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An all inclusive evaluation of salivary flow and PH as affected by orthodontic treatment in younger patients: An original research study

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Abstract

Background and Aim: Orthodontic treatment using fixed appliances is well known to change the oral atmosphere and promote plaque retention around orthodontic brackets and bands, resulting in enamel demineralization and gingival inflammation. The sole endeavor of this paper was to evaluate salivary flow rate and ph as affected by orthodontic treatment in younger patients.

Materials and Methods: Authors logically selected 30 young patients of age range 16-26 years undergoing fixed orthodontic treatment in last two years. The whole saliva was collected by spitting into a sterile test tube for 10 minutes. The volume of the saliva collected during this period was measured and divided by 10 to attain the flow rate in millimeters /minute. The pH of saliva was measured with portable pH meter strips. All these volumetric, flow-metric and ph related armamentarium related to salivary flow rate and pH was available to authors via GC saliva check buffer kit. The recorded data was subjected to suitable statistical tests to obtain p values, mean and other statistical parameters. P values less than 0.05 was considered as significant.

Statistical Analysis and Results: Basic statistical analysis was completed using SPSS statistical package for the Social Sciences version 21 for Windows. Out of the total sample size of 30 patients who participated in the study, 15 were male while 15 were females. 7 patients belonged to the age group of 16-18 years, 8 patients were of 19-21 years of age, 8 patients were 22-24 years of age and 7 patients of 25-26 years of age. Fundamental statistical description [For Evaluation of salivary flow rate (mL/mim)] revealed mean value of 1.76 before orthodontic treatment and 2.13 after orthodontic treatment. P value was reported to be significant for it.

Conclusion: Within the limitation of the study, author found increased salivary flow rate and decreased pH value of saliva after fixed orthodontic therapies in the studied patients.

Keywords: Orthodontic Appliances, Saliva, Flow rate, pH

Introduction

The quality (defined as salivary protein content, viscosity and pH) and the quantity of saliva (mostly related to flow rate) play a crucial role in the equilibrium between demineralization and remineralization of enamel in a cariogenic environment. Specific changes, such as increased pH and flow rate, may contribute to decreased susceptibility to dental caries [1, 2]. All these salivary properties become of utmost importance during orthodontic treatment with fixed appliances, when an increased chance of plaque retention and a greater difficulty in optimal oral hygiene maintenance are thought to predispose to enamel demineralization and white spot formation. Malocclusion is one of the most common dental disorders and is capable of increasing the risk of periodontal disease and dental caries. Orthodontic treatment of malocclusions can often resolve them, or at least prevent their progression [3, 4, 5, 6]. However, complex design of fixed orthodontic appliances can affect the oral hygiene by influencing several parameters including the saliva properties and microbial count. Changes in the saliva parameters such as decrease in pH, flow rate of the saliva may contribute to enamel demineralization and increase the susceptibility to dental caries. Insertion of fixed orthodontic appliances creates stagnation areas. An increase in flow rate promotes the physical cleansing action of saliva, increases its buffering capacity and anti-bacterial activities, and accelerates clearance of substrates [7, 8, 9, 10]. Very few studies have been carried out to find out salivary flow rate and pH of saliva among the patients undergoing fixed orthodontic therapy in India. Therefore the sole endeavor of this study was to investigate the salivary flow rate and ph as affected by orthodontic treatment in younger patients.

Materials and Methods

This prospective study was conducted in the department of Orthodontics of the institute. Authors logically selected 30 young patients of age range 16-26 years undergoing fixed orthodontic treatment in last two years. Simple randomized sampling procedure was employed for this selection**.** Patient who are healthy and who had no dental diseases were included. Patients with chronic systemic illness, on any long term oral medication, who are undergoing chemotherapy or radiotherapy for cancer treatment, with recent use of antibiotics and who are not interested to participate in the study were excluded. Ethical clearance was obtained prior to the execution of the study from institutional

