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Original Research

Efficiency of hybrid aligners in surgical & non surgical cases undergoing orthodontic treatment: An original research

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ABSTRACT:

Introduction: With the increasing prevalence of orthodontic treatment in adults, clear aligner treatments are becoming more popular. The aim of this study was to evaluate the effect of orthodontic treatment on periodontal tissue and to compare orthodontic treatment with fixed appliances (FA) to clear aligner treatment (CAT) in periodontitis patients. **Material and Methods:** A total of 35 patients who underwent orthodontic treatment in the Department of Periodontology were included in this study. After periodontal treatment with meticulous oral hygiene education, patients underwent treatment with FA or CAT, and this study analyzed patient outcomes depending on the treatment strategy. Clinical parameters were assessed at baseline and after orthodontic treatment, and the duration of treatment was compared between these two groups. **Results:** The overall plaque index, the gingival index, and probing depth improved after orthodontic treatment ($P < 0.01$). The overall bone level also improved ($P = 0.045$). However, the bone level changes in the FA and CAT groups were not significantly different. Significant differences were found between the FA and CAT groups in probing depth, change in probing depth, and duration of treatment ($P < 0.05$). However, no significant differences were found between the FA and CAT groups regarding the plaque index, changes in the plaque index, the gingival index, changes in the gingival index, or changes in the alveolar bone level. The percentage of females in the CAT group (88) was significantly greater than in the FA group (37) ($P < 0.01$). **Conclusions:** After orthodontic treatment, clinical parameters were improved in the FA and CAT groups with meticulous oral hygiene education and plaque control. Regarding plaque index and gingival index, no significant differences were found between these two groups. We suggest that combined periodontal and orthodontic treatment can improve patients' periodontal health irrespective of orthodontic techniques.

Keywords: Bone regeneration, Malocclusion, Orthodontics, Periodontitis

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INTRODUCTION

Orthodontic treatment is sometimes considered a predisposing factor for periodontal disease, as fixed orthodontic appliances with wire may inhibit plaque control, resulting in increased bacterial aggregation [1,2]. Second, a fixed appliance is not always aesthetically pleasing for adults, so prothodontic rather than orthodontic treatments are often used. However, orthodontic tooth movement may provide a substantial benefit in periodontal therapy.

Several factors may affect the outcomes of studies, such as differences in the types of orthodontic movement, including movement of teeth with infrabony defects, extrusion, intrusion, molar uprighting, movement in edentulous areas, proclination, and the periodontal treatment schedule [3-5].

Removable clear aligner therapy has recently been

introduced into adult orthodontics, and has been found to have several advantages, including improved aesthetic outcomes. Its main components are clear plastic splints that cover all of the teeth and the marginal aspects of the gingiva and gradually move the teeth into an ideal position. However, most studies on clear aligner therapy were performed in young patients with normal periodontium [6-10].

The aim of this study was to evaluate the effect of orthodontic treatment on periodontal tissue and to compare the effects of orthodontic treatment with fixed appliances and clear aligner therapy on the clinical parameters of patients with periodontitis.

MATERIAL AND METHODS

A total of 40 patients (16 men and 24 women) who underwent orthodontic treatment were screened for enrollment in this study. The inclusion criteria were patients with chronic periodontitis who had > 2 mm of attachment loss and a probing pocket depth > 3 mm [19]. The study protocol was approved by our institutional review board.

All patients demonstrated minor incisor malalignment or pathologic tooth movement in the maxillary or mandibular incisors without evidence of posterior bite collapse.

If the patient's oral hygiene was poor (plaque index > 1.5), education on oral hygiene and periodontal treatment were repeated prior to orthodontic treatment.

(1) Plaque index [20], assessed at four sites (mesiobuccal, mid- buccal, distobuccal, and lingual); (2) Gingival index [21], assessed at four sites (mesiobuccal, mid-buccal, distobuccal, and lingual); (3) the probing depth, measured at six sites (mesiobuccal, mid-buccal, distobuccal, mesiolingual, mid-lingual, and distolingual) and rounded to the nearest millimeter following probing with a pressure of approximately 0.25 N; and (4) the duration of treatment, defined as the time from direct bonding of brackets on the teeth to when the resin-wire splint was bonded on the palatal or lingual side of teeth for retainers in the orthodontic treatments with fixed appliances (FA) group. In the clear aligner treatment (CAT) group, the duration of treatment was defined as the time from the first aligner delivery to the time of retainer bonding to the teeth. The severity of irregularities was classified from grade 5 to grade 0 according to the amount of malalignment or the degree of pathologic migration.

The level of significance chosen for all statistical tests was $P < 0.05$.

