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Original Article

Effect of orthodontic treatment on periodontal health and masticatory function in patients with anterior teeth displacement due to periodontal disease

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Abstract: Aims: To evaluate the combined effect of orthodontic treatment and periodontal care on improving periodontal health and masticatory function in patients with anterior teeth displacement caused by periodontal disease. Methods: This retrospective study involved 200 patients with anterior teeth displacement due to periodontal disease, treated between January 2022 and January 2025. Patients were divided into a control group (n=103), receiving standard periodontal treatment, and an observation group (n=97), receiving combined periodontal and orthodontic treatment. Clinical measurements, including probing depth (PD), clinical attachment level (CAL), gingival bleeding index (GBI), occlusal force, and chewing efficiency, were taken before, after treatment, and during a 12-month follow-up. Paired t-tests and regression models compared the outcomes. Results: The observation group showed significant improvement in periodontal health compared to the control group (P>0.05). Post-treatment, CAL, GBI and PD decreased significantly (all P<0.001). Masticatory function, including occlusal force and chewing efficiency, improved significantly in the observation group (P<0.001). The overall effective rate was higher in the observation group (96.91%) compared to the control group (74.75%) (P=0.017). Additionally, pain levels, measured by visual analog scale (VAS), were lower in the observation group (P<0.001). Incidence of dental diseases, including gingival bleeding and periodontal abscess, was also significantly lower (P<0.001). Multivariate analysis identified orthodontic treatment (OR: 2.883, 95% CI: 2.183-3.799, P<0.001) as a significant contributor to clinical efficacy. Conclusion: The combination of orthodontic treatment and periodontal care significantly enhances periodontal health, masticatory function, and reduces dental complications in patients with anterior teeth displacement due to periodontal disease.

Keywords: Orthodontic treatment, periodontal health, masticatory function, anterior teeth displacement, periodontal disease

Introduction

Periodontal disease is a prevalent condition that significantly impacts oral health, leading to various complications such as tooth mobility, loss, and displacement, particularly in the anterior region [1]. Anterior teeth displacement due to periodontal disease not only affects aesthetics but also worsens masticatory function and further compromises periodontal health [2]. Over the years, numerous studies have highlighted the importance of periodontal treatment in mitigating these issues. However, limited information is available regarding the benefits of orthodontic treatment in such cases [3]. Orthodontic therapy, primarily aimed at correcting malocclusion and improving dental alignment, may offer substantial advantages in restoring both functional and aesthetic outcomes, especially in patients with anterior teeth displacement caused by periodontal disease.

The application of orthodontic treatment in patients with periodontal disease presents both challenges and benefits. While orthodontics can correct misaligned teeth and restore occlusal function, it is crucial to consider the

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patient's underlying periodontal health, as a negative outcome may exacerbate existing issues, such as further attachment loss or root resorption [4]. Existing literature on the efficacy of orthodontics in such patients presents inconsistent findings, with some studies reporting success in stabilizing and improving the function of teeth, while others emphasize the risks associated with moving teeth in compromised periodontal structures [5-7]. The effect of orthodontic treatment on periodontal health and masticatory function remains a controversial subject and warrants further investigation to understand its long-term effects and safety.

In addition to aligning teeth, orthodontic treatment can significantly impact masticatory function [8]. Proper alignment and occlusion are essential for effective chewing and overall oral health. Anterior teeth displacement due to malocclusion from periodontal disease often disrupts normal masticatory function, leading to difficulties in chewing, excessive tooth wear, and temporomandibular joint discrepancies [9, 10]. While orthodontic therapy may improve functional aspects, the potential benefits for masticatory efficiency and overall oral health in these patients have not been fully explored.

The aim of this study is to assess the success of orthodontic treatment in improving periodontal health and masticatory function in individuals with anterior teeth displacement caused by periodontal disease. By comparing pre-treatment and post-treatment outcomes, this study seeks to provide a clearer understanding of how orthodontics can aid in regenerating periodontal conditions and enhancing masticatory function. Furthermore, this research aims to fill a gap in the existing literature, providing valuable insights for clinicians and informing their approach to similar patient cases.

Materials and methods

Case selection

A retrospective analysis was conducted on 200 patients with anterior teeth displacement due to periodontal disease at Songjiang Hospital from January 2022 to January 2025. This study was approved by the Ethics Committee of Songjiang Hospital, Affiliated to Shanghai Jiao Tong University Medical School. Based on treatment methods, patients were divided into a control group receiving periodontal basic treatment (n=103) and an observation group receiving periodontal basic treatment combined with orthodontic treatment (n=97).