ethical committee. Authors also ensured to obtain written consent from study participants. Demographic information such as name, age, gender etc was recorded. Salivary flow rate was assessed before the start of orthodontic treatment and after six weeks of treatment. The whole saliva was collected by spitting into a sterile test tube for 10 minutes. The volume of the saliva collected during this period was measured and divided by 10 to attain the flow rate in millimeters /minute. The pH of saliva was measured with portable pH meter strips. The strips were not allowed to dry before scoring it as this can affect the visual interpretation of the colour. The colour change on the pH paper was matched with the standard colour scale on the chart and then assigned the exact pH value. All these volumetric, flow-metric and ph related armamentarium related to salivary flow rate and pH was available to authors via GC saliva check buffer kit (GC Corp., Tokyo, Japan). Author had finalized to conduct and complete this study on the basis of experimental flow-metric as related to saliva. Literature has well evidenced that such kind of studies are extremely useful in obtaining detailed information regarding individual and group perceptions and attitudes. In addition, these studies also offer a wider range of information with better intelligibility. Right before the execution of the study, author had explained the relative significance of this study to all participating patients. The privacy and other interrelated rights of the patients along with their freedom of expression were kept absolutely confidential. The recorded data was subjected to suitable statistical tests to obtain p values, mean and other statistical parameters. P values less than 0.05 was considered as significant.

Statistical Analysis and Results

All the recorded data were arranged in logical manner and subjected to suitable statistical analysis using SPSS statistical package for the Social Sciences version 21.0 for Windows. Out of the total sample size of 30 patients who participated in the study, 15 were male while 15 were females. 7 patients belonged to the age group of 16-18 years, 8 patients were of 19-21 years of age, 8 patients were 22-24 years of age and 7 patients of 25-26 years of age. P value was reported to be significant for it. Overall it had 15 male and 15 female subjects (refer Table 1-2 & Graph 1). Fundamental statistical description with level of significance evaluation using Pearson Chi-Square Test [For Evaluation of salivary flow rate (mL/mim)] revealed mean value of 1.76 before orthodontic treatment and 2.13 after orthodontic treatment. P value was reported to be significant for it. Basic statistical description with level of significance evaluation using Pearson Chi-Square Test [For Evaluation of pH values] illustrates mean value 7.76 before treatment and 6.13 after orthodontic treatment (refer Table 3-4). P value was reported to be significant for it.

Table 1: Patients distribution according to gender: Statistical Evaluation using Student's t-test

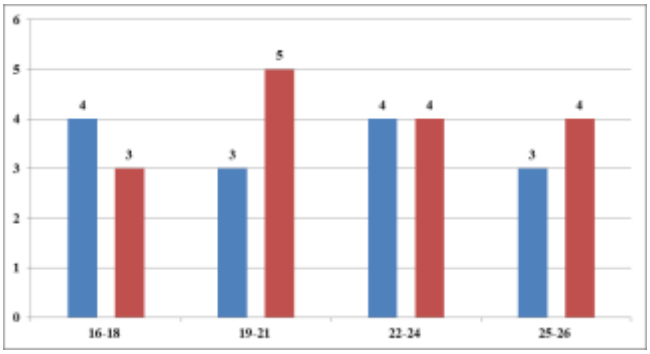
Sex	Number [n]	Mean	SD	P value
Male	15	2.34	1.324	0.468
Female	15	2.89	1.465	

*p<0.05 significant

Table 2: Patients distribution according to age groups: Evaluation of level of significance using ANOVA test

Patients distribution according to age groups								
Group	**Age Range**	**Male**	**Female**	**n**	**Mean**	**SD**	**P value**	
I	16-18	4	3	7	2.32	1.532	0.000*	*Significant
II	19-21	3	5	8	2.23	1.765		
III	22-24	4	4	8	2.23	2.174		
IV	25-26	3	4	7	2.23	2.165		

*p<0.05 significant



Graph 1: Allocation of the patients among various age groups

Table 3: Fundamental statistical description with level of significance evaluation using Pearson Chi-Square Test [For Evaluation of salivary flow rate (mL/mim)]

