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.1-2 It reduces caries in both permanent and deciduous teeth.3 For this reason, fluoride toothpaste is regarded as an integral part of caries-prevention measure worldwide.4 Topical fluoride (e.g., rinses, varnishes, gels, and pastes) uses the same fluoride concentration and has been used in addition to fluoride toothpaste, achieving a marked reduction in caries compared with toothpaste used alone.5 Several studies have shown that even low levels of fluoride, from the regular use of toothpaste, can have a positive effect on enamel remineralization and remineralization.6-9

Four factors influence the anticaries efficacy of fluoride toothpaste: (1) brushing frequency (i.e., brushing, duration of brushing, toothpaste concentration, and rinsing time); (10) Brushing should be done twice daily;7 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 rinsing frequency increase.10-11 A toothpaste technique in which a slurry rinse with the toothpaste is used after brushing increases the efficacy of the fluoride toothpaste12-13.4 A reduced amount of caries in preschool children by an average of 26%.14 Furthermore, brushing immediately after brushing reduces the salivary fluoride level about 12 to 15% compared with brushing alone.15 Postbrushing rinsing habits might play an important role in the oral reposition of residual fluoride from dentifrices that could, in turn, affect their clinical efficacy.16

Enamel demineralization associated with fixed orthodontic appliances is a rapid process caused by cariogenic microorganisms that develop around brackets and under ill-fitting bands.17-19 Despite improvements in preventive and preventive efforts, demineralization can occur around orthodontic appliances after only 1 month.19 There is a higher risk of demineralization adjacent to brackets at earlier ages, because of the lower resistance to enamel and poorer cooperation by younger patients in the orthodontic treatment process.20-21 Children in the Kingdom of Saudi Arabia (KSA) have a high prevalence of dental caries. A recent study by Bkhoury22 found a mean incidence of decayed, extracted, and filled teeth of 6.5 in healthy 5-year-old children.

Clinical trials are needed to provide evidence-based advice on the optimal caries-prevention strategy with clear practice guidelines.23 For orthodontic patients, more research is required to determine the various modes of delivering fluoride.24 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 significant level of 5%, standard deviations of 5.0 DFS, least detectable difference of 0.5 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 following teeth were isolated for both control and test groups by using a standardised 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.M.L.) who was blinded to the patients’ group.

The examination consisted of recording the plaque index and 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 examination was performed by a dentist (A.M.L.) who was blinded to the patients’ group. At the end of the trial or treatment, the use of fluoridated mouthwash and the fluoride toothpaste by the subjects was recorded to assess 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 use of fluoridated mouthwash, and the fluoride toothpaste by the subjects, and the use of the toothpaste and brushing and rinsing instructions by the test group was assessed. Of the 5 instructions, if patients followed 1 or 2, they were considered “good,” and, 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 obtained measurements. DFS and prevented fractions (PF) were calculated according to these 2 formulas (DDFS = follow-up DFS - baseline DFS) and (PF = control group DDFS - test group DDFS)/control group DDFS × 100).

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

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

<table>
<thead>
<tr>
<th>Test (n = 51)</th>
<th>Control (n = 49)</th>
<th>Test (n = 51)</th>
<th>Control (n = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Plaque index</td>
<td>1.4 ± 0.5</td>
<td>1.5 ± 0.6</td>
<td>1.1 ± 0.3</td>
</tr>
<tr>
<td>Clinical DFS</td>
<td>5.6 ± 5.7</td>
<td>5.7 ± 5.4</td>
<td>5.8 ± 6.0</td>
</tr>
<tr>
<td>Radiographic DFS</td>
<td>2.7 ± 3.0</td>
<td>2.3 ± 3.2</td>
<td>3.1 ± 3.0</td>
</tr>
<tr>
<td>Total DFS</td>
<td>8.3 ± 7.5</td>
<td>8.1 ± 8.4</td>
<td>9.0 ± 8.9</td>
</tr>
</tbody>
</table>

Fig 1. MPFT instructions. A, use 2 cm of dentifrice on a wet toothbrush, spread the toothpaste evenly in both arches; B, brush all surfaces for 2 minutes; C, use a tip of water (1 full hand) with the dentifrice remaining in the mouth and fill the toothpaste slurry between the teeth by active cheek movements for 30 seconds before expectorating; D, brush twice a day, after breakfast and at night before going to bed; and E, brush twice a day (after breakfast and immediately before going to bed).
Results

At the end of treatment, 50 patients were lost or excluded, leaving 200 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 = 51: 10 male, 41 female; mean age, 16.2 ± 4.9 years) and the control group (n = 49: 17 male, 32 female; mean age, 16.9 ± 4.8 years). Intraexaminer 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 results 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 supplement; 90% had 5 to 5 meals (plus snacks) 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 overall behavior/teeth available was almost the same in both groups (test, 20.9 ± 1.7; control, 20.8 ± 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 had increases in 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 3. Compared with the test group, control group patients had more than 7 times the clinical DFS (P < 0.001), 3 times the radiographic DFS (P < 0.001), and more than 5 times the clinical plus radiographic DFS (P < 0.001), with FF values of 87%, 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 behavior 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 technique is easy to teach. Patients can be instructed on how to perform it, they can perform it in the orthodontic clinic, and a pamphlet can be handed to them with clear illustrations and instructions. Compared with other dental specialists, orthodontists have a great opportunity to emphasize fluoride toothpaste regimens in their clinics, since patients usually visit the clinic every 12 weeks, giving the orthodontist an excellent opportunity to stress the importance of using fluoride toothpaste and illustrating the instructions again.

Although the MPTT is important, patients must be aware of the importance of rinsing with the toothpaste as it can cause some oral discomfort 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 systemic point of view.

Orthodontists must be aware that the MPTT technique used in this study was used for patients with a high risk for caries. The caries prevalence among teenagers and adolescents in KA is high.28,29 Saudi children have high sugar intake28 and poor knowledge of oral hygiene.38 The large difference found in the DFS between the test and control group patients in KA 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.

Tab II: Variables for compliance with respect to DFS at baseline, follow-up, and caries incidence (DFS).

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