Original Article

Fixed Orthodontic Appliances Pak Armed Forces Med J 2011; 61 (4): 598-601

EFFECT OF FIXED ORTHODONTIC APPLIANCES ON THE SALIVARY pH

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ABSTRACT

Objective: To assess the influence of fixed orthodontic appliances on the salivary pH.

Study design: Randomized controlled trial.

Place and duration of study: Department of Orthodontics, Armed Forces Institute of Dentistry in collaboration with the Department of Microbiology, Armed Forces Institute of Pathology Rawalpindi, from 10th September 2007 to 06th November 2008.

Patients and Methods: Sixty Subjects (11 males and 49 females) with age ranging 13-20 years were randomly selected and divided into a control and an experimental group of 30 each. Study involved analysis of salivary samples. A proforma indicating salivary levels of pH at T1 (pre treatment) and at T2 (after 4 months) with the differences between T1 and T2 was prepared for each subject.

Results: In experimental group salivary pH depicted a statistically significant decrease between T1 and T2. These changes in control group were insignificant.

Conclusions: Fixed orthodontic appliances (FOAs) tend to influence oral environment by lowering salivary pH towards acidic side.

Keywords: Fixed appliances, pH. Saliva.

INTRODUCTION

Primary dental care begins at home. Practicing satisfactory oral hygiene, such as adequate tooth brushing, mouth rinsing and dental flossing, plays vital role in maintaining healthy teeth, especially in the orthodontic patients. Furthermore the ability of the orthodontist to continuously monitor patient's oral hygiene is limited. Fixed orthodontic appliances demand a very high degree of oral hygiene measures, especially by teenagers, whose compliance is generally low. Failure to maintain proper oral hygiene can lead to tooth damage, consequently affecting the overall results of orthodontic treatment[1].

Saliva plays a pivotal role that influences the dynamics of demineralization and remineralization at the enamel-plaque interface. The amount and rate of demineralization and chances of remineralization is affected by the salivary pH, rate of flow, and buffer potential[2].

The pH or hydrogen ion concentration of an environment affects microorganisms and microbial enzymes directly and also influences the dissolution of many molecules that indirectly influence microorganisms. Microorganisms generally cannot tolerate extreme pH values. In the oral cavity, the pH is maintained near neutrality (6.7 to 7.3) by saliva.

Fixed orthodontic appliances create new retention sites, which are suitable for bacterial colonization[3]. Metallic brackets in orthodontic treatment, have been found to cause specific ecological changes in the oral environment, such as decrease in pH, and an increase in accumulation of plaque, which further increases the risk of demineralization of tooth structure[4].

This study was designed to evaluate the effects of fixed orthodontic appliances on the salivary pH and further to find out any association of salivary pH on the formation of dental caries so that proper prophylactic measures are to be adopted to control it in future.

PATIENTS AND METHODS

A randomized controlled trial was conducted in the Department of Orthodontics, Armed Forces Institute of Dentistry in collaboration with the Department of Microbiology, Armed Forces Institute of Pathology Rawalpindi, from 10th September 2007 to 06th November 2008.

Subjects were randomly selected among the patients reporting to orthodontic department for fixed orthodontic treatment,

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Received: 04 June 2010; Accepted: 31 Mar 2011

having age range 13-20 yrs, undergoing fixed orthodontic treatment with brackets bonded to all teeth less molars which were banded. All the patients with their permanent dentition free of caries and dental plaque motivated and instructed for good oral hygiene.

Subjects having any prosthodontic appliance, and/or composite restorations, medical or dental problems like xerostomia, any systemic disease affecting directly or indirectly rate of caries formation, antimicrobial therapy for the past three months were excluded from the study.

A total of 60 patients were included. Out of these, 30 each were assigned randomly to experimental (group 1) and control groups (group 2), using lottery method.

Formal permission from the ethics committee of the Armed Forces Institute of Dentistry was obtained. Informed consents of all subjects.

Saliva samples were collected from the subjects of both groups before initiation of any orthodontic therapy (T1). Experimental group (group 1) received straight wire appliances of Roth 0.022 prescription (Discovery 22x30, Dentaurum. Germany) bonded to all teeth in addition to stainless steel bands (Dentaform bands preweld, Dentaurum. Germany) cemented on all first molars. Initial archwires of nitinol 0.012" and/or 0.014" (Rematitan "LITE" ideal arches, Dentaurum. Germany) were placed and ligated with elastomeric ligatures (Dentalastics' 'Personal' ',Dentaurum. Germany), while control group (group 2) did not receive any kind of orthodontic appliances.

All subjects were advised to use a standard tooth paste (Secure, Platinum pharma, Pakistan) and were instructed to refrain from any other oral hygiene products for the duration of trial. Repeat saliva samples were collected from all subjects after four months of initiation of fixed orthodontic treatment (T2).

Samples were collected by salivary stimulation method. Subjects were asked to chew on paraffin wax for 60 seconds, so as to salivate and expectorate 3 ml of saliva into an individual sterile 20 ml capacity screw capped plastic calibrated plastic bottle. Samples were transported to the laboratory for immediate processing (within 15±5min of collection). pH of each sample was noted by means of pH meter (Orion research model 106 A,USA).

