Oral Health Changes during Early Phase of Orthodontic Treatment

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Abstract

Purpose: Aim of this study was to assess the influence of fixed orthodontic appliance on S. Mutans and S. sobrinus counts in orthodontic patients with regard to their previous Decayed, Missing and Filled surface Index (DMFT) during first twelve weeks of the orthodontic treatment.

Material and Methods: 22 patients who satisfied inclusion criteria: healthy systemic and periodontal condition, avoidance of antibiotic therapy and antiseptic mouthwashes in the past three months was included. All clinical measurements took place prior to fixed orthodontic appliance placement and twelve weeks after placement of fixed orthodontic appliance in the following order 1) stimulated saliva flow (SS) 2) OHI-s index and 3) DMFT. Polymerase chain method (PCR) was used to detect presence of S. Mutans and S. sobrinus at T1 and T2.

Results: T-test showed significant increase in DMFT index and SS between T1 and T2. Results also indicated significant improvement in OHI-S index. By use of PCR method S. Mutans was detected in 2 patients at T1 interval. At interval T2 two more patients had S. Mutans, but increase was not significant. With same method S. sobrinus was detected only in two patients at T2 interval.

Conclusion: Fixed orthodontic appliances have induced changes in caries microflora even in the presence of enhanced oral hygiene habits although these.

Keywords: Enamel demineralization; DMFT; S. Mutans; S. sobrinus; Orthodontics

Introduction

An unwanted effect of fixed orthodontic appliance on oral health has been proven in numerous research studies [1,2]. One of such is increase in plaque accumulation which presents risk factor for enamel demineralization and might result in discontinuation of the orthodontic treatment [3,4]. Prevention of enamel demineralization present serious problem for patients and clinicians during fixed orthodontic treatment. According to Fink and Smith [5] average duration of orthodontic treatment was 23.1 months. As most of orthodontic patients are preadolescent and adolescent [6] it is unlikely to expect high levels of oral hygiene habits during entire treatment time. Although conventional caries risk factors (DMFT index, plaque values, salivary flow) are described and provide important information of patients caries risk profile there is still controversy regarding their interrelationship [4,7]. Oral microbiota attachment in the orthodontic patients had been mainly associated with increased level of Streptococcus mutans and Streptococcus sobrinus who have been recognized as etiological agents of dental caries [8-10]. However, few authors question the role of S. Mutans in caries development and underline the role of S. sobrinus in caries development [10,11]. Despite improvements in the properties of the dental materials and prophylactic efforts enamel demineralization during orthodontic treatment still presents clinical challenge. Aim of this study was to assess the influence of fixed orthodontic appliance on S. Mutans and S. sobrinus counts in patients with regard to their previous caries experience (DMFT index) during first twelve weeks of orthodontic treatment. Further the object of present study was to identify the role of caries risk factors such as OHI-s index, stimulated salivary flow (SS) and their possible changes during first twelve weeks of orthodontic treatment.

Material and Methods

This prospective clinical study included total of 22 patients, 12 female (54.5%) and 10 male (45.5%) with fixed orthodontic appliances (Discovery, Dentaurum, Germany and Spirit MB, Ormco/A Company, Florida). Blue phase G2, Ivoclar, Vivadent adhesive was used for brackets bonding and elastomere ligatures were used for ligation.

Patients were recruited in the private orthodontic office in Zagreb, Croatia, and all satisfied inclusion criteria: healthy systemic and periodontal condition (depth of periodontal pockets ≤ 3 mm) and avoidance of antibiotic therapy and antiseptic mouthwashes during research period and three months before research. This study was approved by the Ethical Committee, School of Dental medicine University of Zagreb, Croatia and all patients or their parents signed informed consent. All patients received precise instructions in oral hygiene regime (instructions in teeth brushing methods especially around brackets for a minimum of 3 minutes three times a day) and dietary intake before orthodontic appliance placement and during each recall. All clinical measurements took place in the dental chair, between 9 and 11 AM at T1 (prior placement of fixed orthodontic appliance) and T2 (twelve weeks after placement of fixed orthodontic appliance).

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in the following order 1) stimulated whole salivary flow (SS) 2) OHI-s index and 3) DMFT index.

**Stimulated Whole Saliva Collection (SS)**

All patients were asked to refrain from eating, drinking and teeth brushing two hours prior to all clinical examinations. Patients were asked to chew 1 g of paraffin wax during one minute followed by saliva collection into calibrated, dry and sterilized test tubes during five minutes. The obtained salivary amount was expressed as ml/min [12].

