Comparison between fixed orthodontics appliance and removable orthodontics appliance by gingival parameters and patient satisfaction – A transverse study

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Abstract:

Fixed orthodontic appliance (FOA) temporarily affects the periodontal patient's health, as the apparatus complicates the oral hygiene. The use of aligners in orthodontic treatment significantly has increased in the last ten years. Research on the effects of aligner treatment on oral hygiene and gingival condition is rare. This transverse study measures patient satisfaction and oral hygiene during orthodontic treatment of patients by Invisalign or FOA. **Methods:** A total of 140 patient's (FOA:70 , Invisalign:70) who employed orthodontic treatment for more than 6 months. Patient satisfaction, nutrition habits and oral hygiene were certified via a detailed questionnaire. Clinical examination was performed to evaluate patients' periodontal condition and satisfaction and their overall wellbeing before and during the orthodontic treatment. For statistical analysis the Kruskal–Wallis Test and Chi–square test were used; as multiple testing was applied, a Holm's correction was performed. **Results:** The Invisalign patients were in orthodontic treatment for 15±7.4 months whereas patients with FOA were in orthodontic treatment for 18.2±10.5 months . In a observing way a better gingival health conditions were recorded in Invisalign patient (GI:0.50±0.48 for FOA Versus 0.37±0.35 for Invisalign ; SBI:14.8±7.9 for FOA versus 8.1±4.2 for Invisalign), meanwhile the amount of dental plaque was also less in Invisalign (API:38.2%±10.8 for FOA versus 28.5%±25.1 for Invisalign), As greater patients satisfaction were found in Invisalign patients than in FOA patients by the questionnaires reports. **Conclusion:** From the patients treatment and from the results collected we found that Invisalign patients have a better periodontal health, oral hygiene and patient satisfaction than patients treated by FOA.

Introduction

FOA limits the ability of patients to perform good oral hygiene and that results in the collection of bacterial plaque which can temporarily ruin periodontal process[1–5]. Using a stringent recall system during treatment can avoid the impairment of the periodontal status as well as dental decalcification[6–8]. In most patients, especially children, FOA is the treatment of choice. For esthetic reasons, however, FOA is not very popular among adults. Another treatment has been developed since 1999 and offers better esthetics and better periodontal

hygiene, as well as the advantage of motivation for brushing and nutrition[9,10].

Because of the recentness of FOA, only a limited number of studies are available that compare the effects of Invisalign and FOA on oral hygiene, periodontal health and patient satisfaction. Miethke RR [11] showed that treatment with Invisalign did not increase periodontal risk or significantly affect oral hygiene even though teeth and gingiva were covered by aligners for nearly the whole day. This indicates that patients treated by Invisalign have better gingiva and periodontal health than FOA patients.

The objective of this study is to compare the effect of Invisalign versus FOA treatments on oral health, periodontal health and patient satisfaction.

The primary hypothesis of this study is that Invisalign patients have better oral hygiene and gingival inflammation parameters than FOA patients. Second hypothesis is that quality of life associated with Invisalign is better than that of FOA during orthodontic treatment.

Methods:

The study was performed on consecutive orthodontic patients at the United Dental and Orthodontics Clinic in Sana'a, the Republic of Yemen.

140 patients were included in our transverse study.

Patient inclusion criteria :-

1- Invisalign and (FOA) for at least six months.

2- Before the orthodontic treatment sulcus bleed index <20%[12] .

3- Before the orthodontic treatment approximal plaque index <25%[12] .

Patient exclusion criteria :-

1) Diseases that affect periodontal health.
2) Pregnancy.
3) Smoking.
4) Qat.

Patients received the same instructions for proper usage of tooth brush and dental floss, as well as a weekly checkup. Instructions were repeated constantly to give a accurate results. All the instructions were given before and during the treatment, and patients were recommended to use tooth brush and dental floss three times daily at least. Also, after periodontal examination, patients received professional hygiene treatment prior to orthodontic treatment, and a recall system was applied, including professional cleaning every six months.

The participants were informed that their data were being used for study purposes, and their parents or guardians were informed too. Patient data was collected in the first visit (before orthodontic treatment).

