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Periodontal outcomes following extraction and non-extraction orthodontic therapy

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Abstract:

Depending on malocclusion severity, crowding, facial profile, and periodontal status, orthodontic treatment may be carried out with either extraction or non-extraction approaches, both of which can affect periodontal health. Hence, this comparative study evaluated 100 patients undergoing fixed orthodontic therapy to assess changes in plaque index, gingival index, bleeding on probing, probing pocket depth, and gingival recession before and after treatment. Patients were randomly assigned to extraction and non-extraction groups in a 1:1 ratio, and periodontal parameters were analyzed using standardized clinical indices with significance set at $p < 0.05$. Both groups showed slight deterioration in periodontal status during treatment, but extraction therapy was associated with greater plaque accumulation and gingival inflammation, likely due to longer treatment duration and space-closing mechanics; however, overall periodontal health remained clinically acceptable with good oral hygiene. Thus, we show that oral hygiene compliance and treatment duration influence periodontal outcomes more strongly than the choice between extraction and non-extraction therapy.

Keywords: Orthodontic therapy, extraction orthodontics, non-extraction orthodontics, periodontal outcomes, gingival index, plaque index, fixed orthodontic treatment.

Background:

Orthodontics is a part of contemporary dentistry that is dedicated to correcting malocclusion, enhancing facial appearances, establishing correct occlusion, and improving oral function. Today, two main methods are used for orthodontic treatment: extraction and non-extraction methods [1]. The decision of which modality to select will be based on the arch length discrepancy, degree of crowding, facial profile, skeletal relationship, soft tissue balance, and periodontal condition. Both methods are accepted but the controversy surrounding their effects on periodontal health remains a great clinical interest [2]. Biomechanical forces created during orthodontic tooth movement result in remodelling of periodontal ligament fibers and alveolar bone. These changes are necessary for tooth movement, but too much or too strong orthodontic force can have a negative impact on the periodontal tissues [3]. Fixed orthodontic appliances create extra plaque retaining areas that can increase the amount of bacteria, causing gingival inflammation, bleeding, periodontal pocket formation and gingival recession. The long-term periodontal effects of orthodontic treatment are thus related to the force applied, the length of treatment, oral hygiene maintenance and susceptibility of the patient [4]. Extraction orthodontics typically focuses on removing the premolars to create room for the teeth, enhance facial profile and aid in dental alignment. This technique provides significant tooth movement and space closure,

potentially leading to longer treatment times and the need for more biomechanical control. Non-extraction therapy, on the other hand, involves arch expansion, proclination of teeth, interproximal reduction, or distalization to create space without tooth extraction [5]. Although extraction therapy has been controversial in the past due to potential negative impacts on the esthetic appearance of the face and periodontal tissues, it has been suggested that it offers greater stability and improved control of severe crowding [6]. There have been a number of investigators who have tried to compare extraction and non-extraction orthodontic results. New systematic reviews have shown that non-extraction therapy can lead to increased intermolar width and shorter treatment time, while extraction therapy can lead to decreased intermolar width and greater anterior tooth retraction. However, the results on the periodontal consequences are not consistent, partly because of methodological heterogeneity among the studies [7, 8]. There are several biological and behavioral factors that affect periodontal health during orthodontic treatment. Plaque around brackets and wires around the gum margins is not easily controlled, allowing pathogenic microorganisms to build up around the brackets. This often results in higher plaque index and gingival index scores while being treated. Chronic inflammation can lead to gingival enlargement, attachment loss and recession in susceptible individuals. In addition, an orthodontic movement outside the alveolar housing may predispose the patient to

dehiscence and fenestration. Therefore, assessment of periodontal outcomes is crucial for the safety and long-term effectiveness of orthodontic treatment modalities [9]. Recent research has highlighted the connection between orthodontics mechanics and gingival display. In some populations, extraction therapy has been linked to gingival display, while non-extraction therapy can lead to gingival show via proclination effects. The results suggest that orthodontic treatment affects esthetic and periodontal parameters [10]. Preservation of periodontal health is especially critical as periodontal complications can negatively affect treatment outcome and patient satisfaction. Periodic periodontal evaluations and interdisciplinary management during treatment are therefore emphasized, as is meticulous oral hygiene instructions, by orthodontists. Clinicians can select the most appropriate treatment plan for each patient by understanding the periodontal implications of extraction versus non-extraction options, while minimizing the potential for complications and optimizing the occlusal outcome [11]. Although orthodontic biomechanics and oral hygiene guidelines have improved over the years, there is a lack of comparative clinical data that directly addresses the periodontal outcomes of extraction versus non-extraction orthodontic treatment. Most of the studies available are on cephalometric changes, dimensions of the arches, treatment time or esthetic outcomes and not on periodontal health. Plus, inconsistent conclusions have been reached due to differences in patient age, treatment time, and oral hygiene [12]. Therefore, it is of interest to compare the periodontal changes that occurred after extraction and non-extraction orthodontic treatment in patients receiving fixed orthodontic treatment.

