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Original Article

Effectiveness of different preventive agents on initial occlusal and proximal caries lesions: A follow-up study

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Abstract *Background/purpose:* Monitoring the effects of different caries-preventive agents on initial caries lesions in orthodontic patients is important. Therefore, the purpose of this study is to investigate the efficacy of different preventive methods in preventing occlusal and proximal incipient lesions (ILs) during fixed orthodontic treatment.
Materials and methods: Forty-eight subjects at the beginning of fixed orthodontic treatment were included. All subjects were well educated and motivated to use the fluoride toothpaste (Colgate Total, 1450 ppm F) three times a day during the study period. Four different groups were created with a split-mouth design: placebo, fluoride gel, fluoride varnish, and chlorhexidine varnish. The occlusal surfaces of the second molar teeth were assessed with DIAGNOdent pen (DD) during the first 12 months (6th and 12th), and the proximal surfaces of each quadrant were monitored using bitewing radiographs until the 24th month (baseline and 24th month).
Results: The mean DD values increased in each group during the first 6 months compared to the baseline, but a significant increment was only obtained in the control and fluoride gel groups ($p < 0.05$). Fluoride and chlorhexidine varnish had significantly more preventive effects than the control and the fluoride gel for occlusal surfaces at the 6th and 12th month and for intact proximal surfaces at the 24th month, but no significant differences were found between the two varnish groups ($p > 0.05$). No significant differences were found between the four methods in terms of caries progression for proximal ILs after 24 months.
Conclusion: Effective toothbrushing with 1450 ppm fluoridated toothpaste and topical fluoride gel application seems to be inadequate for prevention of new proximal ILs during fixed

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orthodontic treatment. Fluoride and chlorhexidine varnish showed more protection in relation to occlusal surfaces.

Introduction

Incipient caries lesions (ILs) around the surfaces of banded or bonded teeth are a common orthodontic problem.[1] The presence of fixed orthodontic appliances further affects oral hygiene and leads to the cleaning of teeth becoming more difficult; hence, accumulation of dental plaque around brackets and bands increases, which causes enamel demineralization.[2] Current literature indicates that this is associated with a fixed orthodontic treatment prevalence rate of 26%—89% for incipient lesions.[3] Although the patients are instructed about efficient oral care processes, IL still remains an actual clinical problem in fixed orthodontic appliances. These lesions cause problems such as poor esthetics, patient dissatisfaction, and legal complications after orthodontic treatment.[4] Factors such as the patient's medical history, dental history, medication history, diet, salivary flow rate, levels of calcium, phosphate, bicarbonate in saliva, fluoride levels, and genetic susceptibility also play an important role in IL.[5] These problems have made it important to determine patient's saliva, oral care condition and caries risk and to evaluate, when necessary, early-preventive implementations before the orthodontic treatment. In order to respond to this problem, many studies have focused on finding solutions to IL that occur during fixed orthodontic treatment.[3,5]

Most studies in the literature have specifically focused on dental materials used for connecting to orthodontic brackets,[6—9] or for sealing the buccal surfaces of teeth.[10,11] Topical fluoride application of toothpastes, gels, rinses, and varnishes was found to be beneficial in patients with fixed appliances.[12] Chlorhexidine varnish treatment was found to be beneficial in inhibiting salivary *Streptococcus mutans* levels and in reducing gingivitis, thereby improving oral hygiene in these patients.[13] Early detection of ILs during orthodontic treatment is of great importance, as it allows clinicians to implement preventive measures to control the demineralization process before lesions progress.[14] On the other hand, most studies in the literature have focused on buccal surface ILs[8—13]; only one study reported information on occlusal caries progression in patients undergoing orthodontic treatment.[15] In general, the susceptibility of different tooth surfaces to caries lesions is markedly different, with the pit and fissure (occlusal) surfaces the most susceptible, and smooth (labial and lingual) surfaces the least prone.[16] The occlusal surfaces of molar regions remain the most frequent sites of attack during childhood and adolescence. In a longitudinal study of adolescents, it was found that occlusal surfaces on molars and premolars accounted for 60% of the total DMFS score.[17]

Monitoring the effects of different caries-preventive agents on initial caries on different teeth surface is, therefore, very important. However, to the best of our knowledge, no study has investigated the effects of different methods on occlusal and proximal ILs during orthodontic treatment. Therefore, the objective of this study was to compare the effectiveness of four different methods (placebo, fluoride gel, fluoride varnish, and chlorhexidine varnish) in preventing ILs during orthodontic treatment with a fixed appliance. The null hypothesis to be tested was that no statistically significant difference exists between the control and treatment groups at 6th, 12th, and 24th months.

Materials and methods

Ethical approval for this study was obtained from the Ethics Committee of the Dentistry School of the University of Selçuk (2012-08/10). Informed consent was obtained from all participants, and their parents were informed about the clinical study. Subjects were evaluated clinically at each 3-month point over the course of two years, but outcomes were obtained only at baseline and at the 6th, 12th, and 24th month thereafter. The primary endpoint measure was laser fluorescence (DIAGNOdent pen) readings of the occlusal surface of the second molars performed at baseline and at the 6th- and 12th-month appointment. The secondary endpoint was a bitewing radiograph (for monitoring proximal enamel lesions in each quadrant, as described below) carried out at baseline and at the 24th month.

Study design and subjects

This study was a split-mouth, blinded, four-parallel-group study and had a follow-up design. A power analysis was established using G*Power software (Ver. 3.0.10; Franz Faul, Universitat Kiel, Germany). A total sample size of 180 teeth (45 teeth per group) would give more than 90% power to detect significant differences with a 0.25 effect size among four groups and at a $p = 0.05$ significance level.

A sample of 48 patients (28 females and 20 males, 13—16 years old, mean age: 14.4 ± 0.9) undergoing fixed orthodontic treatment at the Department of Orthodontics was recruited for this study. All subjects lived in a community with no water fluoridation. The fluoride level of drinking water was less than 0.3 ppm in the city where the subjects lived. The following inclusion criteria were applied: patients were at the bonding stage of fixed appliance therapy, had occlusal restorations of at least two first molars, had four second molars with clinically intact occlusal surfaces and fully erupted, had all premolar teeth (non-extraction treatment) fully erupted and visible at the start of the study, had all posterior teeth (from first premolar to second

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