Inclusion criteria: (1) Participants aged 18-65 years, both male and female. (2) Diagnosis of anterior teeth displacement due to periodontal disease confirmed by X-ray and clinical symptoms [11]. (3) Complete clinical data.

Exclusion criteria: (1) Patients with uncontrolled systemic diseases, such as diabetes, cardiovascular disorders, or any condition that could interfere with periodontal or orthodontic treatment. (2) Pregnant or breastfeeding women, as these conditions may affect treatment outcomes. (3) Patients with severe skeletal malocclusion not amenable to conventional orthodontic methods or those with severe bruxism or parafunctional habits that could interfere with orthodontic treatment. (4) Individuals with advanced or aggressive periodontitis requiring surgical intervention at the start of the study. (5) Patients with cognitive or psychological disorders that would prevent them from understanding or adhering to the treatment protocol or attending follow-up visits. (6) Individuals unable or unwilling to comply with study requirements, including follow-up visits and adherence to oral hygiene instructions. (7) Patients who had received orthodontic treatment within the last five years or had undergone periodontal surgery in the same area prior to the study.

Intervention methods

Patients in the control group received standard periodontal treatment, which included initial non-surgical therapy aimed at reducing periodontal inflammation and improving oral hygiene. This typically involved scaling and root planing (SRP), followed by comprehensive oral hygiene instruction. After the initial therapy, patients were re-evaluated, and maintenance therapy was provided at regular intervals to ensure long-term periodontal health. No orthodontic treatment was administered.

In addition to the periodontal basic treatment outlined above, patients in the observation group also underwent orthodontic intervention. After the initial periodontal therapy, orthodontic treatment was provided to correct anterior teeth displacement due to periodontal disease.

The orthodontic approach was tailored to each patient's needs, using either fixed or removable appliances to align the anterior teeth while preserving periodontal health. The treatment plan was carefully adjusted to avoid exacerbating the periodontal condition, aiming to improve occlusion and function. Close monitoring was conducted throughout the treatment period to assess its impact on both periodontal health and masticatory function.

Data collection and outcome measurement

Data were collected at three time points: (1) baseline (pre-treatment), (2) immediately post-treatment (after completion of orthodontic therapy), and (3) at the 12-month follow-up. Clinical measurements (probing depth (PD), clinical attachment level (CAL), gingival bleeding index (GBI)) were taken by trained periodontists blinded to group assignments. Masticatory function tests (occlusal force and chewing efficiency) were performed by a trained dental technician.

The primary outcomes included improvements in periodontal health and masticatory function following orthodontic treatment. Periodontal health was assessed using: (1) PD: Measured at six sites around each tooth using a periodontal probe [12]. (2) Clinical Attachment Level (CAL): Measured from the cemento-enamel junction to the base of the sulcus [13]. (3) Gingival Bleeding Index (GBI): A score indicating the presence of gingival inflammation.

Masticatory function was assessed based on: (1) Occlusal force: Measured using a bite force gauge (e.g., [Brand and Model]) [14]. (2) Chewing efficiency: Assessed using a color-changing chewing gum test to assess food triturating ability, with higher scores indicating better function [15]. Clinical efficacy was categorized as follows [16]: (1) Significant effect: Complete or partial disappearance of periodontal pockets, resolution of symptoms, and restoration of anterior teeth position and occlusal function, remaining stable over time. (2) Moderate effect: Visible improvements in periodontal status, some recovery of anterior teeth position, partial recovery of occlusal function, with slight mobility of teeth. (3) No effect: No improvement in periodontal condition or anterior teeth movement, with persistent periodontal disease symptoms.

Overall clinical efficacy was calculated by combining the "Significant Effect" and "Moderate Effect" groups to determine the total effective rate. This method provides a clear assessment of treatment outcomes, combining both objective and subjective evaluations.

The secondary outcomes included aesthetic changes and patient satisfaction, assessed via the Visual Analog Scale (VAS) [17] and inflammatory index. VAS scores were recorded before intervention and one week post-treatment.

Inflammatory index testing: Inflammatory markers, including C-reactive Protein (CRP), Procalcitonin (PCT), and White Blood Cell (WBC) count, were assessed before and after treatment. CRP levels were measured using a high-sensitivity ELISA method, with results expressed in mg/L. PCT levels were measured using a Human Procalcitonin ELISA Kit (Catalog No. E-EL-H0890, Elabscience, USA), with results expressed in ng/mL. WBC count was determined using an automated hematology analyzer (e.g., Sysmex XN-1000, Sysmex Corporation, Japan), with results expressed in *10^9/L.