RESULTS

The mean age of the 35 patients included was 52.97 ± 9.42 years (range, 35–74 years) at the start of orthodontic treatment. A total of 21 patients (60) were female. Seven patients (37) in the FA group were female, compared to 14 patients (88) in the CAT group (Table 1). The gender ratio was significantly different in the FA and CAT groups ($P < 0.01$). Twenty-two patients under- went treatment of the mandible. In both groups, orthodontic treatment was performed more frequently on the mandible than the maxilla. Eleven patients (58) in the FA group and 11 patients (69) in the CAT group underwent treatment of the mandible Comparison between orthodontic treatments with fixed appliances versus clear aligners

The overall plaque index scores were 1.34 ± 0.36 and 1.03 ± 0.32 at baseline and after orthodontic treatment, respectively (Table 1). A statistically significant difference was found between baseline and after orthodontic treatment ($P < 0.01$). Overall, the change in the plaque index was 0.28 ± 0.27. The change in plaque index scores in the FA group (0.38 ± 0.28) was greater than in the CAT group (0.16 ± 0.22), although this difference was not statistically significant.

The overall gingival index scores improved from 0.56 ± 0.11 at baseline to 0.48 ± 0.12 after orthodontic treatment ($P < 0.01$). After orthodontic treatment, the gingival index score in the FA group (0.59 ± 0.13) was higher than in the CAT group (0.52 ± 0.06), although this difference was not statistically significant differences. The overall probing depths decreased from 2.58 ± 0.78 mm to 2.23 ± 0.72 mm after orthodontic treatment ($P < 0.01$). The probing depth of the FA group was 3.01 ± 0.77 mm and 2.53 ± 0.78 mm at baseline and after treatment, respectively, while the probing depth of the CAT group was 2.08 ± 0.43 mm and 1.88 ± 0.44 mm at baseline and after treatment, respectively. A statistically significant difference was found between the FA and CAT groups with regard to the change in probing depth (0.48 ± 0.34 mm vs. 0.20 ± 0.29 mm; $P < 0.01$).

The overall alveolar bone level was improved. However, the bone level changes in the FA and CAT groups after orthodontic treatment were not significantly different. In the FA group, the alveolar bone level was 4.02 ± 1.48 mm and 3.48 ± 1.10 mm at base- line and after orthodontic treatment, respectively. No statistically significant difference was found in the change of alveolar bone level between the FA group (0.54 ± 0.69 mm) and the CAT group (0.22 ± 0.49 mm). The total duration of orthodontic treatment was 5.01 ± 2.20 months. The treatment duration of the FA group (4.16 ± 1.71 months) was shorter than that of the CAT group (6.03 ± 2.34 months) ($P < 0.05$).

CORRELATION AMONG CLINICAL PARAMETERS

No significant correlation was found between the duration of treatment and patient age (Table 2). The duration of orthodontic treatment was significantly related to gingival index scores at baseline. The duration of treatment was also negatively correlated with the probing depth at baseline, but this

correlation was not statistically significant. Changes in alveolar bone level were significantly correlated with plaque index scores, gingival index scores, probing depths, and alveolar bone level at baseline (P = 0.009, P = 0.020, P = 0.038, and P < 0.001, respectively). However, no correlation was found between changes in alveolar bone level and patient age.

Table 1: Comparison between orthodontic treatment with fixed appliances and clear aligner treatment (n = 35).

Clinical parameters	Total	FA	CAT	*P*-value
Number of patients	35	19	16	
Age (year)	52.97 ± 9.42	51.78 ± 7.44	54.38 ± 11.45	NS
Male/Female (female%)	14/21 (60)	12/7 (37)	2/14 (88)	0.002
Mx/Mn (Mn%)	13/22 (63)	8/11 (58)	5/11 (69)	NS
Change in plaque index	0.28 ± 0.27	0.38 ± 0.28	0.16 ± 0.22	NS
Baseline	1.34 ± 0.36	1.41 ± 0.36	1.26 ± 0.36	NS
Post-treatment	1.03 ± 0.32	1.02 ± 0.29	1.04 ± 0.37	NS
Change in gingival index	0.08 ± 0.06	0.08 ± 0.06	0.10 ± 0.06	NS
Baseline	0.56 ± 0.11	0.59 ± 0.13	0.52 ± 0.06	NS
Post-treatment	0.48 ± 0.12	0.52 ± 0.14	0.43 ± 0.06	NS
Change in probing depth	0.35 ± 0.34	0.48 ± 0.34	0.20 ± 0.29	0.008
Baseline	2.58 ± 0.78	3.01 ± 0.77	2.08 ± 0.43	0.001
Post-treatment	2.23 ± 0.72	2.53 ± 0.78	1.88 ± 0.44	0.005
Change in bone level	0.39 ± 0.62	0.54 ± 0.69	0.22 ± 0.49	NS
Baseline	3.53 ± 1.26	4.02 ± 1.48	2.94 ± 0.56	0.015
Post-treatment	3.13 ± 0.95	3.48 ± 1.10	2.72 ± 0.51	0.018
Duration of treatment (month)	5.01 ± 2.20	4.16 ± 1.71	6.03 ± 2.34	0.017

FA: orthodontic treatment with fixed appliances, CAT: clear aligner treatment, Mx: maxilla, Mn: mandible, NS: statistically not significant.

