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Oral health status among patients treated with fixed orthodontic appliance at different time intervals

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Abstract

Background: Fixed orthodontic appliance considered a risk factor that effect oral health status. Aims of this study were evaluation of oral hygiene, gingival health and caries experience among patients with fixed orthodontic appliance at different time intervals of treatment.

Material & Methods:- 32 patients (24 female and 8 male) included in this study and they underwent clinical examination plaque, calculus, gingival health and caries experience by using Loe, 1967, Green and vermillion, 1960 and WHO, 1987 indices at four time intervals: 2-3 weeks after appliance insertion, 2 months, 4 months, 6 months. The statistical analysis of data was by using statistical Package for social Sciences (SPSS version 18).

Results:- The means of all variables examined increased during six months of orthodontic treatment with high significant difference during visits. 49.6% of patients developed new caries lesions after six months of treatment.

Conclusion:- Patients underwent orthodontic treatment at high risk for developing oral health problems.

Keywords:- Oral hygiene, Gingival health, Caries experience, Fixed orthodontic appliance.

Introduction

Orthodontic treatment is a competence in dentistry, like many other specialties in dental domain that deal with improved facial and dental aesthetics and oral health status and function through mechanisms such as correction of jaw relation, decrease occlusal trauma, good alignment of teeth to increased ease of plaque removal and others, but unwanted side-effects of fixed orthodontic appliance on oral health had proven in numerous research studies which could be related to the patient or practitioner [1, 2].

The placement of orthodontic brackets, wires, etc. developed an obstruction to conventional oral hygiene procedures because of orthodontic appliance protected the plaque from the tooth brushing action, mastication and salivary fluid actions [3,4], that lead to poor oral hygienedue to accumulation of bacterial plaque especially on the cervical region of the brackets and below the arches wire where a major demineralization areas and increased significantly with increased the length of treatment [5,6].

In addition, the growing bacteria on the teeth and orthodontic appliance would cause inflammation of the gingival tissues [7], these adverse

effects of fixed orthodontic appliances are presented complex problems in clinical practice during fixed orthodontic therapy that lead to discontinue or even termination of treatment [6,8].

The application of preventive programs to maintain or improve a patient's hygiene, but the expectation of excellent of oral hygiene levels during entire treatment time for reasons most often related to patient's compliance (9, 10).

Advance development in dental materials properties and orthodontic appliances for prevention the adverse effects of orthodontic treatment especially caries development and inflammation of gingival tissues, but till now it presents a clinical challenge [11, 12], various preventive strategies have been suggested [13]. The importance of education and motivation of patients on oral health condition and the evaluation of oral hygiene status during the first months of orthodontic treatment to ensure early diagnosis of any health problems [14].

This longitudinal study was conducted to evaluate oral health status among patients underwent fixed orthodontic treatment at different time intervals during orthodontic treatment. Longitudinal study of these oral and dental variables may focus the light on the changes in oral health status that occur among orthodontic patients as the fixed orthodontic appliance considered as a risk factor for progression of oral and dental diseases.

Materials and methods

The longitudinal study was done in specialist health center for orthodontic and prosthodontic in Bab Al-Muadham\Baghdad city for 8 months period; sample was selected from patients who required orthodontic treatment with fixed orthodontic appliances. An informed consent was taken from the patients before examination.

35 Patients (25 female, 10 male) age range (18-25 years) diagnosed with skeletal class I occlusion, CL I malocclusion (mild to moderate crowding) according to Angle's molar classification in 1900 [15]. Patients with previous orthodontic treatment were excluded from study. There was drop out and excluded of patients during six months of study and the final study sample was 32 patients (24 female, 8 male).

Patients were followed for six months and underwent a systematic clinical evaluation of their oral health status related with fixed orthodontic appliance, by using plaque and gingival index [16], calculus [17] and DMFS [18] indices as following:-

-1st visit:- (2-3) weeks after orthodontic appliance insertion.