Sample size calculation

The sample size was calculated to achieve sufficient statistical power to detect significant differences between the two groups. A power analysis, based on expected effect sizes for the primary outcomes (CAL, PD, and masticatory function), was performed. With a significance level of 0.05 and a power of 80%, the required sample size for each group was estimated using standard statistical formulas for comparing two independent means. Based on these calculations, 103 patients in the control group and 97 in the observation group were determined to provide sufficient power to detect clinically meaningful differences. This sample size ensures the study can adequately detect significant improvements in periodontal health and masticatory function, while maintaining an acceptable margin for error.

Statistical analysis

Statistical analyses were conducted using SPSS software (version 22.0, IBM Corp., Armonk, NY, USA). Descriptive statistics summarized baseline characteristics. Paired t-tests

Table 1. Comparison of clinical characteristics between the two groups

Parameter	Control Group (n=103)	Observation Group (n=97)	t/χ^2	*P*-value
Age (years)	42.62 ± 12.37	43.38 ± 11.74	0.451	0.653
Gender (Male/Female)	45/58	46/51	0.281	0.596
Probing Depth (mm)	4.08 ± 1.14	4.00 ± 1.16	0.508	0.612
Clinical Attachment Level (mm)	5.15 ± 1.27	5.01 ± 0.91	0.853	0.395
Gingival Bleeding Index	1.15 ± 0.47	1.09 ± 0.32	0.965	0.336
Plaque Index (PI)	1.23 ± 0.21	1.18 ± 0.42	1.240	0.216
Pocket Depth ≥5 mm (%)	32.0%	31.5%	0.023	0.879
Occlusal Force (N)	62.88 ± 7.63	61.90 ± 3.89	1.137	0.257
Chewing Efficiency (%)	75.24 ± 8.11	76.40 ± 7.00	1.083	0.280
Masticatory Muscle Strength (kg)	13.10 ± 2.40	13.26 ± 2.18	0.496	0.620
Maxillary Midline Deviation (mm)	2.47 ± 0.31	2.35 ± 0.55	1.802	0.073
Facial Symmetry Index	0.87 ± 0.14	0.85 ± 0.10	0.969	0.334
Anterior Teeth Displacement (mm)	4.42 ± 1.19	4.23 ± 1.08	1.156	0.249

were used to compare changes in periodontal health and masticatory function for normally distributed continuous variables (e.g., CAL, occlusal force), while the Wilcoxon signed-rank test was applied for non-normally distributed variables (e.g., chewing efficiency). Categorical data were presented as n (%) and were analyzed using the chi-square test. Pearson correlation analysis was conducted to explore the relationship between changes in periodontal health and masticatory function. A multiple linear regression model adjusted for potential confounding factors, such as age, gender, baseline periodontal condition, and treatment duration. All tests were two-tailed, and statistical significance was set at P<0.05.

Results

Comparison of clinical characteristics

At baseline, there were no significant differences between the control and observation groups in terms of clinical characteristics, including age, gender, and periodontal health parameters (all P>0.05). Masticatory function measures, such as occlusal force and chewing efficiency, were also comparable between the groups, with only a slight, non-significant difference in masticatory muscle strength in the observation group (all P>0.05) (**Table 1**).

Comparison of Intraoral photographs before and after treatment

In the control group, pre-treatment images (**Figure 1A** and **1B**) demonstrate anterior teeth displacement and crowding. Post-treatment images (**Figure 1C** and **1D**) show gingival health and effective plaque control, with no orthodontic therapy applied. Pre-treatment images (**Figure 2A** and **2B**) exhibit anterior crowding and periodontal inflammation. Post-treatment images (**Figure 2C** and **2D**) reveal improved teeth alignment, healthy gingiva, and enhanced oral cleanliness after combined orthodontic and periodontal therapy.

Comparison of periodontal conditions

Figure 3 presents the comparison of periodontal conditions between the two groups before and after treatment. Alveolar bone height (**Figure 3A**) showed no significant differences between the groups at either time point (P>0.05). However, CAL (**Figure 3B**) in the observation group improved significantly after treatment, with a marked reduction in attachment loss compared to the control group (P<0.001). Similarly, the GBI (**Figure 3C**) was significantly lower in the observation group post-treatment, indicating better gingival health and less bleeding (P<0.001). Both PD (**Figure 3D**) and pocket depth (**Figure 3E**) in the observation group decreased substantially after treatment, with significant differences compared to the control group (both P<0.001).

