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Evaluating the role of Orthodontic Appliances and it's effect on Periodontal Health of patients

1.Dr. Jnananjan Chattopadhyay, 2.Dr. Inder Pal Singh Muzlada, 3. Dr. Mahathi B.Gurijala, 4.Dr. Swati Kesharwani, 5.Dr. Satendra Kumar Agarwal, 6.Dr. Karri Tyson

¹Assistant Professor, Department of Dentistry, Murshidabad Medical College, Berhampore, Murshidabad, WB, India.

²3rd Year PG Student, Department of Oral Pathology and Microbiology, Government Dental College, Indore, M.P., India.

³Senior Lecturer, Department of Orthodontics and Dentofacial Orthopaedics, Bhabha College of Dental Sciences, Bhopal, M.P., India.

^{4,5}Reader, KGF College of Dental Sciences and Hospital, KGF, Karnataka, 563115, India.

⁶3rd Year PG Student, Department of Oral Pathology and Microbiology, Bhabha College of Dental Sciences, Bhopal, M.P., India.

Corresponding author: Dr. Jnananjan Chattopadhyay

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Abstract

Background

Orthodontic appliances are widely used to correct malocclusions and improve dental aesthetics and function. However, their impact on periodontal health remains a concern, as these appliances can contribute to plaque accumulation, leading to gingival inflammation and periodontal disease. This study aimed to evaluate the role of orthodontic appliances and their effects on the periodontal health of patients undergoing orthodontic treatment.

Materials and Methods

A total of 100 patients undergoing orthodontic treatment were selected for this study. Patients were divided into two groups: Group A (fixed orthodontic appliances, n=50) and Group B (removable orthodontic appliances, n=50). Periodontal health was assessed using the Gingival Index (GI), Plaque Index (PI), and Probing Depth (PD) at baseline, 3 months, and 6 months. Statistical analysis was performed using paired t-tests and ANOVA to compare the periodontal parameters between the two groups and across different time points.

Results

At baseline, there were no significant differences in GI, PI, or PD between the two groups ($p>0.05$). However, at 3 months, Group A showed a significant increase in GI and PI compared to Group B ($p<0.05$). By 6 months, Group A exhibited higher PD values, indicating early signs of periodontal attachment loss ($p<0.01$). In contrast, Group B maintained relatively stable periodontal parameters throughout the study period.

Conclusion

Fixed orthodontic appliances are associated with a higher risk of periodontal health deterioration compared to removable appliances. The findings suggest that patients with fixed appliances require more rigorous oral hygiene practices and regular periodontal monitoring to prevent potential periodontal complications during orthodontic treatment.

Keywords: Orthodontic appliances, periodontal health, gingival index, plaque index, probing depth, fixed appliances, removable appliances.

Introduction

Orthodontic treatment has become an essential aspect of modern dentistry, offering functional and aesthetic benefits by correcting malocclusions and improving overall oral health. However, the placement of orthodontic appliances, particularly fixed appliances, has been associated with various challenges concerning periodontal health. These appliances create additional retentive areas for plaque accumulation, leading to an increased risk of gingivitis and periodontitis if proper oral hygiene is not maintained (1,2).

The complex design of fixed orthodontic appliances, including brackets, bands, and wires, makes it difficult for patients to maintain optimal oral hygiene, resulting in increased plaque retention and subsequent gingival inflammation. Studies have shown that the presence of these appliances is correlated with elevated levels of plaque and gingival indices (3,4). Moreover, the duration of orthodontic treatment has been identified as a critical factor in the progression of periodontal disease, with longer treatment times potentially exacerbating periodontal complications (5).

In contrast, removable orthodontic appliances are believed to have a less detrimental impact on periodontal health due to their ability to be removed during oral hygiene practices. However, there is still limited comparative research available on the differential effects of fixed versus removable appliances on periodontal health over extended treatment periods.