-2nd visit:- (2 months ±2weeks) after orthodontic appliance insertion.

-3rd visit:- (4 months ±2weeks) after orthodontic appliance insertion.

-4th visit:- (6 months ±2weeks) after orthodontic appliance insertion.

Fixed orthodontic appliance consisted of stainless steel brackets (VOTION\Ortho Technology Inc. Florida\ USA) bonded according to Roth technique with Resilience\Orthodontic bonding solution (Ortho Technology Inc. Florida\USA), Stainless steel bands (OrthoClassic\USA) used on first molars in both arches (except patients with previously extracted these teeth, bands added to second molars teeth) banded with glass ionomer luting (riva luting, SDI Dental limited\Ireland), Nickel titanium and stainless steel arch wires (Ortho Technology Inc.

Florida\USA) ligated to the brackets with elastomers (World Class Technology, ortho Classic).

For standardization, each patient was received package consist of manual two headed tooth brush especially designed for orthodontic patients, one head for brushing around the brackets and the other head was interdental tooth brush for brushing of the spaces around brackets, under the arch and between teeth (Ortho Technology, China) and dentifrice (Colgate with fluoride concentration of 1440ppm).

They received general oral hygiene instructions about how to use them properly and instructed to brush their teeth more than three times a day (especially after meals and before bed time, give them appropriate advisements about dietary habits (patients were requested to avoid carbonated soft drinks/acidic juices and candies) and other oral hygiene measures (Derks et al. in 2004 recommended either daily use of mouth rinse contain either fluoride or chlorhexidine mouth rinse not more than 2 weeks).

Results

The current longitudinal study revealed that the study sample started with 35 patients (25 female, 10 male) age range (18-25 years). During four time intervals, certain changes were occur lead to drop out of three patients (1 female, 2 male) and the final study sample was 32 (24 female, 8 male).

Concerning plaque index, the patients exhibited a mean plaque value (0.46±0.21) before appliance insertion which increased continuously during four time intervals of treatment to reach (0.82±0.26) in forth visit. Statistically high significant difference was noticed between four visits ($P<0.01$).

According to calculus index, no calculus was recorded in the baseline treatment compared to the last visit of treatment which reach to (0.34±0.37) and a high significant difference was found between visits.

In regard to gingival index, mean value was higher in the end of treatment (1.63±0.39) compared to baseline value (1.00±0.24) with a high significant difference, Table\1.

Table\2 revealed that DS and FS fractions recorded a higher mean values during forth visit (5.06±4.10, 4.06±5.63) respectively compared with baseline mean values (3.41±3.37, 3.84±5.44) respectively with high significant difference for DS ($P<0.01$) and no significant difference for FS ($P>0.05$). The same for DMFS, higher value in forth visit (10.53±7.15) compared with baseline visit (8.66±7.00) and difference was statistically highly significant ($P<0.01$). MS Fraction stayed constant value (1.41±3.42) during all visits and statistically no difference was found.

It was clear that in the third and fourth visits decay surface fraction (DS) comprised the major part of DMFS among the patients underwent fixed orthodontic treatment followed by filling surface (FS), while the missing surface recorded the lowest value.

Figure\1 revealed that no caries development during the first two visits of treatment, but there was a sharp increase in percentage of patients after 4 months of treatment 43.7% (14 patients), 46.9% (15 patients) continued to develop new caries in the last visit of study.

Discussion

The results of this study showed that time (duration of fixed orthodontic treatment) had highly significant effect on plaque formation in which plaque

increased with high significant difference during visits; this was in accordance to Naranjo et al. [19], while Ristic et al. [9] found increased in plaque formation during the first three months of orthodontic treatment followed by decreased plaque formation after six months of treatment.

This increased in plaque accumulation might be due to patients had numerous components of orthodontic appliance that made the conventional oral hygiene practice difficult and lead to accumulation of plaque and prolonged retention on tooth surface around the orthodontic brackets and auxiliaries of the fixed orthodontic appliance [20].