Patient gingival conditions were estimated using the gingival index (GI) of Silness and Loe[13], and (SBI) according to Lange [12].

For FOA patients, the amount of plaque was recorded using the modified plaque index (MPI) according to Attin[14] and adjusted to API. For Invisalign patients, the API was determined according to Lange[12] . API and MPI were determined using plaque disclosing tablets for 30 seconds.

All the participants answered a detailed questionnaire about their overall wellbeing,

gingival hygiene conditions, food choices and whether they are likely to undergo the same treatment again or not.

Statistical Analysis:

The statistical analysis was carried out using SPSS software (version 23.0; IBM, Armonk, NY).

Descriptive statistics were calculated for all used variables. For the categorical data absolute and relative frequencies are presented, for the continuous data mean and standard deviation are shown.

The main objective of this study is to compare between FOA and Invisalign , in the parameters for API , SBI and GI. For this objective we applied a "collective table model" including age as covariate for API , SBI, and GI, with Holm's correction with a local significance level of alpha of 0.016 to account for multiple testing.

All other analyses were performed on a preliminary basis. Kruskal–Wallis test was applied for continuous data and Chi–square test was used for categorical variables. All p–values were calculated using the Colquhoun method[15].

Results:

140 patients were enrolled for the treatment. The age of the patients varied between 10 to 40 years old. 70 patients for Invisalign (22 male and 48 female) and 70 patients for FOA (20 male and 50 female). The Invisalign patients (n= 70) were within the range of 10 – 35 years and an average age of 15.6±7.4, the (FOA) patients (n= 70) were in the range of 11–39 years and an average age of 18.2±10.5. The majority of patients were females (FOA 71.4% versus Invisalign 68.57%) . All patients underwent orthodontic treatment for a period of 6.1–24.2 months for FOA and 6.0–22.4 months for Invisalign (Table 1).

Tables

Table 1. Demographic data of patients with FOA or Invisalign® included in the study

Variable	FOA	Invisalign	p-value
Age (years)	18.2 ± 10.5	15.6 ± 7.4	≤0.001
Gender (male/female)	20/50	22/48	0.275
Duration of orthodontic treatment (months)	15.15 ± 9.05	14.2 ± 8.2	0.830

Values represent descriptive mean ± standard deviation

Before treatment, the analysis showed that both FOA and Invisalign patients showed no noticeable differences in periodontal conditions. Both Invisalign and FOA had good periodontal health measured by API (19.1%±7.4 for FOA and 15.9%±9.8 for Invisalign) (table 2).

During orthodontic treatment there were notable changes in periodontal condition in both Invisalign and (FOA) patients. Dental plaque increased but was higher in FOA (38.2% ±20.8), measured by API, than FOA (28.5% ±25.1), measured by MPI. GI and SBI barely increased during the treatment, but increased in FOA more than Invisalign by a

factor of 2 during the treatment. This indicates that Invisalign patients had better gingival and periodontal conditions than FOA (Table 2).

Table 2. Clinical parameters of patients with FOA or Invisalign® before and during orthodontic treatment

Clinical parameter	FOA	Invisalign	p-value
API (%) - before treatment	19.1 ± 7.4	15.9 ± 9.8	0.069
API (%) - during treatment	38.2 ± 20.8	28.5 ± 25.1	0.109
Relative difference	19.1 ± 16.9	12.6 ± 17.5	0.180*
SBI (%) - before treatment	7.6 ± 4.5	6.3 ± 3.9	0.505
SBI (%) - during treatment	14.8 ± 7.9	8.1 ± 4.8	≤0.001
Relative difference	7.2 ± 6.7	1.8 ± 1.2	≤0.001*
GI - before treatment	0.30 ± 0.25	0.28 ± 0.27	0.920
GI - during treatment	0.50 ± 0.48	0.37 ± 0.35	0.073
Relative difference	0.20± 0.29	0.09 ± 0.10	0.001*

Tables

Values represent descriptive mean ± standard deviation

*Adjusted for age

Patient quality–of–life questionnaire:–

Invisalign patients reported less well–being compared to patients treated by FOA (64.28% for FOA versus 25.7% for Invisalign).