Evaluation of salivary flow rate (mL/mim)							
Variable No.	**Mean**	**Std. Deviation**	**Std. Error**	**95% CI**	**Pearson Chi-Square Value**	**df**	**Level of Significance (p value)**
Before treatment	1.76	0.264	0.000	1.96	2.242	2.0	0.030*
After treatment (Six Weeks)	2.13	1.346	0.078	1.96	2.498	1.0	0.010*

*p<0.05 significant

Table 4: Fundamental statistical description with level of significance evaluation using Pearson Chi-Square Test [For Evaluation of pH values]

Evaluation of pH values							
Variable No.	**Mean**	**Std. Deviation**	**Std. Error**	**95% CI**	**Pearson Chi-Square Value**	**df**	**Level of Significance (p value)**
Before treatment	7.76	0.264	0.000	1.96	2.242	2.0	0.010*
After treatment (Six Weeks)	6.13	1.346	0.078	1.96	2.498	1.0	0.000*

*p<0.05 significant

Discussion

Placement of fixed orthodontic appliances compromises the patients' oral hygiene not only by impeding oral hygiene procedures, but also by changing the saliva properties and microbial count. Therefore, in the present study, total microbial count and salivary flow and pH were analyzed at different time points before and during fixed orthodontic treatment. Saliva is produced and secreted by the salivary glands [11, 12, 13]. It consists mainly of water (99%) and other organic and inorganic components that contribute to the major functions of the salivary glands. In addition, saliva contains antibacterial, antiviral, and antifungal components that help maintain the normal oral flora. Saliva plays a vital role in maintaining oral health by performing several functions such as lubrication, antimicrobial activity, maintenance of homeostasis, and control of demineralization/remineralization of the teeth. Saliva promotes good oral health [14, 15] Human saliva has got many important functions like lubrication of the oral tissues, making oral functions like speech, mastication and deglutition possible and also protecting teeth and oral mucosal surfaces in different ways. The lubricating and antimicrobial functions of saliva are maintained mainly by resting saliva. Stimulation of salivary flow results in a flushing effect and the clearance of oral debris and noxious agents.[16] Orthodontic treatment using fixed appliances is known to alter the oral environment and encourage plaque retention around orthodontic brackets and bands, resulting in enamel demineralization and gingival inflammation.[17] Saliva is involved in myriad functions, such as mechanical cleansing, demineralization and remineralization of the enamel, protection against oral microbial flora, and buffering of acids in the oral cavity. Maintenance of oral hygiene is difficult in individuals with fixed orthodontic appliances, and this leads to plaque accumulation, gingival inflammation, dental caries, and other periodontal conditions. White spot lesions usually develop within a month of starting fixed orthodontic treatment. Salivary flow rate plays a vital role in oral health; an increased flow rate increases the cleansing action and antimicrobial activities of saliva, whereas a decreased flow rate promotes plaque retention, demineralization, and caries formation. Several studies have reported increased flow rates in patients with fixed orthodontic appliances [18]. The quality and the quantity of saliva play an important role in the oral equilibrium. Specific changes, such as increased pH, buffer capacity and flow rate, may contribute to decreased susceptibility to dental caries. Orthodontic treatment has gained increasing popularity owing to increased self-awareness of oral health-related quality of life and facial esthetics [19]. However, treatments using fixed appliances may induce the formation of bacterial biofilms in healthy oral cavities, and these can compromise oral hygiene and lead to enamel demineralization and gingival inflammation [20]. Areas around metal brackets are difficult to clean and are prone to the adhesion of bacteria and debris, whereas in the case of orthodontic bands, biofilm formation occurs mostly at the gingival margin, leading to periodontal inflammation. Several studies have demonstrated the development of white spot lesions on the tooth surface following orthodontic treatment [21].

Conclusion

In the present study, author found increased salivary flow rate and decreased pH value of saliva after fixed orthodontic therapies in the studied patients. It is therefore always advisable to clinically correlate these findings so as to finalize accurate treatment planning. However, we expect some other large scale studies to be conducted that could further establish certain standard guidelines in these perspectives.

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