This study investigated calculus development during four time intervals, it was revealed that patients were free of calculus at baseline visit (orthodontic appliance insertion) and started to develop during the first 2-3 weeks after appliance insertion with mean value of 0.01±0.01. It could be attributed to the fact that calculus is mineralized bacterial plaque that becomes hard as result of precipitation of mineral salts. It usually calcifies between the first fourteen days of plaque formation. It presents on teeth surfaces and dental prostheses [21].

This study revealed that duration of orthodontic treatment had a high significant effects on gingival health condition in which gingivitis increased with high significant difference during visits, this was in accordance to Naranjo et al.[19] found the gingivitis increased with significant differences within times. While Ristic et al. [9] found increased in gingival inflammation during the first three months of orthodontic treatment followed by decreased gingival inflammation after six months of treatment.

and that could be due to the presence of the bands, brackets, arch wires and auxiliaries that made the brushing inefficient resulting plaque accumulation which consider the primary cause of gingival disease and the development of calculus which consider predisposing factor for progression of an inflammatory gingival condition [21] and this was proved in this study that plaque and calculus formation increased significantly within time.

Another explanation that any defect in cementation of bands or improper position of bands and wrong technique in bonding of the brackets (excess sealant or over extended composite that reached to gingival margins) all these condition lead to sever type of gingivitis [21].

Generally, there were controversy between studies in the results who searched about caries experience as it was well known that the caries is multifactorial and can change from a population to another one, from an individual to another one and even from a group of teeth to another one [22].

There was no new caries development during the first two visits of study (2 months±2 weeks); this might be attributed to the resting salivary flow raised after the first month [23]. In addition, studies showed that salivary pH and buffering sufficiency increased with increased in salivary flow rate that might wash away acids formed by proliferated bacteria and the buffer capacity might counteract the change in salivary pH [24]. This result was in accordance to Al-Shami [23] and Jordan and LeBlanc [25] who found the same results but it was in contrast to Pejda et al.[12] who found significant increase in caries development during the first three months of orthodontic treatment. In fact, there was decreased in DS

fraction with increased in FS fraction in the first visit because of many patients filled their decayed teeth.

This high frequency of carious lesions reported in this study could be attributed to oral hygiene level as the time interval increases, oral hygiene was not maintained because of presence of orthodontic appliance and patient's motivation toward maintenance of oral hygiene became low, socioeconomic issues [12]. In addition, changes in oral ecosystem as were noticed in many studies that increased levels of cariogenic bacteria with increased duration of the orthodontic therapy and number of orthodontic attachments [25, 26].

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Table 1: Mean and standard deviation and standard error of plaque, calculus and gingival indices during four time intervals

Variables	Baseline			1st visit			2nd visit			3rd visit			4th visit				
	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	F	Sig.
Plaque	0.46	0.21	0.04	0.57	0.26	0.05	0.69	0.32	0.06	0.79	0.33	0.06	0.82	0.26	0.05	18.95	0.00 **
Calculus	0.00	0.00	0.00	0.01	0.03	0.01	0.16	0.25	0.04	0.26	0.35	0.06	0.34	0.37	0.07	19.008	0.00 **
Gingival	1.00	0.24	0.04	1.02	0.11	0.02	1.17	0.27	0.05	1.43	0.36	0.06	1.63	0.39	0.07	24.42	0.00 **

Table2: Mean and standard deviation and standard error of DMFS and their components during four time intervals