This study aims to evaluate the role of orthodontic appliances in the context of periodontal health, comparing the effects of fixed and removable appliances on key periodontal parameters, including the Gingival Index (GI), Plaque Index (PI), and Probing Depth (PD). By understanding the periodontal implications of different orthodontic treatment modalities, clinicians can better tailor their treatment plans to minimize the risk of periodontal complications in patients undergoing orthodontic therapy.

Materials and Methods

Study Design and Population

A total of 100 patients requiring orthodontic treatment were recruited for the study. The inclusion criteria were patients aged 18-35 years with healthy periodontal status at baseline, no history of periodontal therapy in the past 6 months, and no systemic conditions affecting periodontal health. Patients with a history of smoking, pregnancy, or use of medications affecting periodontal health were excluded from the study.

Group Allocation

The 100 patients were randomly assigned into two groups:

- **Group A (Fixed Appliances):** This group included 50 patients treated with fixed orthodontic appliances, comprising metal brackets, bands, and archwires.
- **Group B (Removable Appliances):** This group included 50 patients treated with removable orthodontic appliances, such as clear aligners or removable retainers.

Periodontal Assessment

Periodontal health was assessed using three key parameters:

- **Gingival Index (GI):** The GI was used to assess the severity of gingival inflammation on a scale from 0 to 3, where 0 indicates healthy gingiva and 3 indicates severe inflammation with spontaneous bleeding (1).

- **Plaque Index (PI):** The PI was measured using the Silness-Löe Plaque Index, scoring plaque accumulation on a scale from 0 to 3, where 0 indicates no plaque and 3 indicates an abundance of soft matter within the gingival pocket or on the tooth and gingival margin (2).
- **Probing Depth (PD):** PD was measured using a Williams periodontal probe, recording the distance from the gingival margin to the base of the periodontal pocket at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual, disto-lingual) (3).

Assessments were conducted at three time points: baseline (before appliance placement), at 3 months, and at 6 months post-placement of orthodontic appliances.

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means and standard deviations, were calculated for GI, PI, and PD for each group at each time point. Paired t-tests were used to compare changes in periodontal parameters within each group over time, and independent t-tests were used to compare the periodontal parameters between the two groups at each time point. Analysis of Variance (ANOVA) was performed to assess the overall effect of time and appliance type on periodontal health. A p-value of <0.05 was considered statistically significant.

Results

The study included 100 patients who were randomly assigned to Group A (fixed appliances) and Group B (removable appliances), with 50 patients in each group. The periodontal health of all participants was evaluated at baseline, 3 months, and 6 months using the Gingival Index (GI), Plaque Index (PI), and Probing Depth (PD). The results are summarized in the tables below.

Table 1: Comparison of Gingival Index (GI) Between Group A and Group B

Time Point	Group A (Fixed Appliances) Mean \pm SD	Group B (Removable Appliances) Mean \pm SD	p-value
Baseline	0.72 \pm 0.15	0.71 \pm 0.16	0.780
3 Months	1.45 \pm 0.20	0.95 \pm 0.18	<0.001
6 Months	2.10 \pm 0.25	1.12 \pm 0.20	<0.001

At baseline, there was no significant difference in the Gingival Index between the two groups ($p=0.780$). However, by 3 months, Group A exhibited a significant increase in GI compared to Group B ($p<0.001$). This trend continued at 6 months, with Group A showing significantly higher GI values than Group B ($p<0.001$).

Table 2: Comparison of Plaque Index (PI) Between Group A and Group B

Time Point	Group A (Fixed Appliances) Mean \pm SD	Group B (Removable Appliances) Mean \pm SD	p-value
Baseline	0.85 \pm 0.18	0.83 \pm 0.17	0.650
3 Months	1.78 \pm 0.22	1.05 \pm 0.19	<0.001

6 Months	2.35 ± 0.30	1.22 ± 0.21	<0.001
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Similar to the GI, the Plaque Index did not differ significantly between the groups at baseline ($p=0.650$). By 3 months, Group A had a significantly higher PI compared to Group B ($p<0.001$), and this difference further increased by 6 months ($p<0.001$).

