Effect of fixed orthodontic appliance on some factors and elements of saliva

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Zena Hekmat Altaee[1], Muhammad Hammad Jasim Al-Ajeely[2] & Yasir Mufeed Abdulateef[3]

[1] M.Sc. Orthodontist, College of Dentistry, Anbar University, Iraq.
[2] Ph.D. Clinical Biochemistry, College of Medicine, Anbar University, Iraq.
[3] M.B.Ch.B.FICMS Microbiology and immunity, College of Pharmacy, Anbar University, Iraq.

Correspondence to;
Dr. Zena Hekmat Altaee
zena.hikmat20@gmail.com

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Abstract

Objectives: the aim of this study to evaluate changes in the saliva of individuals undergoing orthodontic treatment with fixed appliances.

Materials and Methods: Thirty-four people (15male and 19 female) in this study, aged (16-32) years old with the mean age of 23.60±5.46 were selected among individuals that sought dental care at the Ramadi city. Two samples were taken from each patient, one before beginning the orthodontic treatment and the other1 month after placement of the appliance. pH, Salivary flow rate, concentrations of calcium, phosphate, magnesium. glucose total proteins, albumin, and IgA were measured in all salivary samples.

Results: There was a significant decrease in the salivary pH, concentration of calcium and phosphate after placement of fixed appliance ($p<0.05$), there was also significant increase in salivary flow rate, glucose, and IgA concentrations in the saliva after placement of fixed appliance and no significant change in magnesium concentration.

Conclusions: Orthodontic treatment changes the oral environmental factors. It is necessary to maintain the balance between the protective factors and the caries risk factors during the orthodontic treatment with a rigorous home care program toward correct oral hygiene procedures necessary to control plaque accumulation for caries and periodontal disease prevention.

Keywords: *Saliva, fixed orthodontics appliance. demineralization.*

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Introduction:

Saliva is the principal defensive mechanism in the oral cavity and is critical for preserving and maintaining the health of oral tissues. So saliva is important to identify the changes in the oral environment that play a critical role in maintaining oral homeostasis; it modulates the ecosystem through lubrication of the alimentary bolus, protection against microorganisms, buffer and repair of the oral mucosa, and helps in dental remineralization. Saliva is a complex secretion that plays a major role in maintaining the oral and dental health. Saliva, unlike the other body fluid, it is a difficult subject to study because of the wide intra and inter-individual variations regarding both composition and physical proprieties [1,2].

The main component of saliva is water (99%), and the remaining 1% is of inorganic and organic components[2,3].

The protective character of saliva against caries are a result of the salivary flow, of its buffering capacity and its calcium and phosphate concentrations, and well as of several antibacterial systems[4]. The process of eliminating sugar is affected by the salivary flow. The increase in salivary flow results in faster dilution of substances in the oral cavity[3].

Secretory immunoglobulin A(S-IgA) is the most frequently found immunoglobulin in mixed saliva and is considered to be a secretory factor for acquired immunity in the oral cavity in patients undergoing orthodontic treatment with fixed appliances[5,6]. In some cases involving long treatment duration, the clinicians are committed to preserving the oral health of the patient. There exist few clinical studies that show the physiologic and biological characteristics of saliva and the correlation with clinical specific entities. Therefore, the aim of the present study was to identify changes in the oral environment by saliva analysis after placement of fixed orthodontic appliances on permanent dentition for both genders.

Materials and Methods:

Thirty-four people (15male and 19 female), aged (16-32) years old with the mean age of 23.60±5.46 were selected among individuals that sought dental care at the Ramadi city, the patients should not have any systemic disease or drug intake, The duration of the study from March 2014 to September 2014.

Two samples were taken from each patient, one before beginning the orthodontic treatment and the other one month after placement of the appliance. The orthodontics attachments were placed in both arches.

The saliva samples were collected in the afternoon period between (1- 3.30 p.m.), at least 1 hour after lunch. Samples were taken following washing & rinsing the oral cavity with water to remove any debris and contaminating materials.

The unstimulated whole mixed saliva was usually collected with the subject sitting quietly using spitting method. The patient was seated on a chair with the head bent forward to a horizontal Position. The subjects were instructed to accumulate saliva in the mouth then spit into a clean graduated glass tube. The time of collection was 10 minutes. A PH-paper was used for determination of PH values of salivary samples collection prior to the centrifugation. The average of salivary PH value was recorded, and then the samples centrifuged at 4500 r.p.m. for 15 minutes to measure the flow rate of saliva recorded in ml/10min.The samples were separated & kept in an ice box to be stored later at -20c in a deep freeze until the time of the analysis.