Variables	Baseline			1st visit			2nd visit			3rd visit			4th visit				
	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	Mean	±SD	SE	F	Sig.
DS	3.41	3.37	0.60	3.31	3.25	0.57	3.31	3.25	0.57	4.25	3.77	0.67	5.06	4.10	0.72	22.094	0.00 **
MS	1.41	3.42	0.60	1.41	3.42	0.60	1.41	3.42	0.60	1.41	3.42	0.60	1.41	3.42	0.60	.	.
FS	3.84	5.44	0.96	3.94	5.35	0.94	3.94	5.35	0.94	3.94	5.35	0.94	4.06	5.63	1.00	1.621	.207 #
DMFS	8.66	7.00	1.24	8.66	7.00	1.24	8.66	7.00	1.24	9.59	7.00	1.24	10.53	7.15	1.26	25.549	0.00 **

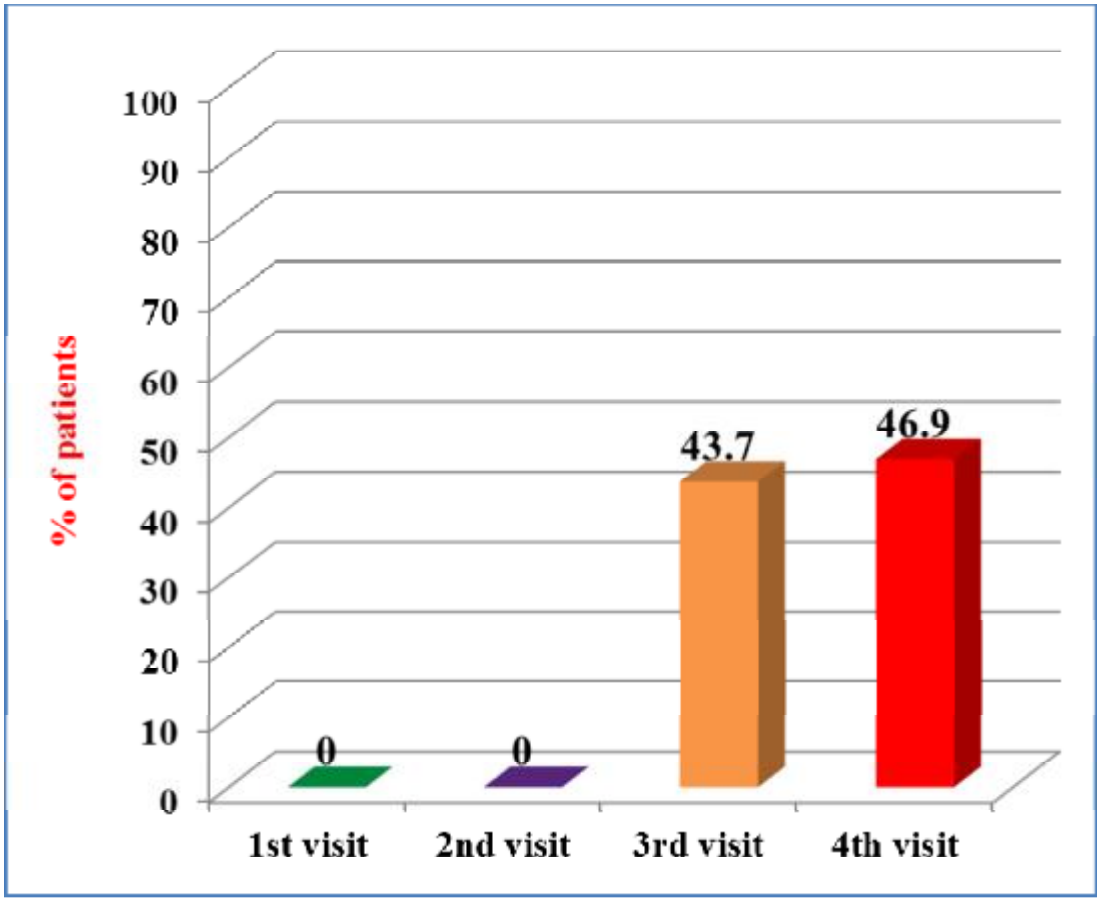

Figure 1: Development of new caries lesions during four time intervals