Table 3: Comparison of Probing Depth (PD) Between Group A and Group B

Time Point	Group A (Fixed Appliances) Mean ± SD (mm)	Group B (Removable Appliances) Mean ± SD (mm)	p-value
Baseline	2.25 ± 0.30	2.22 ± 0.32	0.720
3 Months	2.70 ± 0.35	2.35 ± 0.28	<0.001
6 Months	3.10 ± 0.40	2.45 ± 0.30	<0.001

Probing depth measurements were similar between the two groups at baseline ($p=0.720$). By 3 months, Group A showed a significant increase in PD compared to Group B ($p<0.001$). At 6 months, the PD in Group A increased further, indicating early signs of periodontal attachment loss, and was significantly higher than that in Group B ($p<0.001$).

Summary of Results

- **Gingival Index (GI):** Group A showed a significant increase in GI at 3 and 6 months compared to Group B ($p<0.001$).
- **Plaque Index (PI):** Group A exhibited significantly higher PI values at 3 and 6 months compared to Group B ($p<0.001$).
- **Probing Depth (PD):** Group A demonstrated a significant increase in PD at 3 and 6 months compared to Group B ($p<0.001$).

These findings indicate that patients with fixed orthodontic appliances experienced greater deterioration in periodontal health compared to those with removable appliances.

Discussion

The findings of this study highlight the significant impact of orthodontic appliances on periodontal health, particularly in patients with fixed appliances. The results indicate that fixed orthodontic appliances are associated with higher Gingival Index (GI), Plaque Index (PI), and Probing Depth (PD) values over time, suggesting a greater risk of periodontal deterioration in these patients compared to those with removable appliances.

The increased GI and PI values observed in Group A (fixed appliances) at both 3 and 6 months align with previous studies that have documented the challenges associated with maintaining oral hygiene in the presence of fixed orthodontic appliances. Fixed appliances create additional plaque retention areas, which can lead to an accumulation of bacterial plaque and subsequent gingival inflammation (1,2). This is consistent with the work of Årtun and Al-Azemi (3), who reported that patients with fixed appliances tend to experience a higher incidence of gingival inflammation and plaque accumulation compared to those with removable appliances.

Moreover, the significant increase in Probing Depth (PD) observed in Group A suggests that prolonged use of fixed orthodontic appliances may contribute to early periodontal attachment loss. This finding corroborates the results of Zachrisson and Alnaes (4), who found that orthodontic treatment with fixed appliances could lead to an increase in probing depth, particularly in patients with poor oral hygiene practices. The progressive increase in PD over

the 6-month period in this study emphasizes the need for vigilant periodontal monitoring and intervention in patients undergoing fixed orthodontic treatment.

In contrast, the relatively stable periodontal parameters observed in Group B (removable appliances) underscore the potential benefits of these appliances in reducing the risk of periodontal complications. Removable appliances allow for better oral hygiene maintenance as they can be taken out during brushing and flossing, minimizing plaque accumulation and gingival inflammation (5). This is supported by Naranjo et al. (6), who noted that patients with removable appliances generally exhibit better periodontal health outcomes compared to those with fixed appliances.

The results of this study have important clinical implications. First, they underscore the necessity for orthodontists to educate patients with fixed appliances about the importance of meticulous oral hygiene and regular periodontal check-ups. Second, they suggest that, where feasible, the use of removable appliances might be preferable in patients with a high risk of periodontal disease or those who may struggle with oral hygiene practices.

Despite these findings, the study has some limitations. The relatively short follow-up period of 6 months may not fully capture the long-term effects of orthodontic appliances on periodontal health. Future studies with longer follow-up periods are needed to better understand the chronic impact of these appliances on periodontal status. Additionally, this study did not account for the variability in patients' oral hygiene practices, which could influence periodontal outcomes.

Conclusion

In conclusion, this study demonstrates that fixed orthodontic appliances pose a greater risk to periodontal health than removable appliances, as evidenced by higher GI, PI, and PD values over time. Clinicians should consider these risks when planning orthodontic treatment and implement strategies to mitigate potential periodontal complications.

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