Comparison of pain levels

Figure 4 presents a comparison of pain levels between the groups, as measured by the VAS before and after treatment. Prior to the intervention, there was no significant difference in VAS scores between the two groups (P>0.05). However, post-treatment, the observation gr-

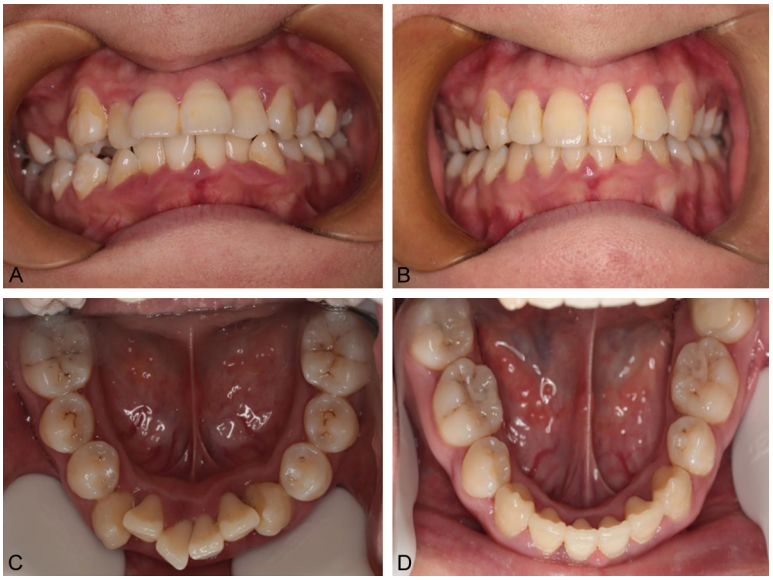

Figure 1. Intraoral photographs of a representative patient from the control group before and after periodontal basic treatment. A, B. Pre-treatment images showing anterior teeth displacement, crowding, and signs of periodontal inflammation. C, D. Post-treatment images showing modest improvements in gingival health and cleanliness, with limited change in teeth alignment due to the absence of orthodontic intervention.

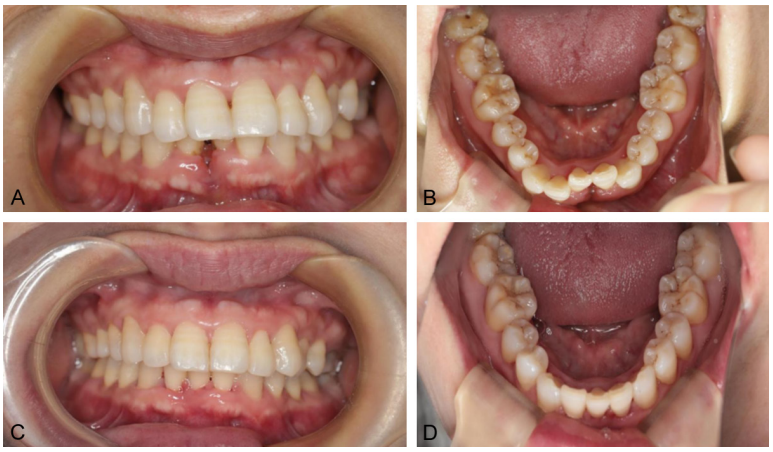

Figure 2. Intraoral photographs of a representative patient from the observation group before and after treatment. A, B. Pre-treatment images showing anterior teeth displacement and periodontal inflammation. C, D. Post-treatment images after combined orthodontic and periodontal therapy, demonstrating improved alignment, periodontal condition, and overall oral health.

oup showed a significant reduction in pain, with VAS scores markedly lower than those in the control group (P<0.001).

Comparison of clinical efficacy

The observation group showed a significantly higher total effective rate (96.91%) compared to the control group (74.75%) (P=0.017). Specifically, 92.78% of patients in the observation group showed effective results, while only 17.48% of patients in the control group demonstrated similar efficacy. The proportion of patients with moderate efficacy was 4.12% in the observation group, compared to 57.28% in the control group. Additionally, the percentage of ineffective cases was lower in the observation group (3.09%) than in the control group (25.24%) (**Table 2**).

Comparison of masticatory function

The results in the table reveal significant differences in both anterior occlusion and masticatory function scores following the intervention. For anterior occlusion, the comparison between the groups showed a highly significant difference post-intervention (P<0.001), indicating that the intervention effectively influenced occlusion measurements. Similarly, significant changes were observed in masticatory function scores. After the intervention, the observation group showed a notable increase in masticatory function (P<0.001), while the control group also showed improvement, though the difference in post-intervention scores between the groups remained statistically significant (P<0.001) (**Table 3**).