Table 2: Spearman's correlation coefficients between clinical parameters and treatment duration.

Correlations	r	*P*-value
Treatment duration with age	–0.041	0.814
Treatment duration with PlIPre	–0.156	0.370
Treatment duration with GIPre	–0.336	0.048
Treatment duration with PDPre	–0.247	0.153
Treatment duration with BLPre	–0.111	0.550
Bone level change with age	0.03	0.862
Bone level change with PlIPre	0.436	0.009
Bone level change with GIPre	0.391	0.020
Bone level change with PDpre	0.389	0.038
Bone level change with BLPre	0.622	< 0.001

r: Spearman's correlation coefficient, PlIPre: plaque index at baseline, GIPre: gingival index at baseline, PDPre: probing depth at baseline, BLPre: alveolar bone level at baseline.

DISCUSSION

The aim of this study was to evaluate the effect of orthodontic treatment on periodontal tissue and to compare two different orthodontic treatments in patients with periodontitis. The effects of orthodontic treatment were evaluated depending both on the technique and the treatment site. After orthodontic treatment, the overall plaque index, gingival index, and probing depth improved (P < 0.01). The overall bone level also improved (P = 0.45). However, bone level changes over the course of treatment showed no significant differences in the FA and CAT groups.

The plaque index improved in both groups following orthodontic treatment, but no statistically significant differences were observed between the FA and CAT groups. Statistically significant differences were found between the FA and CAT groups regarding probing depth. Studies reported that the plaque index scores of patients with fixed appliances were significantly higher than those of patients with clear aligners at baseline and at three different evaluation time points.[11,12] However, they found no statistically significant differences in probing depth between patients with fixed appliances and those with clear aligners. Regarding the alveolar bone level, we expected some alveolar bone loss after orthodontic treatment. We found, however, that the alveolar bone level improved in both groups. Intraoral radiographs were used to calculate the exact alveolar bone level, and no significant differences were found between examiners, Kim et al. [2] reported that determining the prognosis for bone loss is possible using

panoramic radiographs, and that additional intraoral films may be helpful when rapid changes in bone level are expected.

The duration of treatment in the FA group was shorter than in the CAT group. All of the patients included in this study experienced anterior crowding or pathologic migration in the anterior area of the maxilla or the mandible. In the CAT group, some patients had difficulty wearing the clear aligner for nearly 23 hours each day. Proffit et al. [3] suggested that adjunctive orthodontic tooth movement would take longer than six months and should be avoided.

In orthodontic tooth movement, bone resorption occurs by re- moving alveolar bone from the path of the moving dental root, which is dangerous in periodontally compromised patients [6]. It has been suggested that different combinations of cell-cell and cell-matrix interactions occur via orthodontic forces [6,7].

Most contemporary fixed orthodontic appliances use light continuous forces as part of orthodontic mechanotherapy to achieve tooth movement. The characteristic feature of continuous interrupted tooth movement is formation of new bone layers in the richly cellular tissue at the entrance of open marrow spaces as soon as the tooth movement stops. A histochemical study showed that the application of continuous force produced concomitant alveolar bone resorption and formation at the pressure areas in rat molars [14-18].

In contrast, it has been shown that tooth movement in clear aligner therapy occurs via intermittent forces applied by the aligners [19]. In the analysis, author reported that light continuous orthodontic forces are perceived as intermittent by the periodontium. Additionally, it was reported that weak intermittent forces could effectively induce receptor activator of nuclear factor kappa-B ligand activity via IL-1ß expression with less damage in the periodontal ligament cell [1,20].

In this study, despite a patient preference for CAT and our efforts for randomization, we could not avoiding using CAT for severely mobile or labially inclined teeth.

In the decision-making process regarding orthodontic treatment in patients with periodontitis, the clinical attachment level, the mobility of teeth, and the inclination of incisors should be considered. Most of all, continuous and repeated professional tooth cleansing and oral hygiene education are the most important factor for successful combined periodontal and orthodontic treatment.

CONCLUSION

Within the limitations of this study, we suggest that combined periodontal and orthodontic treatment can improve patients' periodontal health irrespective of orthodontic techniques. With the exception of cases where CAT cannot be applied, such as severely mobile or inclined teeth, both FA and CAT can be used for combined periodontal and orthodontic treatment.

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