



THE EFFECT OF CORRECTION OF ANOMALOUS PEAKS DURING ORTHODONTIC TREATMENT ON PERIODONTAL TISSUES

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ABSTRACT

The correction of occlusal anomalies through orthodontic treatment remains one of the most significant challenges in modern dentistry, as it involves not only the realignment of dental arches but also the preservation of periodontal health. Orthodontic interventions directly influence the condition of periodontal tissues due to the application of mechanical forces that trigger complex biological responses in alveolar bone, periodontal ligament, and gingival structures. This article explores the relationship between orthodontic treatment and periodontal health, with particular attention to the possible risks and preventive strategies. The clinical and radiographic findings presented demonstrate how orthodontic biomechanics may lead to both positive and negative periodontal outcomes depending on patient-specific conditions and treatment approaches. The article emphasizes the necessity of interdisciplinary collaboration between orthodontists and periodontists to ensure long-term functional and aesthetic stability.

Keywords. Orthodontic treatment, periodontal tissues, occlusal anomalies, biomechanics, alveolar bone, gingiva, orthodontic forces, periodontium, oral health, interdisciplinary dentistry.

АННОТАЦИЯ

Коррекция окклюзионных аномалий посредством ортодонтического лечения остается одной из важнейших задач современной стоматологии, поскольку она включает в себя не только выравнивание зубных дуг, но и сохранение здоровья пародонта. Ортодонтические вмешательства напрямую влияют на состояние тканей пародонта из-за приложения механических сил, которые вызывают сложные биологические реакции в альвеолярной кости, пародонтальной связке и десневых структурах. В данной статье рассматривается взаимосвязь между ортодонтическим лечением и здоровьем пародонта, с особым вниманием к возможным рискам и профилактическим стратегиям. Представленные клинические и рентгенологические данные демонстрируют, как ортодонтическая биомеханика может приводить как к положительным, так и к отрицательным результатам в отношении пародонта в зависимости от индивидуальных особенностей пациента и подходов к лечению. В статье подчеркивается необходимость междисциплинарного сотрудничества ортодонтонтов и пародонтологов для обеспечения долгосрочной функциональной и эстетической стабильности.

Ключевые слова. Ортодонтическое лечение, ткани пародонта, аномалии окклюзии, биомеханика, альвеолярная кость, десна, ортодонтические силы, пародонт, здоровье полости рта, междисциплинарная стоматология.

INTRODUCTION

Orthodontics and periodontology are two closely interconnected branches of dental science, as the correction of malocclusion is inherently dependent on the integrity and health of periodontal structures. Periodontal tissues—including the gingiva, periodontal ligament, alveolar bone, and



cementum—act as the biological foundation upon which orthodontic forces are applied. Any change in tooth position inevitably exerts stress and strain upon these structures, stimulating bone remodeling and cellular activity within the ligament. While controlled orthodontic forces can induce favorable remodeling processes, poorly managed or excessive force application can result in tissue damage, bone resorption, or even loss of periodontal attachment.

Occlusal anomalies, such as open bite, crossbite, deep bite, and crowding, represent functional and aesthetic challenges that affect a significant portion of the global population. Epidemiological data suggest that malocclusion prevalence among adolescents ranges from 39% to 93% depending on diagnostic criteria and region. Left untreated, occlusal anomalies can lead to masticatory dysfunction, temporomandibular joint disorders, impaired aesthetics, and psychological discomfort. Orthodontic treatment, whether by fixed appliances, aligners, or surgical-orthodontic combinations, offers effective solutions to these anomalies. However, the success of such treatments must be judged not only by the alignment of teeth but also by the preservation of periodontal health.

One of the most debated aspects in contemporary orthodontics is the extent to which orthodontic appliances contribute to periodontal risk factors. Fixed appliances, for example, often complicate oral hygiene, creating niches for plaque accumulation, which in turn heightens the risk of gingivitis and periodontitis. Moreover, the biomechanical forces transmitted through brackets and wires cause controlled inflammation of periodontal tissues, which is a prerequisite for tooth movement but can become pathologic if the balance between force magnitude, duration, and tissue capacity is disturbed.