Measurement of the calcium, phosphate, magnesium, glucose, total protein, albumin by Miura 200 UV-Visible Spectrophotometry Fully-automated Clinical Chemistry Analyzer, ISE company, Italy.

IgA measurement: The IgA saliva Enzyme-Linked-Immuno-Sorbent-Assay (ELISA) is intended for the quantitative determination of sIgA, manufactured by DRG International Inc., USA. Is based on simultaneous binding of human IgA to two antibodies, one monoclonal immobilized on microwell plates, the other, polyclonal conjugates with horseradish peroxidase (HRP). After incubation the bound/free separation is performed by a simple solid-phase washing. The enzyme in the bound-fraction reacts with the Substrate (H2O2) and the TMB Substrate and develops a blue color that changes to yellow when the Stop Solution (H2SO4) is added. The color intensity is proportional to the IgA concentration in the sample. The IgA concentration in the sample is calculated based on a standard curve.[7] All statistical analyzes were carried out using SPSS Version 16.were employed to evaluate differences within and between the groups. A p-value of 5% was considered to be statistically significant.

Results:

From this study the distribution of salivary markers regarding gender before and after placement orthodontic appliances show significant decrease in the salivary pH after treatment ($p<0.05$)and shows the placement of orthodontic appliances promoted a salivary flow in the subjects, with significant differences in the salivary production before and after treatment ($p<0.05$). The salivary flow rate was greater in males than female as shown in (Table 1).

Salivary elements distribution regarding gender before and after placement orthodontic appliances show a significant decrease in the calcium and phosphate concentration $p<0.05$ after placement fixed orthodontic appliance, no significant change in magnesium concentration ($p>0.05$) and significant increase in total concentration of glucose after placement fixed orthodontic appliance (table2).

In this study the Total protein, albumin and IgA distribution in respect to gender before and after placement orthodontic appliances show insignificant increase in the total protein, Albumin, ($p>0.05$)and a highly significant increase in the IgA $p<0.001$ after placement fixed orthodontic appliance as shown in (table3).

Table 1: The distribution of salivary markers regarding gender and total sample before and after orthodontic treatment.

	Gender	Before	After	P
PH	**Male**	7.63 ±0.66	6.73 ±0.34	0.03
	Female	7.54 ± 0.49	7.16 ±.53	0.02
	Total	7.01 ±.53	6.8 ± 0.63	0.04
Salivary flow rate (ml/10min)	**Male**	5.11 ±0.56	7.1 ± 0.61	0.00
	Female	5.10 ± 0.78	6.35 ± 0.34	0.001
	Total	5.2 ± 1.09	8.3 ± 1.63	0.047

Table 2: Salivary elements distribution regarding gender and total sample before and after orthodontic treatment.

	Gender	Before	After	P
Calcium mg/dl	**Male**	4.02 ±1.9	3.73 ±0.6	0.05
	Female	4.67 ±1.3	3.21 ±0.54	0.04
	Total	4.68 ±0.97	3.17 ±0.34	0.04
Phosphate mg/dl	**Male**	13.11 ± 4.28	9.24 ± 3.56	0.021
	Female	11.7 ± 4.05	7.83 ± 4.34	0.01
	Total	11.58 ± 4.99	8.66 ± 4.58	0.007
Magnesium mg/dl	**Male**	1.13 ± 0.72	0.93 ± 0.49	0.36
	Female	0.63 ± 0.39	0.89 ± 0.33	0.60
	Total	0.95 ± 0.62	0.84 ± 0.41	0.63
Glucose mg/dl	**Male**	10.16 ±24.01	25.4 ±29.6	0.04
	Female	4.6 ±21.8	5.37 ± 22.08	0.06
	Total	4.05 ± 25.64	17.23 ± 35.19	0.03

Discussion:

Saliva plays an important role in caries development because of its participation in the dilution of substances in the oral cavity, mechanical cleansing,post-eruptive maturation, demineralization and remineralization of dental enamel, pellicle formation, antimicrobial action and buffering of acids produced by biofilm and foods[8,9].

In the group using orthodontic appliances, there was a significant decrease in salivary pH ($p<0.05$) (table1). These results are similar to those reported by Kanaya et al.[19], who found a pH decrease in individuals that underwent orthodontic treatment.