**OHI’s Index (OHI-s)**

Six index teeth according to the Green and Vermilion Simplified OHI-s index [13] were used to determine plaque values. Presence of orthodontic brackets on the teeth disturbs evaluation of plaque values as described in OHI-s index, therefore plaque values were determined in dichotomies (positive presence of plaque on labial surface was marked as 1 and negative as 0). OHI index was calculated as total score divided by number 6.

**Decayed, Missing and Filled Teeth Index (DMFT)**

The DMFT index includes a record of the presence or absence of all teeth including presumptive cause of tooth loss. DMFT index was determined using sum of decayed (DT), missing (MT) and filled teeth (FT) according to the WHO [14]. The examinations were performed using a dental mirror, a dental explorer and a full-mouth set of periapical radiographs. Prior to the clinical examination of DMFT each tooth was cleansed and dried with an oil-free drier. Patients were divided in two groups according to the DMFT index in interval T0 – high caries risk group (DMFT >11.44) and low risk group (DMFT <11.44). We used date from study Uludamar et al. [15] to set 11.44 value of DMFT as the border between high and low caries risk groups.

**Bacterial Markers**

DNA isolation, PCR amplification and detection were performed as previously described [16,17]. Complete microbiological analysis was performed at the Department of Clinical and Molecular Microbiology, University Hospital Centre Zagreb, Croatia.

**Statistical Analysis**

Statistical calculations were made with Statistical Package for Social Sciences 19 (SPSS Inc, Chicago, IL). The data were tested regarding the normal distribution by applying the Shapiro-Wilk test. OHI-S in both T1 (p=0.046) and T2 (p=0.032) significantly deviated from normal distribution therefore nonparametric tests were used. Other investigated variables had normal distribution and parametric test were used. The results were described by parameters of mean and standard deviation of T1 and T2 measurements. Differences between two periods were analyzed with Wilcoxon test for OHI-S and paired t-test for other variables. Differences between groups were assessed using non paired t-test and Mann-Whitney test. For correlation between two variables we used Pearson’s and Spearman’s correlation coefficient. In all statistical tests, the significance level was set at 5%.

**Results**

The study included 22 patients, 12 female (54.5%) and 10 male (45.5%). The average age of patients was 25.09 ± 4.36 with a range age from 18 to 30 years. The mean values and standard error of the means of the variables at T1 and T2 time interval are presented in Table 1. There was not any significant difference between male and female patients. Paired t-test showed significant increase in DMFT index and stimulated salivary flow between T1 and T2. Results also indicate significant improvement in OHI-S (Z=-2.908, df=21, p=0.004) (Table 2). Tests of correlation demonstrated no significant correlation between DMFT and other variables (Table 3). We divided patients according to DMFT at interval T1 into low and high caries risk patients. Non paired t-test did not show significant difference in the stimulated salivary flow between the two groups (t=767, df=20, p=0.452 at T1, and t=-142, df=20, p=0.888 at T2). Mann-Whitney test did not show significant difference in OHI-S index between two groups (Z=-1.634, p=0.173 at T1, and Z=-2.48, p=0.669 at T2). Using PCR method S. Mutans was detected in 2 patients at T1 interval. At interval T2 two more patients had S. Mutans, but increase was not significant (Z=-1.414, p=0.157). With same method S. sobrinus was not detected at T1 and two cases were positive at T2 interval. It is interesting to note that new cases of positive S. Mutans are the same patients that had positive S. sobrinus at interval T2.

**Discussion**

Adverse effects of fixed orthodontic appliances present complex problem in clinical practice even in the patients who have improved their oral hygiene habits during fixed orthodontic therapy [3,18].

Object of this study was to investigate the presence of S. Mutans and S. sobrinus in patients with different caries risk experience (DMFT) and to correlate the prevalence of these streptococci with plaque index and stimulated saliva during first twelve weeks of orthodontic treatment.