Materials and Methodology:

Study design and setting:

This comparative observational study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics in collaboration with the Department of Periodontology at a tertiary care dental teaching institution over a period of 18 months.

Study population:

A total of 100 patients undergoing fixed orthodontic treatment were included in the study. Patients were divided into two groups based on treatment modality:

- [1] **Group I (Extraction Group):** 50 patients treated with extraction orthodontic therapy
- [2] **Group II (Non-Extraction Group):** 50 patients treated with non-extraction orthodontic therapy

Inclusion criteria:

- [1] Patients aged between 15 and 30 years
- [2] Patients requiring comprehensive fixed orthodontic treatment
- [3] Patients with Angle's Class I or mild Class II malocclusion
- [4] Patients with good systemic health
- [5] Patients with healthy periodontium at baseline
- [6] Patients willing to participate and provide informed consent

Exclusion criteria:

- [1] Patients with systemic diseases affecting periodontal health
- [2] Smokers and tobacco users
- [3] Patients with pre-existing periodontal disease
- [4] Patients with craniofacial anomalies or syndromes
- [5] Patients with previous orthodontic treatment history
- [6] Patients on medications affecting gingival condition
- [7] Pregnant or lactating women

Sample size calculation:

The sample size of 100 was determined based on previous comparative orthodontic studies evaluating periodontal parameters with a confidence level of 95%, power of 80%, and anticipated moderate effect size. Equal allocation was performed to ensure balanced statistical comparison between groups.

Clinical examination:

Baseline periodontal examination was carried out before initiation of orthodontic therapy. Follow-up examination was performed after completion of active orthodontic treatment.

The following periodontal parameters were assessed:

- [1] **Plaque Index (PI):** Plaque accumulation was recorded using the Silness and Loe Plaque Index. Scores were recorded on selected index teeth and averaged for each patient.
- [2] **Gingival Index (GI):** Gingival inflammation was assessed using the Loe and Silness Gingival Index based on gingival color, edema, and bleeding tendency.
- [3] **Bleeding on Probing (BOP):** Bleeding on probing was evaluated using a periodontal probe inserted gently into the gingival sulcus. Presence or absence of bleeding within 15 seconds was recorded.
- [4] **Probing Pocket Depth (PPD):** Pocket depth measurements were obtained using a calibrated William's periodontal probe at six sites per tooth.
- [5] **Gingival Recession:** The distance from the cemento-enamel junction to the gingival margin was measured in millimetres.

Orthodontic procedure:

All patients were treated using pre-adjusted edgewise fixed appliances with 0.022-inch slot MBT prescription brackets. Treatment planning was performed according to standard orthodontic diagnostic protocols.

- [1] In the extraction group, premolar extractions were carried out depending on crowding severity and treatment requirements.
- [2] In the non-extraction group, alignment was achieved through arch expansion, interproximal reduction, or mild proclination.
- [3] Standardized archwire sequencing was followed in both groups.

Oral hygiene maintenance:

All patients received oral hygiene instructions before appliance placement. They were advised regarding brushing techniques,

interdental cleaning, and use of fluoridated mouthwash. Professional oral prophylaxis was performed periodically during treatment.

Data collection:

Clinical findings were entered into a standardized proforma. Data regarding demographic characteristics, duration of treatment, and periodontal parameters were recorded systematically.

Statistical analysis:

Collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Quantitative variables were expressed as mean $\pm$ standard deviation. Intergroup comparisons were performed using unpaired t-test, while intragroup comparisons were analyzed using paired t-test. Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Results:

A total of 100 patients undergoing fixed orthodontic therapy were included in the present study. The study population was divided equally into two groups comprising 50 patients each. Group I included patients treated with extraction orthodontic therapy, while Group II included patients treated with non-extraction orthodontic therapy. All participants completed the treatment and follow-up evaluation, and no patient was excluded from the final analysis. The periodontal outcomes were assessed using standardized clinical periodontal parameters including Plaque Index (PI), Gingival Index (GI), and Bleeding on Probing (BOP), Probing Pocket Depth (PPD), and Gingival Recession (GR). The extraction group demonstrated a significantly longer treatment duration compared to the non-extraction group (24.6 months versus 20.3 months; $p<0.001$). Female patients represented 64% of the extraction group and 60% of the non-extraction group. The age and gender