Patients under orthodontic treatment may be more prone to tooth demineralization since the mean salivary pH were diminished. Consequently, preventive measures should be taken since there is a direct association between pH and increased risk of caries. There is a rapid shift in the composition of the bacterial flora, with an increase in the levels of acidogenic bacteria Streptococcus mutans, lactobacilli, which leads to a decrease in pH. As it reaches the critical value (pH 5.5), the demineralization-remineralization balance is pushed toward mineral loss and demineralization[11].

In the present study, salivary flow was greater in males, which is similar to international reports[12,13,14]. The differences have been attributed to two theories: women present smaller salivary glands in comparison with men and the female hormonal changes[13-16]. Furthermore, the mechanical stimulus is associated with increased salivary secretion, this study support a direct and prolonged stimulatory effect related to fixed orthodontic appliances similar finding was found in other studies[17.18].

The concentration of calcium ions and phosphate ion in saliva were significantly decreased after treatment (table2). Individuals with a low calcium and phosphate concentration in saliva have a lower pH and, therefore, a greater susceptibility to demineralization[3,8].

The factors associated with the risk of caries, such as concentration of the calcium,phosphate ions and salivary pH, were altered in the group with fixed orthodontic appliances, which suggests that orthodontic treatment may have an effect the intraoral environment[19].

Because fixed appliances remain in the mouth for a long time, the preventive measures, such as oral

Table-3 Total protein, albumin, and IgA distribution with respect to gender and total sample before and after orthodontic treatment.

	Gender	Before	After	P
Total protein mg/dl	**Male**	o.22 ± 0.18	0.31 ± 0.19	0.27
	Female	0.20 ± 0.11	0.30 ± 0.15	0.70
	Total	0.22 ± 0.13	0.23 ± 0.13	0.78
Albumin mg/dl	**Male**	28 ± 20.33	41.33 ± 43.03	0.28
	Female	23.25 ± 24.82	28.33 ± 21.16	0.41
	Total	26.17 ± 22.49	33.01 ± 33.41	0.32
IGA µg/ml.	**Male**	96.3 ± 114.6	203.9 ± 155.9	0.001
	Female	58.74 ± 123.8	164.6 ± 75.4	0.007
	Total	78.62 ± 95.8	118.7 ± 149.6	0.000*

*Highly significance p<0.001

hygiene, diet advising, topic fluoride application and prophylaxis should be considered.

While the concentration of magnesium shows no significant change this agree with Kerosuo et al.[20] who show the concentration of released elements did not show significant changes (increase or decrease) during the first month after bonding brackets[21].

In this study great significant glucose concentration was found in the saliva of the patient underwent orthodontic treatment, this was by reports by Forsberg et al.[22]. These finding may be associated with the decrease pH level. At the same time, glucose levels favor the proliferation of microorganisms and enhance their colonization on teeth and suppresses the killing capacity of neutrophils[23-26].

Both total protein and albumin analysis show a non-significant increase. Thus, it could act as clinical parameters for assessing metabolic changes in such tissues under the influence of tooth movement make these biochemical markers having a beneficial role in future diagnosis[27]. Moreover, There is a high significant increase of S-IgA in patients with orthodontic appliances. This finding can be explained by the stimulatory effect exerted directly by the conditions created in the mouth by the presence of the appliances which make good oral hygiene more difficult to achieve and thus change the microflora and oral homeostasis.

Different authors have studied the influence of orthodontic appliances on the oral environment[28-31]. Furthermore, in orthodontic therapy, different materials are used and subjected to a damp oral environment[30]. The use of biomaterial components in orthodontic practice was shown to release potential allergens such as metal ions from orthodontic appliances which might alter the composition of salivary secretion and cause pathomorphological changes in the mouth that can be a potential source of antigen stimulation[32]. Therefore, saliva is an important protector of oral mucosal tissues and teeth, and its constant role is supported even in adverse conditions, such as the presence of orthodontic appliances in the mouth[33].

Conclusions:

Orthodontic treatment changes the oral environmental factors. Individuals after placement of fixed orthodontic appliances had lower salivary pH, calcium, and phosphate concentration than before placement appliances. With a significant increase in glucose levels that favor the proliferation of microorganisms and enhance their colonization on teeth and oral mucous membranes. Furthermore, Orthodontic appliances appeared to be a local immunogenic factor, which provided a strong stimulus for oral secretory immunity. It is necessary to maintain the balance between the protective factors and the caries risk factors during the orthodontic treatment with a rigorous home care program toward correct oral hygiene procedures necessary to control plaque accumulation for caries and periodontal disease prevention.

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