Modified fluoride toothpaste technique reduces caries in orthodontic patients: a longitudinal, randomized clinical trial

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Fluoride toothpaste has been widely used for more than 4 decades and remains a benchmark for the prevention of dental caries. It reduces caries in both permanent and deciduous teeth. For this reason, fluoride toothpaste is an integral component of caries-prevention measures worldwide. Topical fluoride (relished in rinses, pastes, and varnishes), used in addition to fluoride toothpaste, achieve a more rapid yield in caries compared with toothpaste used alone. Several studies have shown that even low levels of fluoride, from the regular use of toothpaste, can have a preventive effect on enamel demineralization and remineralization.

Four factors influence the anticaries efficacy of fluoride toothpaste: brushing, duration of brushing, fluoride concentration, and presence of other ingredients. Brushing should be done twice daily, and patients should be persuaded to brush for a longer time. The salivary fluoride concentration measured after dentifrice application decreases significantly as the water rinse volume, rinse duration, and rinse frequency increases.

A toothpaste technique in which a slurry rinse with the toothpaste is used after brushing increases the efficacy of the fluoride toothpaste. A study of the efficacy of fluoride caries in preschool children by an average of 26%. Furthermore, rinsing immediately after brushing reduces the salivary fluoride level about 12 to 14 hours compared with brushing alone. Postbrushing rinsing habits might play an important role in the oral reaction of fluoride released from dentifrices that could, in turn, affect their clinical efficacy.

Enamel demineralization associated with fixed orthodontic appliances is a rapid process caused by cariogenic microorganisms that develop around brackets and under ill-fitting bands. Despite improvements in mechanical and preventive efforts, demineralization can occur around orthodontic appliances after only 1 month. There is a higher risk of demineralization adjacent to brackets at earlier ages, because of the lower resistance of enamel and poorer cooperation by younger patients in the orthodontic treatment process. Children in the Kingdom of Saudi Arabia (KSA) have a high prevalence of dental caries. A recent study by Brown found a mean incidence of decayed, extracted, and filled (DEFT) teeth of 6.3 in healthy 5-year-old children.

Clinical trials are needed to give evidence-based advice on the optimal caries-prevention strategies with clear practice guidelines. For orthodontic patients, more research is required to study the various modes of delivering fluoride. The hypothesis of this study was that toothpaste slurry rinsing would reduce the numbers of decayed and filled tooth surfaces (DFS) in orthodontic patients.

Material and Methods

A power analysis with an assumed significance level of 5%, standard deviations of 5.0 DFS, least detectable difference of 2.0 DFS, and a power for that detection of 90% was performed and produced a minimum sample size of 45 observations per group.

Our subjects consisted of 150 orthodontic patients at baseline, recruited consecutively during 6 months at a private orthodontic clinic in Riyadh, KSA. They were randomly divided into 2 groups (test and control groups) with 75 patients in each. The clinic’s receptionist assigned patients with odd birth dates to the test group and patients with even birth dates to the control group. The Saudi Ministry of Health Ethics Committee approved the study. Information sheets were given to the patients before they consented to participate in the study; written consent was obtained from all subjects before the trial.

Before the start of the treatment or the trial, the follow-up was performed for both control and test groups by using a standardized form: frequency of brushing, amount of toothpaste, frequency of fluoride rinses, and the fluoride content of the toothpaste used. The number of meals eaten in a 24-hour period was also recorded. The information was obtained by a dentist (A.L.M) who was blind to the patients’ group.

The examination consisted of recording the plaque index of each surface of the second molars. Plaque surfaces underlined with caries were scored as recuring caries.

After the data collection, the patients in both test and control groups received Colgate Max Cavity toothpaste containing 1450 ppm fluoride (Colgate, Riyadh, KSA).

The test group received verbal and written instructions about the brushing technique: (1) use 2 cm (1 g) of dentifrice on a wet toothbrush; (2) spread the toothpaste evenly in both arches; (3) brush all surfaces for 2 minutes; (4) use a small amount of water, the equivalent of 1 handful with the dentifrice remaining in the mouth and the fretting plane slurry between the teeth by active cheek movements for 30 seconds before expectorating; (5) avoid further rinsing with water; and (6) avoid drinking or eating for 2 hours; (7) brush twice a day, after breakfast and at night before going to bed; and (8) abstain from all other types of dentifrice during treatment and until its completion (Fig. 1). To ensure that all patients in both groups had a supply of the given follow-up test, they were given a tube at each visit or on request.

The control group was given the routine clinical oral hygiene instructions: brushing twice a day after breakfast and after dinner before going to bed, and rinsing with a fluoridated mouthwash. At each patient visit to the clinic for the treatment follow-up, the instructions were repeated by the assigned nurse or assistant.

At the end of the trial or treatment, the use of fluoridated mouthwash and the study toothpaste by the control group and the use of the toothpaste and brushing and rinsing instructions by the test group was assessed. For the test group patients, a standard form was used to rank their compliance with the duration of brushing, the frequency of brushing, the amount of water used, and the method of filtering the dentifrice slurry, and the time between brushing, rinsing, and eating. They were ranked from 0 according to the number of instructions they had followed. Of the 5 instructions, if patients followed 1 or 2, they were considered “good.” If they followed more than 3, they were “very good.”

Statistical Analysis

The Statistical Package for Social Sciences (version 18.0, SPSS, Chicago, IL) was used for the statistical analysis of the determined measurements. DFS and prevented fractions (PF) were calculated according to these 2 formulae (DFS follow-up DFS + baseline DFS and PF 5 [control group DFS] – test group DFS)/ [control group DFS] x 100).