Comparison of tooth mobility

The comparison of tooth mobility between the groups revealed significant differences in the <1 mm and >3 mm categories before and after the intervention (both P<0.05), but no significant differences in the 1-2 mm and 2-3 mm categories (both P>0.05). In the <1 mm category, the control group showed an increase from 30.1% to 60.1%, while the observation group increased from 26.8% to 63.9% (P<0.001). For

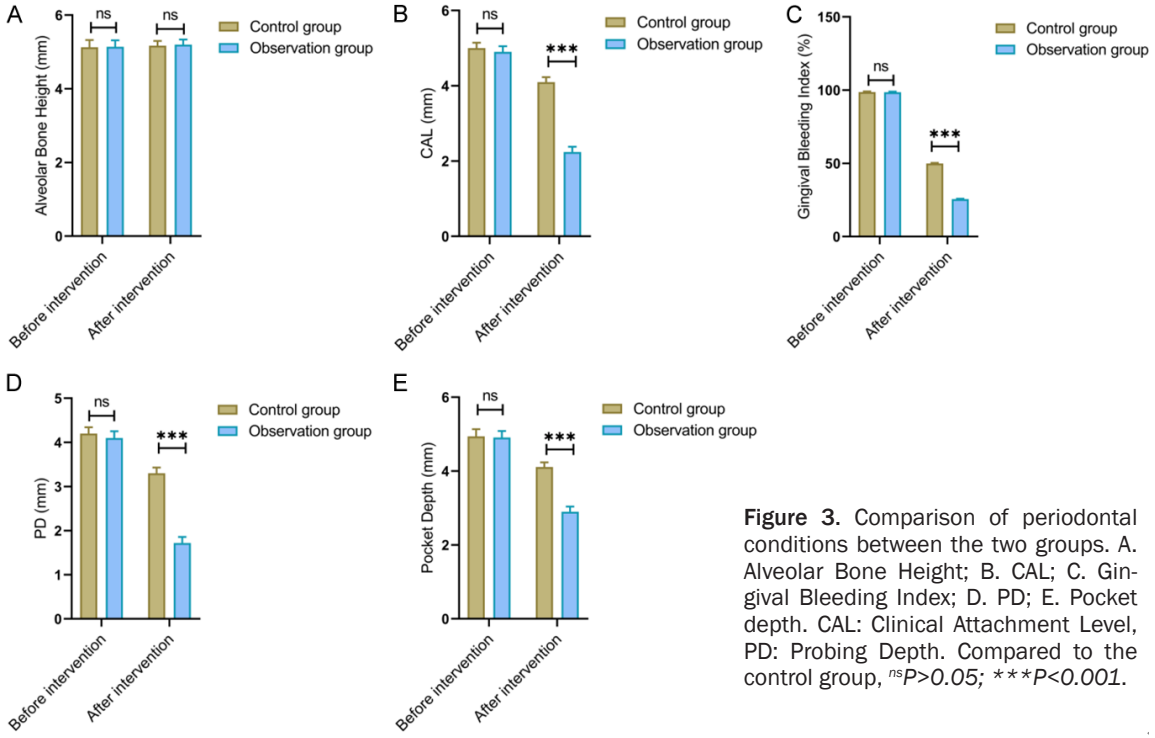

Figure 3. Comparison of periodontal conditions between the two groups. A. Alveolar Bone Height; B. CAL; C. Gingival Bleeding Index; D. PD; E. Pocket depth. CAL: Clinical Attachment Level, PD: Probing Depth. Compared to the control group, *$^{ns}P>0.05$; ***$P<0.001$.

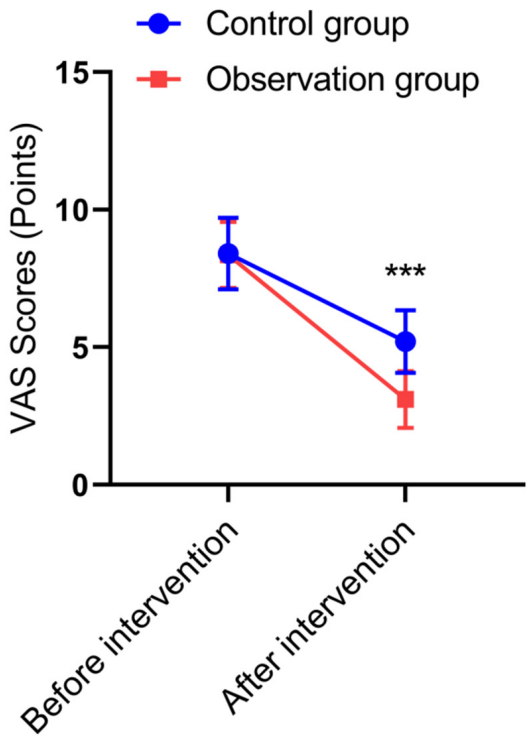

Figure 4. Comparison of pain levels between the two groups of patients. VAS: Visual Analog Scale. Compared to the control group, ***$P<0.001$.

