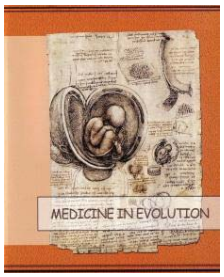
Effects of Topical Fluoride Applications on Caries Risk In Patients With Fix Orthodontic Appliances



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Abstract

The outcome of orthodontic treatment is usually aesthetically and functionally satisfactory. Caries is an undesirable side-effect of treatment with fixed orthodontic appliances. So pathogenic microbes like streptococcus mutants and lactobacillus gather, multiply and ferment the carbohydrates and sucrose. Therefore, it is crucial to understand how orthodontic treatment and different professional fluoride treatment affect caries risk and individual risk factors.

Keywords: fluoride varnish, caries risk, oral health, fix orthodontic appliance

INTRODUCTION

The multiband appliance facilitates food retention and aggravates the cleaning ability of the teeth. Studies have indicated that plaque levels increase during treatment with fixed appliances [1]. As a result white spot lesions can easily develop [2].

Caries forms through the dissolution of hydroxyapatite due to the process of bacterial fermentation in the presence of biofilm or plaque. A triggering factor is crowding. Other predilection sites for soft debris and plaque accumulation are related to the dental anatomy: occlusal deep fissures/pits, gingival margins, interproximal spaces and tooth restorations.

Another parameter of importance for caries development is exposure to fluoride (F), which can inhibit demineralization and enhance remineralization [3]. The main target of fluoride varnishes is to prevent the tooth surface to develop carious cavities by helping to remineralize the enamel with fluoride and prevent the surface from losing minerals. It is utilized as a primary preventive measure in patients with high to moderate caries risk. They exist with low fluoride concentration for long exposure and high fluoride concentration for a shorter exposure. Experimental studies indicate that fluoride affects the oral bacteria in several ways, by affecting their metabolism. It has been suggested that the uptake of fluoride by oral bacteria are pH dependent and that the fluoride reduces the acid tolerance of the bacteria.

Antimicrobial varnish is used to control and reduce the acidic outcome produced by the fermentation of soft deposits and plaque on the tooth surface. As a result, the bacterial balance shifts to a healthier level by inhibiting microbial growth [4, 5]. As a second positive effect, the demineralization reduces. Additionally, it minimizes the inflammation of gingival tissue caused by bacteria.

Previous studies have indicated that topical application of different solution with fluoride content reduced acidogenesis of the dental plaque. Other *in vivo* studies reported that fluoride rinsing resulted in a significantly reduced plaque index and a significant inhibition of acid production [6].

Aim and objectives

The purpose of the study is the evaluation of the outcome, including the advantages and disadvantages of professional fluoride administration on caries risk in patients with orthodontic treatment.

MATERIALS AND METHODS

The study took place during the period of October 2016–December 2019. 18 patients enrolled were asked to participate in the study (or a parent approved if the patient was less than 18 years of age).

The following inclusion criteria were used: patients between 12 and 20 years of age, scheduled for treatment of both the upper and lower arches with fixed appliances. The exclusion criteria were adults older than 20 years of age and children younger than 12 years of age, treatment in only one jaw or treatment with removable appliances and patients who declined to participate in the study.

The patients were divided randomly in 2 groups: the control group including patients that were instructed to brush their teeth twice a day, using standard toothpaste (1450 ppm F) and varnish group patients that were receiving topical fluoride application (5% natrium fluoride) every 3 months for a period of 1 year.

The first step of the clinical study was to inform the patients wearing fixed orthodontic appliances about the ongoing procedure and patient consent.

Procedures performed were: consultation, staining with toluidine blue, ultrasonic scaling, brushing with a slow speed handpiece in order to remove staining.

For each patient, general data and observation were gathered. The present teeth and their status were noted in a chart. For the qualitative plaque change the Silness- Löe Plaque Index (1964) was noted with the Mira-2-tone dye from Hager Werken by direct application to record the soft debris thickness and plaque deposits. The patients received oral health instructions, where and how to brush more precisely by showing them with a mirror the visualized stained surfaces. They received the explanation, that the multi -dye plaque agent stains the old and thicker plaque accumulation in blue which is older than three days, whereby the younger and thinner plaque is stained in red/pinkish colour. After removing the plaque and tartar by professional tooth cleaning with professional toothpaste and if necessary, the use of the scaler, it followed measuring the Silness-Löe Gingival Index (1963).