Orthodontic tooth movement (OTM) is mediated by cellular and molecular mechanisms within the periodontium. Osteoclasts resorb bone on the pressure side, while osteoblasts deposit bone on the tension side, thus allowing the tooth to migrate within the alveolus. The periodontal ligament, richly supplied with fibroblasts, blood vessels, and sensory nerve fibers, undergoes compression and stretching. This biological remodeling, however, requires intact vascularization and a favorable inflammatory balance. In patients with pre-existing periodontal compromise, orthodontic treatment may accelerate bone loss, whereas in healthy individuals, it often leads to enhanced functional adaptation of tissues.

Recent advances in digital orthodontics, such as aligner therapy and temporary anchorage devices (TADs), have introduced new paradigms in minimizing periodontal complications. Aligner systems offer better hygiene control and reduced plaque accumulation compared to traditional brackets. Similarly, the use of low-force, continuous systems has been associated with more physiological tissue responses. Nonetheless, no orthodontic intervention is free from periodontal risk, and continuous monitoring is indispensable.

The aim of this article is to provide an in-depth analysis of the impact of orthodontic treatment on periodontal tissues during the correction of occlusal anomalies. The study investigates how various orthodontic forces affect alveolar bone remodeling, gingival conditions, and long-term periodontal stability. Furthermore, it discusses preventive measures and clinical strategies that can mitigate periodontal risks during orthodontic therapy. By integrating clinical evidence with biological insights, this article seeks to contribute to a comprehensive understanding of the delicate balance between orthodontic correction and periodontal health.

LITERATURE ANALYSIS AND METHODOLOGY

A vast body of literature has explored the interrelationship between orthodontic treatment and periodontal health. Early research in the mid-20th century primarily emphasized mechanical principles, focusing on tooth movement and force application. However, as periodontology

developed, researchers began to analyze how orthodontic interventions affect gingival tissues, bone metabolism, and systemic inflammatory responses.

Several studies indicate that orthodontic appliances may predispose patients to periodontal complications, especially in cases where oral hygiene is compromised. According to Zachrisson and Alnaes (1974), fixed orthodontic appliances significantly increased plaque accumulation and gingival inflammation within weeks of placement. More recent findings, however, reveal that with proper hygiene education and preventive periodontal therapy, such risks can be minimized.

Another area of interest has been the role of force magnitude and direction in periodontal response. Proffit and Fields (2019) argue that light, continuous forces are biologically optimal for inducing tooth movement with minimal periodontal trauma. In contrast, heavy or intermittent forces often result in hyalinization of the periodontal ligament, undermining its capacity for bone remodeling.

Additionally, recent systematic reviews highlight the impact of orthodontic treatment on alveolar bone density and height. Multiple clinical trials utilizing cone-beam computed tomography (CBCT) have documented minor alveolar bone loss during orthodontic tooth movement, though most changes are reversible with adequate retention and periodontal maintenance.

The emergence of clear aligner systems has significantly altered the discourse on orthodontics and periodontology. Unlike fixed appliances, aligners facilitate improved oral hygiene and reduce plaque-induced inflammation. However, aligners are not immune to complications, as improper fit or extended wear may still induce gingival irritation.

Furthermore, interdisciplinary studies have examined patients with pre-existing periodontitis undergoing orthodontic treatment. While historically considered contraindicated, recent evidence suggests that with careful planning and periodontal stabilization, orthodontic therapy may enhance long-term tooth prognosis by redistributing occlusal forces more favorably.

Thus, the literature emphasizes three key points: (1) orthodontic treatment has inherent periodontal risks, (2) these risks can be mitigated through careful biomechanical planning and hygiene protocols, and (3) collaborative care between orthodontists and periodontists is essential for successful outcomes.

This study employed a prospective clinical observational design. A total of 60 patients aged 15–35 with occlusal anomalies (crowding, deep bite, crossbite) were recruited from the orthodontic department of a university dental clinic. Patients with systemic conditions, uncontrolled periodontitis, or poor compliance were excluded.

All participants were divided into two groups:

1. **Group A:** Treated with fixed appliances (conventional brackets).
2. **Group B:** Treated with clear aligner systems.

Clinical periodontal parameters including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were measured at baseline, 6 months, and 12 months. Radiographic assessment of alveolar bone height was performed using CBCT at baseline and after 12 months.

Orthodontic forces were standardized to light continuous forces (25–50 g) for alignment and leveling. Patients received identical oral hygiene instructions and were provided with fluoride-containing toothpaste. Professional prophylaxis was conducted every three months.

Data were analyzed using SPSS software, with paired t-tests to assess intra-group changes and ANOVA for inter-group comparisons. A p-value <0.05 was considered statistically significant.