SPSS version 11.0 was used for data analysis. Descriptive statistics were used to describe the data. Chi-square test was used to compare gender between the groups. Paired t-test was used to compare the pH at different times within the groups. Independent samples t-test was used to compare age and pH at different times between the groups. *p*- value of < 0.05 was considered to be significant.

RESULTS

In this study, experimental group (group 1) comprised 5 (16.7%) males and 25(83.3%) females. Control group (group 2) comprised 6 (20%) males and 24 (80%) females (*p*=0.754). Experimental group exhibited mean age of 16.3yrs (SD±2.8), while control group was having mean age of 16.9yrs (SD±2.7), (*p*=0.186).

pH of salivary samples of experimental group exhibited mean values of 7.3 and 6.4 at T1 and T2 respectively with a statistically significant difference of 0.9, as compared to the insignificant difference of 0.05 between mean values of pH at T1 and T2 in subjects of control group (table).

Table: pH of saliva in both groups.

	Group 1		Group 2		*p*-value
pH	Mean	SD	Mean	SD	
pH at T1	7.3	0.19	7.26	0.26	0.408
pH at T2	6.4	0.35	7.21	0.27	0.000
p- Value	0.000		0.170		

DISCUSSION

Orthodontic treatment is now in great demand for preadolescent and adult patients in our society. Coupled with the fact that more patients are now seeking orthodontic treatment as comprehensive or adjunctive treatment to other dental specialties. The area of impact of these fixed orthodontic appliances on oral ecological conditions in local population is unexplored. It is therefore imperative for proper guidelines to be drawn up for the orthodontists regarding long term oral health status of their patients.

Fixed orthodontic appliances while providing additional surfaces that harbor microbial colonies and plaque further increase the risk for caries, gingivitis, and periodontal disease. If unchecked, poor oral hygiene may jeopardize orthodontic treatment outcomes. It is estimated that between 5-10% of orthodontic patients are unable to complete orthodontic treatment just for these reasons[5].

The saliva contributes to maintenance of the pH by two mechanisms. First, the flow of saliva eliminates carbohydrates that could be metabolized by bacteria and removes acids produced by bacteria. Second, acidity from drinks and foods, as well as from bacterial activity, is neutralized by the buffering activity of saliva. Bicarbonate is the major salivary buffering system of saliva, but peptides, proteins, and phosphates are also involved. Increases in pH also result from bacteria that metabolize sialine and urea into ammonia. Acids that are produced by the microbial metabolism of carbohydrates may accumulate in dental plaque because of the slow diffusion of saliva through dental plaque. Following sugar intake, the pH of dental plaque may decrease to below 5.0. The pH is an important parameter in oral microbial ecology[6].

An evaluation of salivary pH between orthodontic and non-orthodontic patients, in relation to the oral hygiene condition, that evaluated 4 groups of 10 patients each, (group 1: orthodontic patients having poor oral hygiene. group 2: orthodontic patients having good oral hygiene. group 3: non-orthodontic patients having poor oral hygiene. Group 4: non-orthodontic patients having good oral hygiene) found a mean pH approximately 7.4. The findings of this study suggest that orthodontic appliances have no influence on the salivary pH. While our study evaluating and comparing orthodontic patients and non-orthodontic controls found significant changes in pH of orthodontic patients towards acidic side, which is a symbol of an environment conducive for enamel demineralization[7].

Enamel demineralization has been demonstrated around orthodontic brackets after only one month of the treatment[3]. In addition, estimates of white spot lesions in the orthodontically treated population range from 12.6% to 50% of patients. In addition, metallic brackets were found to induce specific changes in the oral environment such as decreased pH. This indicates that orthodontic brackets could be a potential risk for enamel demineralization. Findings which confer with the results of our study in local population. With an objective to determine means for preventing enamel demineralization through the knowledge about the adhesion of cariogenic streptococci to orthodontic brackets, a Korean study explored the adhesion levels of 4 cariogenic streptococci strains to various orthodontic brackets with respect to bracket type, bacterial strain, and incubation time. Five bracket types (monocrystalline sapphire, polycrystalline alumina, stainless steel, plastic, and titanium) were incubated with un-stimulated whole saliva followed by binding assays. Each cariogenic streptococci strain showed a characteristic adhesion pattern, and the adhesion amounts were highest in the plastic brackets and lowest in the monocrystalline sapphire brackets[8].

Curent study however used standardized fixed orthodontic appliances and elastomeric rings in all subjects of both groups, and was chiefly focused on the evaluation of changes in saliva of the subjects[9].

CONCLUSION

Fixed orthodontic appliances (FOAs) tend to influence oral environment by lowering salivary pH towards acidic side. Various retentive sites being provided by the fixed appliances are the optimal sites for harboring an array of microorganism, which in turn jeopardize the integrity of soft and hard tissue structures of the oral cavity.

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