary lateral incisor				
Present	46	7	25.2420	<0.00001
Absent	4	13		

DISCUSSION

Orthodontic mechano-therapy impacts on the periodontal tissues and structure in two ways. First, the generated force and subsequent tooth movement result a resorptive change; and in addition, the fixed appliances interferes with hygiene maintenance, thus promoting plaque retention. This brings about inflammatory changes of gingiva. Gingival bleeding on probing estimates best the inflammation of the gingiva. It represents one of the two earliest signs of inflammation of the gingiva. It is the most accepted measure for prevalence and progression of periodontal disease in clinical and epidemiological survey because bleeding is the most objective sign that requires less subjective estimation.^[13] In our study, we assessed the gingival bleeding of the persons receiving fixed orthodontic therapy before and after placement of brackets and compared both. We observed a significant increase in bleeding tendency in the subjects. This resonates with the results obtained by Boyd (1992) and many researches.^[6] *P. gingivalis* is a non-motile, pleomorphic, gram-negative, strict anaerobe. It grows on non-specific blood agar media, under anaerobic environment with dark pigmentation. *P. gingivalis* shows strong proteolytic activity, and it is asaccharolytic.^[14] *P. gingivalis* is an aggressive periodontal pathogen, that belongs to “Red complex” microbiota, which draws special concern as it is related to gingival bleeding on probing.^[15] Since long *P. gingivalis* has been found as high in active periodontitis lesions, and reduced in periodontally healthy sites. Its count has been shown directly proportional to the severity of periodontal disease, and its presence indicates a risk factor for probable attachment loss and bone loss. In this study, samples from sub-gingival plaque of fixed orthodontic patients were collected and sent for bacteriological assay, before and 3 months after placing the brackets, and compared for *P. gingivalis*. A significant increase in colony counts of *P. gingivalis* was found, which was in accordance with that of Petti (1997),^[8] Naranjo (2006),^[15] Van Gastel (2008).^[16] and others. However, it went against the study by Seung Mi Lee (2005), who observed no “statistically significant” increase in *P. gingivalis* count, but reported the appearance of Tannerella forsythia, Treponema denticola, and Prevotella nigrescens in sub-gingival plaque.^[17]

CONCLUSION

The purpose of our study was to estimate the gingival bleeding on probing, as well as *P. gingivalis*-a known periodontal microbiota, mostly associated with bleeding, before and after placing the brackets among orthodontic patients, and

Table 2: Change in colony count of *P. gingivalis* before and after placement of brackets among case and control subjects

CFU count of <i>P. gingivalis</i>	T_0 (mean + sd)	T_1 (mean + sd)	$T_1 - T_0$	t-value	P-value
Case	35.20 $\pm$ 17.6906	87.20 $\pm$ 29.0544	52 $\pm$ 30.4630	7.11896	<0.00005
Control	52 $\pm$ 30.4630	18 $\pm$ 6.7823	2 $\pm$ 8.7177		

P. gingivalis: *Porphyromona gingivalis*

probe whether orthodontic mechano-therapy bears a risk for periodontal disease. Findings from our study indicate that fixed orthodontic therapy favors periodontal disease (assessed in terms of gingival bleeding on probing) by plaque retention and subsequent change in sub-gingival microbial flora (assessed by the increase in colony count of *P. gingivalis*). Hence, before approaching for orthodontic therapy, proper periodontal screening is mandatory. Furthermore, a strict periodic recall system (with oral prophylaxis, whenever needed) must be employed for patients undergoing FOA.

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