Previous caries experience (DMFT index) is influenced by oral hygiene regime, socioeconomic issues and oral microbiological microflora and presents crucial information to the orthodontist in their treatment planning. Al Maaitah et al. [19] reported higher risk for development of enamel demineralization in patients who had at least 1 decayed and missed first molar when compared to the patients who had 4 healthy permanent molars. Similarly, Al Mulla et al. [20] reported connection between large number of decayed and filled tooth surfaces (DMFS) and higher values of S. Mutans and Lactobacillus after fixed orthodontic appliance debonding thus indicating DMFS as a possible parameter of caries risk. Although epidemiological studies carried out in many Western countries [21,22] have revealed

<table>
<thead>
<tr>
<th>Age</th>
<th>DMFT</th>
<th>OHI-S</th>
<th>SS(ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>T1</td>
<td>25.09</td>
<td>4.36</td>
<td>13.12</td>
</tr>
<tr>
<td>T2</td>
<td>13.86</td>
<td>4.09</td>
<td>37</td>
</tr>
</tbody>
</table>

**Table 1: Descriptive statistics for pretreatment (T1) and twelve weeks after treatment (T2).**

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMFT (T1-T2)</td>
<td>-4.598</td>
<td>21</td>
<td>&lt;001</td>
</tr>
<tr>
<td>SS (T1-T2)</td>
<td>-2.412</td>
<td>21</td>
<td>025</td>
</tr>
<tr>
<td>OHI-S (T1-T2)</td>
<td>-2.908*</td>
<td>21</td>
<td>004</td>
</tr>
</tbody>
</table>
* Wilcoxon test

**Table 2: Paired- test and Wilcoxon test.**

<table>
<thead>
<tr>
<th>DMFT T1</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>OHI-S T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>S</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.362</td>
<td>-0.31</td>
<td>319</td>
</tr>
<tr>
<td>S</td>
<td>0.088</td>
<td>890</td>
<td>148</td>
</tr>
<tr>
<td>N</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>

*Spearman’s rho

**Table 3: Correlation between DMFT and other variables.**
improvement in the dental health, average DMFT (13.86 ± 4.09) index in our study is disturbing. There are several factors which should be taken into account when interpreting this data: sample size of this study is small, and specific socioeconomic factors as in other transition countries combined with lack of preventive and education programs might influence our finding. Data from the published literature suggest lack of research studies on the epidemiological data regarding dental health of the young adults in Croatia. High average value of DMFT index in this study group indicates need for epidemiological studies and implementation of national prevention programs and education in oral hygiene habits in young adults. Results from this study indicate significant improvement in OHI-s values (Z = -2.908, df=21, p=0.004) at T2 suggesting significant oral hygiene improvement after oral hygiene instructions have been implemented before orthodontic appliance placement and at every recall. Our results are in accordance with study results from Gray and McIntyre [23] who reported short term significant reductions in plaque values when oral hygiene program was implemented during orthodontic treatment. Results from this study indicate significant increase in salivary flow rate after placement of fixed orthodontic appliances. These results are consistent with those of Chang et al. and UluKapı et al. [24,25]. Isolation of cariogenic microflora has been based on laboratory procedures (colonial morphology grown, biochemical and immunologic tests) which can be inaccurate. Polymerase chain reaction (PCR) method presents sensitive and specific method which uses specific DNA fractions for detection of microorganism [26]. Results from this study indicate slight but statistically insignificant increase in cariogenic microflora during T1-T2 period. Using PCR method we were not able to detect S. sobrinus at T1 while at T2 S. sobrinus was detected in two patients. Counts of S. Mutans also showed statistically insignificant increase from T1-T2 period. Although our results showed significant decrease in OHI-s values during tested period this improvement was not followed with improvement in the cariogenic microflora counts. Similar finding was reported by Smiech-Słomkowska et al. [18]. It is interesting that new cases of positive S. sobrinus were found in the same patients that had positive S. Mutans at interval T2. According to the reports from the literature [27] those patients can harbor significant higher caries incidence than those with either S. Mutans or S. sobrinus alone. Furthermore, Ortendahl et al. [28] reported that development of enamel demineralization during orthodontic treatment only in patients in whom S. sobrinus was detected in the plaque. In conclusion, presence of fixed orthodontic appliances presents caries risk factor. Clinicians should evaluate patient’s oral hygiene habits and motivation, respectively. Cariogenic microflora especially in patients with high DMFT index before and during orthodontic treatment should be assessed in order to apply individual preventive oral hygiene measures and to diminish adverse side effects of orthodontic treatment.

Conclusion

We can conclude that fixed orthodontic appliances have not induce statistically significant changes (p=0.157) in oral environment, but during first 12 weeks of orthodontic treatment we found significant improvement of oral hygiene (p=0.004).

References