the 1-2 mm category, both groups showed improvement: the control group moved from 37.8% to 30.1%, and the observation group moved from 30.1% to 26.8%, though the changes were not statistically significant (P>0.05). In the 2-3 mm category, the control group decreased from 15.5% to 6.8%, and the observation group decreased from 19.6% to 4.1% (P>0.05). Finally, in the >3 mm category, the control group decreased from 16.5% to 2.9%, while the observation group decreased from 13.4% to 5.2% (P<0.05) (**Table 4**).

Comparison of inflammatory indexes

The results indicate significant differences between the groups for all inflammatory markers after the intervention (P<0.001). Specifically, CRP levels were (78.2 ± 7.5) mg/L in the control group and (55.1 ± 6.4) mg/L in the observation group post-treatment (P<0.001), showing a significant reduction in the observation group. PCT levels were (0.45 ± 0.09) ng/mL in the control group and (0.22 ± 0.04) ng/mL in the observation group post-treatment (P<0.001), indicating a marked decrease in the observation group. WBC counts were (10.3 ± 2.1) * 10^9/L in the control group and (6.7 ± 1.3) * 10^9/L in the observation group post-treatment (P<0.001), with the observation group showing a significant reduction in WBC counts. No significant differences were ob-

Table 2. Comparison of clinical efficacy between the two groups

Group	Effective (n, %)	Moderately Effective (n, %)	Ineffective (n, %)	Total Effective Rate (%)
Observation Group	90 (92.78)	4 (4.12)	3 (3.09)	94 (96.91)
Control Group	18 (17.48)	59 (57.28)	26 (25.24)	77 (74.75)
Chi-square (χ^2)	-	-	-	5.688
P-value	-	-	-	0.017

Table 3. Comparison of masticatory function changes between the two groups

		Control Group (n=103)	Observation Group (n=97)	t	p
Anterior Occlusion (mm)	Before intervention	5.16 ± 1.09	5.15 ± 1.32	0.065	0.949
	After intervention	3.15 ± 1.29	1.31 ± 0.17	13.885	0.000
	T	12.123	33.048	-	-
	P	0.000	0.000	-	-
Masticatory Function Score (Points)	Before intervention	14.14 ± 3.35	14.58 ± 3.08	0.960	0.338
	After intervention	17.09 ± 4.48	26.88 ± 1.92	19.901	0.000
	T	5.348	33.371	-	-
	P	0.000	0.000	-	-

Table 4. Comparison of tooth mobility between the two groups

		Control Group (n=103)	Observation Group (n=97)	t	p
<1 mm (%)	Before intervention	31 (30.10%)	26 (26.80%)	0.266	0.606
	After intervention	62 (60.19%)	62 (63.92%)	0.294	0.588
	X^2	18.838	26.954	-	-
	P	0.000	0.000	-	-
1-2 mm (%)	Before intervention	39 (37.86%)	31 (30.10%)	0.766	0.382
	After intervention	31 (30.10%)	26 (26.80%)	0.266	0.606
	X^2	1.385	0.621	-	-
	P	0.239	0.431	-	-
2-3 mm (%)	Before intervention	16 (15.53%)	19 (19.59%)	0.569	0.451
	After intervention	7 (6.80%)	4 (4.12%)	0.686	0.407
	X^2	3.964	11.098	-	-
	P	0.046	0.001	-	-
>3 mm (%)	Before intervention	17 (16.50%)	13 (13.40%)	0.377	0.539
	After intervention	3 (2.91%)	5 (5.15%)	0.654	0.419
	X^2	10.854	3.919	-	-
	P	0.001	0.048	-	-

served before the intervention for any inflammatory marker (all P>0.05 **Figure 5**).

