



ORIGINAL ARTICLE

Caries risk profiles in orthodontic patients: A 4-year follow-up study using the Cariogram model in governmental vs. private clinics

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Abstract *Objectives:* To (1) analyze caries-related factors and (2) evaluate caries risk using the Cariogram model for governmental and private orthodontic patients at de-bonding and 4 years after de-bonding.

Materials and methods: Forty orthodontic patients with mean age of 26.4 years were recruited from a governmental (G) group (n = 20) and private (P) group (n = 20) and were examined at de-bonding (T1) and 4 years after de-bonding (T2). The examination included a questionnaire, plaque scoring, caries examination, bitewing radiographs, and assessment of salivary secretion rate, buffering capacity and cariogenic microorganisms. The data were entered into the Cariogram program to illustrate the caries risk profiles.

Results: The chance to avoid new cavities was higher in P-group compared to G-group at T1 (58% and 31%, respectively) ($P < 0.01$) and T2 (77% and 52%, respectively) ($P < 0.001$). Plaque index was significantly higher in G-group, and fluoride was used significantly more in P-group at T1 and T2 ($P < 0.05$). The chance to avoid new cavities was higher at T2 compared to T1 (64% and 44%, respectively) ($P < 0.001$). Saliva secretion rate and buffer capacity were significantly increased, and the plaque index was significantly decreased at T2 compared to T1 ($P < 0.01$).

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Conclusion: According to the Cariogram, orthodontic patients were less likely to avoid new cavities at de-bonding and 4 years after de-bonding in government clinics compared to private clinics, and the caries risk significantly decreased 4 years after orthodontic treatment for all patients, regardless of the location of treatment.

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1. Introduction

Enamel demineralization associated with fixed orthodontic therapy can be a rapid process that is caused by a high and continuous cariogenic challenge in the plaque that develops adjacent to brackets and bands (Øgaard et al., 1988). Several studies in the literature have investigated the association between malocclusion and the development of dental caries. These studies showed contradicting results, with both positive (Gabris et al., 2006; Singh et al., 2011; Nalcaci et al., 2012; Buczkowska-Radlinska et al., 2012; Baskaradoss et al., 2013) and negative (Addy et al., 1988; Helm and Petersen, 1989; Stahl and Grabowski, 2004) relationships shown between malocclusion and the development of dental caries. However, a recent systematic review performed by Hafez et al. (2012); concluded that no evidence actually shows a positive relationship between crowding and the development of dental caries.

Though caries prevalence has declined in several countries (World Health Organization, 2003), it is still a problematic issue in many countries, such as the Kingdom of Saudi Arabia (KSA). Recently, a meta-analysis was performed on a Saudi population to evaluate dental caries, and they found that the mean of DMFT was 3.3 in the permanent dentition (Khan et al., 2013). In 2008, it was reported that the overall caries prevalence among preschool children in the KSA was approximately 75% and that the caries prevalence and severity were significantly higher among children from governmental preschools compared to those from private preschools (Wyne, 2008). Recently, Almosa et al. (2012), showed that orthodontic patients treated in government centers in KSA had a greater caries risk compared to patients treated in private clinics.

Dental caries has a multifactorial etiology and is caused by the interactions of several factors, including past caries experience, diet, fluoride use, extent of plaque, and bacterial and salivary activity, in addition to social and behavioral factors. All of these factors have been considered using a computer program developed by Bratthall et al., called the Cariogram (2013), which has been developed for caries risk assessment. Studies have shown that there is a correlation between the Cariogram results and the development of caries over time for both children and adults (Hansel Petersson et al., 2002; Hansel Petersson et al., 2003), and the validity of the Cariogram has been confirmed (Campus et al., 2012). The Cariogram, when used as a pedagogical tool in clinical practice, has been found to be promising in explaining the caries situation to patients, thus helping the patients improve their preventive measures (Petersson and Bratthall, 2000).

In 2009, a study was conducted to evaluate the caries risk using the Cariogram model in orthodontic patients. The caries-related factors between government and private groups

were compared at de-bonding (Almosa et al., 2012). The Cariogram risk profile showed that orthodontic patients treated in private centers had a low caries risk compared to patients treated in governmental centers. The aims of the present follow up study were (i) to analyze various caries-related factors and evaluate the caries risk for governmental and private orthodontic patients at de-bonding and 4 years after de-bonding, and (ii) to compare the caries-related factors and caries risk profile by using the Cariogram model for those patients over the 4-year period. It was hypothesized that caries risk is higher in patients treated in government clinics compared to those treated in private clinics 4 years after de-bonding and that the caries risk will decrease over time after de-bonding.

2. Materials and methods

2.1. Population and design

This prospective longitudinal study was approved by the Ethics Committee at King Saud University, College of Dentistry Research Centre, Riyadh, KSA (Reg. No. NF 2225). To estimate the sample size, a power analysis was performed based on the difference between the governmental (G) and private (P) groups in the Cariogram values, which was presented previously (Almosa et al., 2012). A minimum of 12 patients per group was required. To account for dropouts, we decided to recall 20 patients from each group (G and P) of the 89 patients who presented for the baseline study (Almosa et al., 2012). The number of patients, the group, the mean age, and the genders of the patients over the 4-year period are illustrated in Fig. 1. Informed consent was obtained prior to the start of the examination. The 40 the patients were treated with the same type of fixed orthodontic appliances in both jaws 4 years ago for 1.5–2 years (mean treatment time 21 months). After de-bonding, routine instructions were given to all patients in both groups, i.e. to brush their teeth with a fluoride toothpaste two times daily.

All patients in this follow-up study were interviewed and examined clinically for the presence of caries by the main author (N.A.) at de-bonding (T1) and 4 years after de-bonding (T2). The patients then underwent plaque scoring, saliva sampling, and bitewing radiographs to evaluate the interproximal surfaces for presence of caries.

2.2. Questionnaire

A standardized structured questionnaire according to the Cariogram manual (Cariogram, 2013) was used to elicit data about medical and dental history, dietary habits, and the use

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