For the descriptive statistics, the mean values with standard deviations were calculated. To determine statistically significant differences between the groups, the independent sam- ple t test was applied between the groups following the test, and good vs very good. The significance level was set at 0.05. The paired t test was used to check intraexaminer reliability for the radiographic analysis. The 25 randomly selected radiographs were checked within a 1-week period.

Fig 1. MFPT instructions. A, use 2 cm of dentifrice on a wet toothbrush, spread the toothpaste evenly in both arches, and brush carefully for 2 minutes; B, use a sip of water (1 full hand) with the dentifrice remaining in the mouth and filter the toothpaste slurry between the teeth by active cheek movements for 30 seconds before expectorating; C, avoid further rinsing with water and avoid eating and drinking for 2 hours; D, brush twice a day (after breakfast and immediately before going to bed).

Table 1. Plaque index, clinical DFS, radiographic DFS, and total DFS of the groups

<table>
<thead>
<tr>
<th>Test (n = 51)</th>
<th>Control (n = 49)</th>
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<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td><strong>Follow-up</strong></td>
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<td><strong>Follow-up</strong></td>
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<td>Plaque index</td>
<td>Clinical DFS</td>
<td>Radiographic DFS</td>
<td>Total DFS</td>
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<td>Mean ± SD</td>
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<td>1.4 ± 0.5</td>
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<tr>
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<td>7.4 ± 7.7</td>
<td>4.1 ± 4.0</td>
<td>11.6 ± 10.0</td>
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Results

At the end of treatment, 30 patients were lost or excluded, leaving only 70 patients. This loss did not affect the power of the study as determined by the power analysis to determine the sample size (Fig 2). The patients were divided into the test group (n 5 51, 10 male; 41 female; mean age, 16.2 ± 4 years) and the control group (n 5 50, 17 male, 33 female; mean age, 16.9 ± 4 years). Intertester reliability for the radiographic examination showed no significant difference (P > 0.05), indicating good reliability.

The information obtained with the standardized form by the examiner blinded to the patients’ groups showed the following for both groups at the start of the trial: 70% brushed 2 or 5 times daily; about 50% used 1 g of toothpaste; and more than 85% used only fluoride toothpaste with no other fluoride supplements; 90% had 5 to 5 molars (plus snicks) a day; and only 6% had 7 or more meals (plus snacks) a day. At follow-up, 86% of the control patients used fluoride toothpaste only; 8% used fluoride toothpaste with fluoride mouthwash infrequently, and the remaining 6% used no fluoride.

The test and control groups’ baseline and follow-up plaque index, clinical DFS, radiographic DFS, and clinical and radiographic DFS values are shown in Table I.

At baseline, there were no significant differences between the groups. At follow-up, the total behavior index available was almost the same in both groups (test: 20.9 ± 1.7; control: 20.9 ± 1.7). At the end of the study, the test group patients had significantly better plaque index scores compared with the control group (P < 0.05). Both groups increased their DFS index, both clinically and radiographically, with a higher increment in the control group.

The clinical, radiographic, and clinical plus radiographic DFS (incidence) are shown in Figure 5. Compared with the control group patients had more than 7 times the clinical DFS (P < 0.001), more than 10 times the radiographic DFS (P < 0.001), and more than 5 times the clinical plus radiographic DFS (P < 0.001), with lower values of 85%, 78%, and 85%, respectively. Baseline and follow-up clinical plus radiographic DFS (total) and DFS (incidence) compliance are shown in Table II. The patients with “very good” compliance had lower DFS incidence than those with “good” compliance, but the difference was not statistically significant.

Discussion

The results of this study provide support for the hypothesis that the recommended MPTT was more effective in preventing caries in orthodontic patients than normal oral hygiene instructions. We observed a difference in the mean caries increment between patients who followed the MPTT and those who did not. This technique resulted in 5 times fewer DFS compared with the control group. The focus of the test group was the MPTT. On the other hand, the control group received oral hygiene instructions, but no special instructions on toothpaste technique. Our results therefore indicate that, in this population, the use of fluoride toothpaste combined with the MPTT is an important regimen that should be considered in the orthodontic clinic.

The MPTT aimed to both increase the fluoride concentration and prolong the time that the fluoride level is elevated in the oral cavity. Spreading dentifrice on the teeth before brushing and rinsing with toothpaste slurry immediately after brushing can be expected to produce more even distribution of the dentifrice and enhance fluoride concentration compared with a more conventional technique.

Brushing twice daily has been shown to be an important factor for caries prevention, whereas not eating or drinking for 2 hours allows a longer time for the elevated fluoride concentration. The MPTT contains a package of advice.

Although the MPTT is important, patients must be aware of possible side effects of rinsing and irritation of the oral mucosa. In our experience, however, few patients reported any complaints. The MPTT delivers more fluoride to the oral cavity, and it will eventually be ingested. However, only 5% to 10% is swallowed, which is negligible from a toxicological point of view.

Orthodontists must be aware that the MPTT used in this study was used for patients with a high risk for caries. The caries prevalence among adolescents and adults in KSA is high. The children have high sugar intake and poor knowledge of oral hygiene. The large difference found in the DFS between the test and control group patients in KSA would not be expected in other countries with a low DFS prevalence. For example, Sweden has a long tradition of fluoride toothpaste and other fluoride products for orthodontic patients; therefore, the expected caries reduction after using the MPTT is lower.

Conclusions

The use of the MPTT described in this study significantly reduces the incidence of new caries lesions in orthodontic patients. A regimen of this kind should therefore be considered in the orthodontic clinic, especially for patients with a high risk for caries.

Editorial note: A complete list of references is available from the publisher. 

**Table I. Incidence of caries (DIF) in the test and control groups after 2 years.** The means and standard deviations are given above each column. There were statistically significant differences (P < 0.001) between the groups in clinical, radiographic, and total DFS.