Comparison of the incidence of dental diseases

The data reveal significant differences in the incidence of dental diseases between the two groups. In the control group, the incidence of gingival bleeding was significantly higher (30.10%) compared to the observation group (5.15%, P<0.05). Similarly, the incidence of periodontal abscess was more common in the control group (15.53%) than in the observation group, where no cases were reported (P<0.05). Other dental issues, including less common conditions, were also higher in the control group (2.91%) compared to none in the observation group (P<0.05). Overall, the total incidence of dental diseases was substantially

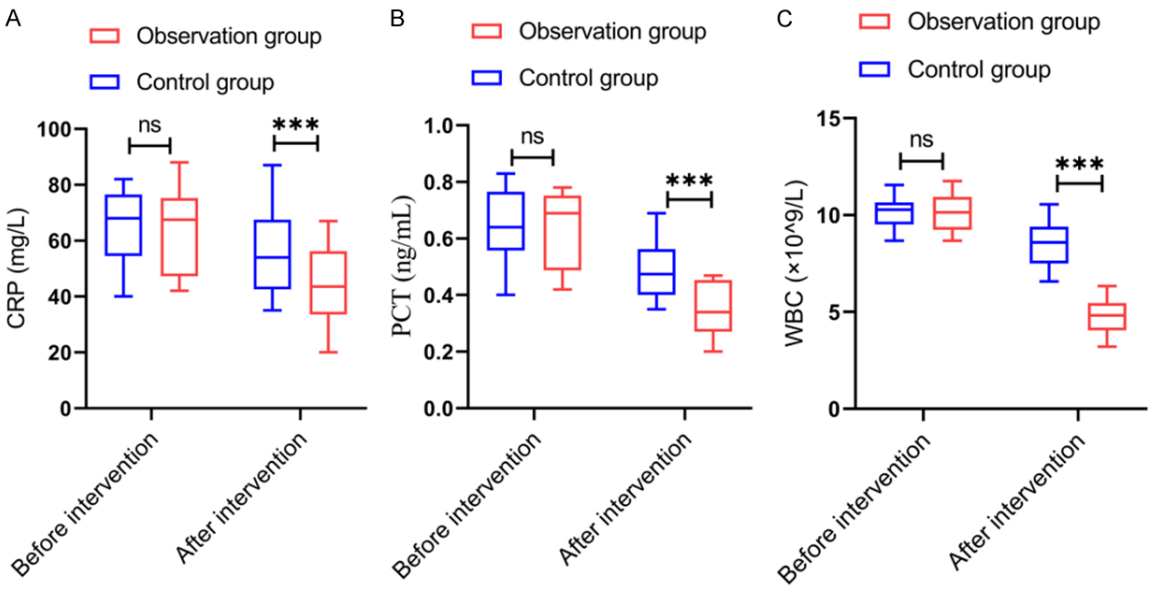

Figure 5. Comparison of inflammatory indexes between the two groups. A. CRP; B. PCT; C. WBC. Note: CRP: C-reactive protein, PCT: procalcitonin, WBC: white blood cells. Compared to the control group, $^{ns}P>0.05$; $***P<0.001$.

Table 5. Comparison of the incidence of dental diseases between the two groups

Group	Gingival Bleeding	Periodontal Abscess	Other	Total Incidence
Control Group (n=103)	31 (30.10%)	16 (15.53%)	3 (2.91%)	50 (48.54%)
Observation Group (n=97)	5 (5.15%)	0 (0.00)	0 (0.00)	5 (5.15%)
X^2	-	-	-	47.170
P	-	-	-	0.000

Table 6. Multivariate regression analysis of independent risk factors for clinical efficacy

Risk factor	B	SE	P	OR	95% CI
Tooth mobility	0.009	0.021	0.660	0.991	0.951-1.033
Masticatory function	0.493	0.369	0.182	0.611	0.296-1.259
Orthodontic treatment	1.059	0.141	0.000	2.883	2.183-3.799
Constant	-9.837	2.113	0.000	0.000	

higher in the control group (48.54%) compared to the observation group (5.15%) (P<0.001) (**Table 5**).

Multivariate regression analysis of independent risk factors for clinical efficacy

The results of the multivariate logistic regression analysis identified orthodontic treatment (OR: 2.883, 95% CI: 2.183-3.799, P<0.001) as a significant independent factor contributing to clinical efficacy. This suggests that patients who received orthodontic treatment were more likely to achieve favorable clinical outcomes. In contrast, tooth mobility (OR: 0.991, 95% CI: 0.951-1.033, P=0.660) and masticatory function (OR: 0.611, 95% CI: 0.296-1.259, P=0.182) did not significantly impact clinical efficacy (**Table 6**).