RESULTS

The clinical and radiographic evaluation of 60 patients demonstrated that orthodontic treatment for occlusal anomaly correction inevitably influenced periodontal parameters. A comparative analysis between patients treated with fixed appliances (Group A) and those treated with aligners (Group B) revealed measurable but distinct outcomes.

At baseline, both groups exhibited no statistically significant differences in plaque index (PI), gingival index (GI), probing pocket depth (PPD), or clinical attachment level (CAL). After six months of treatment, an increase in PI and GI was noted in both groups, with more pronounced changes in Group A. At 12 months, periodontal alterations were further accentuated in patients with fixed appliances, while aligner-treated individuals demonstrated relatively stable parameters.

Radiographic CBCT analysis confirmed measurable alveolar bone remodeling in both groups. Group A patients exhibited a mean bone height reduction of 0.6 mm after 12 months, whereas Group B showed a smaller reduction of 0.2 mm. The differences between the groups were statistically significant ($p < 0.05$).

Table 1. Comparative changes in periodontal parameters after 12 months

Parameter	Group A (Fixed appliances)	Group B (Aligners)	Significance (p)
Plaque Index (PI)	1.1 ± 0.4	0.4 ± 0.2	<0.01
Gingival Index (GI)	0.9 ± 0.3	0.3 ± 0.2	<0.01
Probing Pocket Depth (PPD, mm)	0.5 ± 0.2	0.1 ± 0.1	<0.05
Clinical Attachment Loss (CAL, mm)	0.4 ± 0.2	0.1 ± 0.1	<0.05
Alveolar Bone Height Change (mm)	-0.6 ± 0.3	-0.2 ± 0.2	<0.05

The findings indicate that orthodontic treatment caused statistically significant increases in plaque accumulation and gingival inflammation across both groups, but the magnitude of these changes differed depending on the appliance system. The aligner group demonstrated significantly less deterioration in periodontal health compared to patients treated with fixed appliances.

Overall, the results confirm that appliance type, hygiene accessibility, and biomechanical force distribution exert measurable effects on periodontal outcomes during orthodontic correction of occlusal anomalies.

DISCUSSION

The results of this study reinforce existing evidence that orthodontic treatment has measurable effects on periodontal tissues. The greater changes observed in Group A highlight the well-documented association between fixed appliances and increased plaque accumulation. These findings align with previous research by Attack et al. (1996), who demonstrated that fixed orthodontic appliances exacerbate plaque-induced gingivitis.

The lower periodontal risk in Group B underscores the advantages of aligner therapy. Improved access to tooth surfaces for oral hygiene likely explains the reduced inflammatory response. Moreover, aligners distribute forces more evenly across teeth, potentially reducing localized pressure and bone resorption.

Nevertheless, orthodontic forces inherently induce biological remodeling, which can transiently increase probing depths and cause minor bone loss. The challenge lies in distinguishing



physiological adaptation from pathological breakdown. This emphasizes the importance of patient selection, periodontal monitoring, and customized biomechanical strategies.

Another key finding is that controlled, light forces contributed to relatively stable periodontal outcomes. This observation supports the concept that biological compatibility of orthodontic forces is critical in minimizing tissue damage. Excessive or improperly directed forces may lead to irreversible attachment loss, particularly in patients with thin biotypes or pre-existing periodontal vulnerabilities.

Clinically, these results highlight the importance of interdisciplinary collaboration. Orthodontists must work closely with periodontists to evaluate baseline periodontal status and to establish maintenance protocols throughout treatment. Periodontal prophylaxis at regular intervals, patient education, and early management of gingival inflammation are indispensable in preventing long-term complications.

CONCLUSION

Orthodontic treatment for occlusal anomalies inevitably impacts periodontal tissues. While both fixed appliances and aligners can induce changes in plaque levels, gingival health, and alveolar bone structure, the severity of these changes largely depends on appliance type, force magnitude, and oral hygiene compliance. Aligners demonstrated superior outcomes with fewer adverse effects on periodontal health compared to fixed appliances.

The study underscores the necessity of integrating periodontal care into orthodontic protocols. Careful case selection, application of light continuous forces, and strict hygiene measures are vital for minimizing periodontal risks. Future research should further explore molecular biomarkers of periodontal response during orthodontic therapy to enhance predictive capacity and individualized treatment strategies.

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