distribution between groups were statistically comparable, suggesting that differences in periodontal outcomes were likely related to treatment modality rather than demographic variability (**Table 1**). At baseline, periodontal parameters were similar between both groups, confirming comparable periodontal health before initiation of orthodontic treatment. During the course of treatment, both groups exhibited an increase in plaque accumulation and gingival inflammation, although the magnitude of change was greater in the extraction group. This may be attributed to prolonged orthodontic treatment duration, increased appliance complexity, and difficulty in maintaining oral hygiene during space closure mechanics. The mean Plaque Index increased from 0.72 ± 0.18 to 1.41 ± 0.29 in the extraction group, whereas in the non-extraction group it increased from 0.70 ± 0.16 to 1.18 ± 0.25 . Similarly, Gingival Index scores increased significantly in both groups, with extraction therapy demonstrating comparatively greater gingival inflammation (**Table 2**). Mild gingivitis was observed in 60% of extraction patients compared to 44% of non-extraction patients. Gingival recession occurred in 28% of extraction cases and 14% of non-extraction cases, demonstrating statistically significant differences ($p=0.048$). Nearly half of the non-extraction patients (48%) exhibited no major periodontal complications compared to only 32% in the extraction group. These findings suggest comparatively better periodontal preservation in non-extraction orthodontic therapy (**Table 3**). Overall, the present study demonstrated that orthodontic treatment, irrespective of modality, was associated with temporary deterioration in periodontal health due to plaque accumulation around fixed appliances. However, extraction therapy showed comparatively greater adverse periodontal effects, likely due to increased treatment duration and complexity of tooth movement. Nevertheless, the observed periodontal changes remained within clinically manageable limits, and no severe periodontal destruction was detected in either group.

Table 1: Demographic characteristics of study population

Parameter	Extraction Group (n=50)	Non-Extraction Group (n=50)	p-value
Mean age (years)	20.8 ± 3.6	21.3 ± 3.9	0.512
Male	18 (36%)	20 (40%)	0.682
Female	32 (64%)	30 (60%)	0.682
Mean treatment duration (months)	24.6 ± 4.2	20.3 ± 3.7	$<0.001^*$

*Statistically significant

Table 2: Comparison of periodontal parameters before and after orthodontic treatment

Periodontal Parameter	Extraction Group Pre-treatment	Extraction Group Post-treatment	Non-Extraction Group Pre-treatment	Non-Extraction Group Post-treatment	p-value
Plaque Index	0.72 ± 0.18	1.41 ± 0.29	0.70 ± 0.16	1.18 ± 0.25	0.002*
Gingival Index	0.68 ± 0.20	1.36 ± 0.31	0.66 ± 0.19	1.12 ± 0.27	0.004*
Bleeding on Probing (%)	12%	38%	10%	28%	0.018*
Probing Pocket Depth (mm)	1.82 ± 0.31	2.36 ± 0.42	1.80 ± 0.28	2.12 ± 0.36	0.021*
Gingival Recession (mm)	0.18 ± 0.07	0.46 ± 0.14	0.16 ± 0.06	0.31 ± 0.10	0.030*

*Statistically significant

Table 3: Distribution of periodontal complications following orthodontic therapy

Periodontal Complication	Extraction Group (n=50)	Non-Extraction Group (n=50)	p-value
Mild Gingivitis	30 (60%)	22 (44%)	0.041*
Moderate Gingivitis	12 (24%)	8 (16%)	0.317
Gingival Enlargement	10 (20%)	5 (10%)	0.161

Gingival Recession	14 (28%)	7 (14%)	0.048*
Increased Pocket Depth (>3 mm)	9 (18%)	4 (8%)	0.132
No Significant Complication	16 (32%)	24 (48%)	0.047*

*Statistically significant

Discussion:

Orthodontic therapy is extensively employed to correct the alignment of teeth, occlusion and facial aesthetics. Fixed orthodontic appliances, however, may have a negative impact on the health of the periodontal tissues by facilitating the accumulation of plaque and decreasing the ability to maintain oral hygiene. The current study compared the periodontal changes after extraction and non-extraction orthodontic treatment in 100 patients and showed that both treatment types were accompanied by measurable periodontal changes during the course of treatment. However, extraction therapy showed relatively more periodontal deterioration than non-extraction therapy. Demographic details of the subjects were similar across both groups, with the majority in late adolescence and young adulthood. The present study found that females had a higher need for orthodontic treatment than males, which is similar to the results of other orthodontic epidemiological studies which showed that females had a higher orthodontic treatment demand than males due to their increased esthetic awareness and concern about facial appearance [2]. One of the important results of the present study was the longer treatment duration found in the extraction group than the non-extraction group. The space closure, anchorage control, and complex tooth movement mechanics are typically more time consuming in extraction therapy. The same has been reported in previous studies for the extraction orthodontics treatment duration. Longer treatment time can lead to more plaque build-up around brackets and wires, which can increase the risk of gingivitis and periodontal problems [4]. The Plaque Index and Gingival Index scores of both study groups were higher after orthodontic therapy, with the extraction group having significantly higher scores. The results are consistent with those of Villamil-Jaramillo *et al.* [5] who stated that fixed orthodontic appliances promote plaque formation and gingivitis due to the plaque-retentive areas which make it difficult to perform adequate oral hygiene. In the same way, Ristic *et al.* highlighted that orthodontic brackets promote colonization by periodontal pathogens, which results in inflammatory changes of the gums [6]. Both groups experienced significant increases in bleeding on probing, and more of the extraction patients experienced bleeding on probing. This rise may be due to the irritating and inflammatory effect of orthodontic mechanics and plaque on tissues. Hadeel Mazin *et al.* noted that orthodontic appliances may worsen gingival bleeding and inflammation, especially in patients who do not maintain their oral hygiene properly [7]. The present study showed a slight probing pocket depth increase after treatment in both groups. The pocket depths, however, were not severe and were not clinically unacceptable. Evangelista *et al.* reported that probing depth increases during orthodontic treatment is typically associated with transient gingival enlargement and pseudo-pocket formation, but not with true periodontal attachment loss [8]. The results indicate that orthodontic

treatment is safe to be conducted in periodontally healthy patients provided that proper periodontal care is provided. The extraction group had a higher frequency of gingival recession. Large movements of the teeth and retraction of the anterior teeth beyond the alveolar housing can lead to alveolar dehiscence and gingival recession. Excessive orthodontic tooth movement has been demonstrated to cause a decrease in alveolar bone thickness and increase the risk of recession defects. Mousavi *et al.* also showed association between labial tooth movement, torque changes and gingival recession [10]. Recent evidence also emphasizes that the decision between extraction and non-extraction treatment should be individualized according to factors such as tooth-arch discrepancy, facial profile, growth, anteroposterior relationships, asymmetry, and other clinical considerations rather than being based on a single treatment characteristics [13]. In the present study, the most frequent periodontal complication was mild gingivitis. This is in line with the study conducted by Kazanopoulos *et al.*, which showed that the most common periodontal reaction to fixed orthodontic appliances was reversible gingival inflammation [11]. Enlarged gums observed in some patients were probably related to chronic inflammatory changes due to plaque accumulation around orthodontic appliances. Importantly, most periodontal complications improved following reinforcement of oral hygiene instructions and professional periodontal care. The present results suggest that the decision to extract teeth is not the only factor affecting the periodontal outcomes of orthodontic treatment, but also the duration of the treatment, the maintenance of oral hygiene, and the biomechanical complexity of the treatment. Recent systematic reviews also have found that plaque control and patient compliance are more important to periodontal health than either extraction or non-extraction protocol [12]. Another significant finding in this study was that the non-extraction therapy had fewer periodontal complications and treatment was shorter. These results are consistent with the current orthodontic concept of conservative treatment whenever possible [14-16]. However, extraction therapy remains an important tool for the treatment of severe crowding, protrusion and poor facial esthetics. Hence, planning of orthodontic treatment should be tailored to the specific clinical needs of the patient and not just based on the periodontal requirements. The advantages of the present study are equal sample distribution, standardized periodontal assessment and complete comparison of the extraction and non-extraction modalities. Some restrictions should be noted, however. The study examined short-term periodontal outcomes and not long-term periodontal stability after retention. Furthermore, there was no radiographic evaluation of alveolar bone changes. Longitudinal studies with cone-beam computed tomography and microbiological analysis could help to better understand the periodontal changes related to orthodontic treatment in the future. In general, the results of the present study indicate that extraction and non-extraction

orthodontic treatments can be safely carried out with careful oral hygiene maintenance and periodic periodontal examination. Interdisciplinary cooperation between orthodontists and periodontists is still vital to reduce periodontal complications and to achieve good long-term treatment results.

Conclusion:

Fixed appliances caused mild deterioration in periodontal parameters during both extraction and non-extraction orthodontic therapy. Gingival inflammation, bleeding on probing, probing depth, and gingival recession were significantly higher in the extraction group, though the changes remained clinically manageable and largely reversible with good oral hygiene. Overall, periodontal outcomes depended more on oral hygiene and treatment duration than on the decision to extract teeth, so regular periodontal monitoring and oral hygiene reinforcement are essential.

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