Discussion

The significant improvements observed in periodontal health parameters in the observation group can be attributed to the integrative approach of combining periodontal therapy with orthodontic intervention. We observed significant reductions in CAL and GBI, alongside substantial improvements in pocket depth in the observation group post-treatment. Previous

studies have shown that orthodontic treatment can stabilize the periodontal environment by correcting tooth alignment and occlusion, which helps reduce mechanical stress on the periodontium, decrease periodontal inflammation, and enhance tissue health. The mechanism behind these improvements may be linked to the restoration of proper occlusion, optimizing the functional forces on the teeth and surrounding tissues. Malocclusions tend to concentrate forces on specific sections of both the teeth and the periodontium, exacerbating periodontal damage. Orthodontic treatment, by repositioning the teeth, better distributes these forces, thereby preventing further damage to the periodontium. Our findings support this process, demonstrating that orthodontic therapy, when combined with appropriate periodontal care, helps preserve periodontal tissue. Additionally, the observed improvements in masticatory function can be attributed to the correction of anterior occlusion, which directly enhances the effectiveness of the chewing process [18]. Healthy occlusion ensures more symmetric muscle function and reduces the workload on the temporomandibular joint (TMJ), thereby improving chewing efficiency. This aligns with previous research on the importance of occlusal correction for restoring both the functional and aesthetic benefits in patients with anterior teeth displacement [19, 20]. The significant improvement in masticatory ability in the observation group further proves the functional benefits of orthodontic treatment in such patients.

Our study's results are consistent with several previous studies exploring the integration of orthodontic and periodontal therapies [21-23]. Research has demonstrated the potential benefits of orthodontics for periodontal patients, particularly in stabilizing tooth alignment and improving occlusal function [24, 25]. However, most studies have been limited in scope, focusing on short-term effects or involving small sample sizes. This study contributes to the literature by providing a comprehensive evaluation of both periodontal and masticatory function outcomes over a longer follow-up period and using a large sample size, enhancing the validity and generalizability of the findings. Our research also offers a novel perspective by targeting patients with anterior teeth displacement due to periodontal disease, addressing a gap in the current literature. While much existing research has focused on general malocclusion, few studies have specifically addressed the challenges posed by periodontal disease. By focusing on this patient population, our research offers valuable insights into how orthodontic treatment can be tailored to address complications arising from periodontal issues.

A unique contribution of this study is its emphasis on the combined use of orthodontic and periodontal treatments for patients with anterior teeth displacement due to periodontal disease. Most clinical guidelines and treatment protocols treat these two components separately. Our study demonstrates that an integrated approach yields superior outcomes, improving not only periodontal health but also masticatory function and overall quality of life. By enhancing both the aesthetics and function of the dentition, this dual approach improves patient confidence and chewing efficiency, addressing both the physical and psychological aspects of oral health. The study's robust design, incorporating both clinical measures (such as PD and attachment loss) and functional assessments (such as masticatory function and pain reduction), provides a more holistic view of patient oral health and treatment outcomes, distinguishing it from previous studies focused on single aspects of treatment.

Despite the contributions, the study has several limitations. First, the retrospective design limits our ability to definitively determine whether the observed improvements are directly attributable to orthodontic intervention. While the observational design allows for comparison of treatment outcomes, a prospective randomized controlled trial would be more effective in evaluating the combined effects of orthodontics and periodontal therapy. Second, although our sample size is relatively large, the diversity of patient conditions may not have been fully captured. The findings may vary in other populations with different levels of periodontal disease severity, and future studies should aim to include a broader demographic to enhance the generalizability of the results. Furthermore, the long-term stability of the improvements observed in this study remains uncertain. Although significant results were obtained at the 12-month follow-up, the long-term effects of orthodontic therapy in periodontal patients

are not fully understood. Future studies with extended follow-ups are needed to determine whether the improvements in periodontal health and masticatory function are sustained over time. Additionally, the role of individualized treatment planning, based on the severity of periodontal disease and the patient's specific needs, should be explored. A future study should focus on the optimal integration of orthodontic treatment into periodontal therapy, especially for patients with severe periodontal disease or complicating factors like bruxism.

In conclusion, this research provides substantial evidence regarding the effectiveness of combined orthodontic and periodontal treatment for patients with anterior teeth displacement due to periodontal disease. The combination therapy offers significant benefits to periodontal health, masticatory function, and overall patient outcomes. Our findings help fill an important gap in the existing research, documenting the effectiveness of this integrated approach for a specific patient population, and offering new insights for clinical practice. Further research is needed to evaluate the long-term outcomes of this strategy, refine treatment guidelines, and explore the role of individualized care in maximizing results for patients facing periodontal challenges.

Disclosure of conflict of interest

None.

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