After recording the gingival health, the dental surfaces were dried with air and the varnish was applied with a small brush or applicator on the cervical tooth part and around the brackets.

For each of the patients included in the study Cariogram evaluating individual caries risk, described as 'the chance of avoiding new cavities', and illustrated in a pie chart was performed (figure 1). For all the patients the variable 'clinical judgment' was, retained at its normal setting.

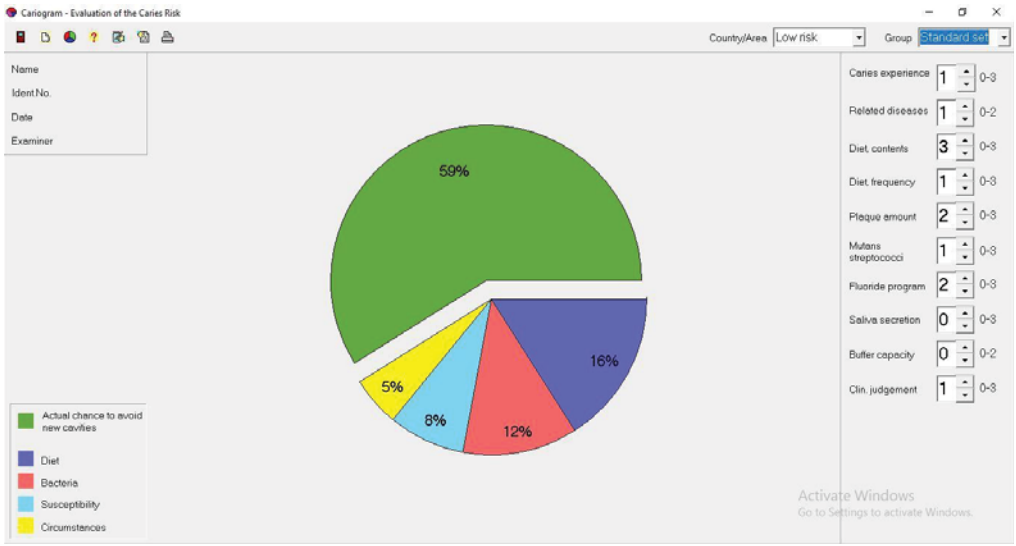

Figure 1. The figure illustrates a Cariogram which expresses to what extent different etiological factors of caries may affect the caries risk for that particular patient

RESULTS

The outcome variables were related to caries risk (assessed at baseline and after one year of treatment according to the Cariogram) and the numbers of cariogenic bacteria (counts of MS and LB in the oral cavity, assessed at baseline and after 1 year).

The oral hygiene was unsatisfied and soft deposits on the tooth and the gingival margin was even visible with the naked eye. The value of the plaque and the value of the gingival index correlate to each other in most cases. Having a mean of 1,04 for the initial PI and 0,91 for the initial GI calculated for all the 18 patients registered, these values indicate a general mild inflammation of the gingiva with plaque accumulation on the free gingival margin and adjacent areas (Figure 2,3).

The caries risk increased statistically significantly in the control group after 1 year with the fixed appliance compared to the risk at baseline ($P < 0.0001$). There were no statistically

significant differences in the caries risk at baseline between the two groups. However, there was a statistically significant difference in the caries risk between the 2 groups after 1 year with the fixed appliance ($P < 0.05$) (Figure 4).

The mean numbers of cariogenic bacteria (LB and MS) increased statistically significantly in the control group after 1 year with the fixed appliance in place ($P < 0.0001$).

The level of dental plaque, related disease, and the frequency of food intake did not change significantly in the control group after 1 year with the fixed appliance, as compared to the respective levels at baseline ($P < 0.0001$).

There were no statistically significant differences in the mean levels of plaque between the 2 groups, either at baseline or after 1 year with the fixed appliance (Figure 5). Regarding the frequency of food intake, the control group showed a statistically significantly higher baseline value than varnish group ($P = 0.029$). However, the frequency of food intake decreased significantly ($P < 0.05$), as compared to baseline levels, in both groups after 1 year with the fixed appliance.