Participants reported that their eating habits changed more in FOA (85.7%) than in Invisalign (75.7%). More patients reported that their laughing habits changed because of esthetic reasons for FOA (45.7%) than for Invisalign (40%). Furthermore 22.8% of FOA would like to undergo the same treatment again as compared to 48.57% for Invisaligin. More FOA patients (81.4%) had to brush their teeth more frequently than before the beginning of the treatment than Invisalign patients (32.8%). Moreover, 20% of FOA patients used an electric tooth brush as compared to 11.4% for Invisalign . We found more gingival irritation for FOA patients as compared to Invisalign (74.28% for FOA and 38.57% for Invisalign). From the patient questionnaire, Invisalign patients spent an average time of 2.3±1.3 min to brush their teeth with a minimum of 1 minute and a maximum of 8 min for 2 to 4 times per day, while for FOA patients the average time was 3.2±1.4 min with a minimum of 1.2 min and a maximum of 7.5 for 3 to 4 times daily. Both groups of patients changed their tooth brushes every 4.5 months (Table 3).

Tables

Table 3. Subjective data of patients with FOA or Invisalign® during orthodontic treatment

Variable	FOA	Invisalign	p-value
Impairment of	64.2	25.7	0.004

general well being			
Suffer under laugh inhibition	45.7	40	0.016
Would decide again to undergo the same treatment	22.8	48.5	0.002
Change of eating habits	85.7	75.7	0.059
Increased frequency of tooth brushing	81.4	32.8	0.001
Electric toothbrush	20	11.4	0.862
Subjective gingiva irritation (% yes)	74.28	38.5	0.003
Brushing time (min)	3.2 ± 1.4	2.3 ± 1.3	0.001
Change of toothbrush (in months)	2.3 ± 1.0	2.4 ± 1.4	0.021

Values represent relative frequency of individuals' positive responses (%) and descriptive mean ± standard deviation (last two questions)

Discussion:

Clinical examination showed that Invisalign treatment has less negative side effects than FOA treatment with regard to gingival hygiene, periodontal health and patient well-being[16,17]. There was no significant increase in plaque accumulation in either group.

The study indicates that removable appliances result in less negative side effects in plaque accumulation and in better oral hygiene. Conversely, fixed appliances result in increased plaque accumulation and decreased oral hygiene during treatment[11,18,19,20]. Increased plaque accumulation can lead to gingivitis and increased risk of caries and decalcification[2,3,4]. Miethke demonstrated that plaque index was much higher in FOA patients than in patients treated with Invisalign. Other periodontal conditions differed in only small amounts[11]. Our patients complied well with instructions, which resulted in good oral hygiene and periodontal health. Most of our patients used the regular recall system and emphasized esthetics. The fact that the patients were very cooperative may be the reason why we didn't find much difference in plaque accumulation between the two groups.

By comparison, Invisalign patients implemented better gingival hygiene and had significantly lower gingival inflammation than FOA patients. Miethke as well indicated that Invisalign patients have better oral hygiene and periodontal health than FOA patients.

Because Invisalign is removable, this affected gingival health because brushing was easier and more comfortable. For the same reason, brushing time for patients with Invisalign was a bit less than for patients with FOA.

In our study, patients used both manual and electrical toothbrushes[21], and we found no difference in both groups between the patients who used manual and those who used electrical toothbrushes. Patient toothbrush

preferences were similar in both groups. Greater patient satisfaction was found in Invisalign patients due to the removability of the appliance. Whereas better eating habits were observed in Invisalign patients, speech impairment was noted in the young (14-17).

Conclusion:

Our primary hypothesis has been largely corroborated. Patients treated with Invisalign were, for the most part, better in gingival health and were largely not different in oral hygiene compared to patients treated with fixed orthodontic appliances.

Our second hypothesis that Invisalign patients have better quality of life was also confirmed.

Lastly, our study has shown that Invisalign is softer on gingival tissue than FOA because of simpler oral hygiene.

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