Figure 2. Dental plaque identification at baseline- teeth stained with Mira 2 tone dye

Figure 3. Clinical view after professional cleaning and topical fluoride application

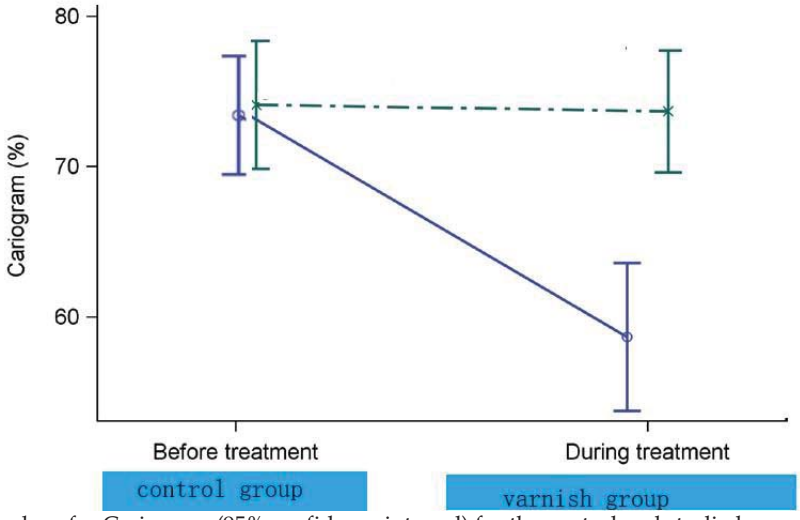

Figure 4. Mean values for Cariogram (95% confidence interval) for the control and studied group before treatment and after 1 year

DISCUSSIONS

The aim of the present study was to evaluate the impact of topical fluoride treatment applied during orthodontic treatment on caries risk and caries risk factors.

Additional fluoride brings a positive effect on caries risk, in the studied (varnish) group the caries risk was unchanged due to the additional fluoride and the decreased food intake frequency. The caries risk increased significantly in the control group, due to a significant increase in the numbers of cariogenic bacteria and a lack of supplementary topical fluoride treatment, since both the food intake frequency and the levels of plaque were not significantly changed. This is also mentioned in other studies that have demonstrated an increase in the number of cariogenic bacteria due to the presence of fixed orthodontic appliances [7]. It has been suggested that oral bacteria vary regarding their levels of sensitivity to fluoride [8].

The impacts of fluoride on the physiological features and metabolic functions of the bacteria may play a more important role than the actual number of cariogenic bacteria. Prevalently recommended for professional application are topical fluoride solutions, gels, or foams. In spite of that, they are less effective than fluoride varnish. However, the focus of this work is specifically on the application of varnishes and on the investigation of the resulting advantages and disadvantages. As the concentration of varnishes is higher, a smaller quantity is necessary as in gels. Although, the use is ascribed to professional health personal only. Varnish is a solution of natural gums and resins in a suitable solvent. A thin coating is applied over the surfaces of the cavity preparations before placement of restorations and is used to protect the teeth. They consist of a film former, which is a high molecular polymer or a low molecular resin. The second part is the biocompatible solvent as water, ethanol, acetone or esters. It also consists of auxiliaries' additives and other additional ingredients. Induration can be archived by two mechanisms, chemical and physical.

Plaque tends to accumulate near the gingival margin and in close proximity to the orthodontic bands, brackets and attachments, which often leads to increased plaque accumulation.

A significantly lower values of plaque indices was found in a test group that used toothpaste and fluoride varnish, as compared to a control group that used only fluoride toothpaste [9]. In this study, however, the amount of plaque did not increase significantly as a result of the orthodontic treatment. There are strict criteria regarding good oral hygiene and low caries activity in order to be accepted for orthodontic treatment, which probably explains the good oral health among the subjects. Also the plaque levels were not affected by the fluoride treatment.

The importance of food intake during orthodontic treatment with a fixed appliance is sometimes described as consistent and sometimes described as inconsistent. Is desirable to have a decreased frequency of food intake and this is in accordance with the results from the varnish fluoride group in the present study. The improved diets may could be explained to the fact that orthodontic patients are often restricted in certain foods or they avoid them for protecting the brackets from debonding. On the other hand, the food habits were unchanged in the control group, indicating that food habits can be persistent.

The Cariogram variables are weighted differently according to a built-in algorithm. Hypothetical calculations have been performed to ensure that the observed results for differences in caries risk are primarily due to the fluoride regime used and not the food intake frequency.

Limitations of the present study: the number of the subjects included in the present study is low and the subjects are not representative for the entire age group population. The study results may be different in a group with higher levels of cariogenic bacteria and higher caries prevalence.

CONCLUSIONS

During orthodontic treatment any additional fluoride treatment (other than daily toothbrushing with fluoride toothpaste) is highly recommended in order to minimize the risk for developing new caries lesions.

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