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

By Ahsa H. Al Mulla, Saud Al Khuraei, Joud Al Birdhoo, Gouda Sowaid, and Riyadh, Saudi Arabia

Fluoride toothpaste has been widely used for more than 4 decades and remains a benchmark for the prevention of dental caries.1 It reduces caries in both permanent and deciduous teeth.2 For this reason, fluoride toothpaste is an essential part of any caries-prevention measure worldwide.3 Topical fluoride (ointments, varnishes, or rinses), used in addition to fluoride toothpaste, achieve a marked reduction in caries compared with toothpaste used alone.4 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.5,6

Four factors influence the anticaries efficacy of fluoride toothpaste: the concentration of fluoride, brushing, duration of brushing, fluoride concentration, and the number of brushings.7,8 Brushing should be done twice daily,9,10 and patients should be persuaded to brush for a longer time.11 The salivary fluoride concentration measured after fluoride application decreases significantly as the water rinse volume, rinse duration, and rinse frequency increase.12,13 A toothpaste technique in which a slurry rinse with the toothpaste is used after brushing increases the efficacy of the fluoride toothpaste.14 A reduced concentration of fluoride caries in preschool children by an average of 26%.15 Furthermore, eating immediately after brushing reduces the salivary fluoride level about 12 to 20% compared with brushing alone.16 Postbrushing rinsing habits might play an important role in the oral retention of fluoride.17 Fluoride from dentifrices that could, in turn, affect their clinical efficacy.18

Enamel demineralization associated with fixed orthodontic appliances is a rapid process caused by cariogenic microorganisms that develop around brackets and under ill-fitting bands.19,20 Despite improvements in microbial 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 of enamel and poorer cooperation by younger patients in the orthodontic treatment process.21 Children in the Kingdom of Saudi Arabia (KSA) have a high prevalence of dental caries. A recent study by Brown22 found a mean incidence of decayed, extracted, and filled teeth of 6.5 in healthy 5-year-old children.

Clinical trials are needed to give evidence-based advice on the optimal caries-prevention strategy,23 with clear practice guidelines.24 For orthodontic patients, more research is required to evaluate various modes of delivering fluoride.25 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 dentists 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 letters 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 criteria for caries were established 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.M.L.) who was blindfolded to the patients’ group.

The examination consisted of recording the plaque index,26 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 blindfolded to the patients’ group.

At the end of the trial or treatment, the patients were asked to use the fluoride toothpaste 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 1 to 5 according to the number of instructions they had followed. 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) was used for the statistical analysis of the determined measurements. DFS and prevented fractions (PF) were calculated according to these 2 formulas (DFS5 follow-up DFS baseline DFS and PF 5 control group DFS test group DFS/5 control group DFS 5 100).

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 of follow-up tests, and good vs very good. The significance level was set at P<.05. The paired t test was used to check intra-examiner reliability for the radiographic analysis. The 25 randomly selected radiographs were checked within a 1-week period.

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

At the end of treatment, 30 patients were lost or excluded, leaving 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 = 51; 10 male, 41 female; mean age, 16.2 ± 4 years) and the control group (n = 50; 17 male, 33 female; mean age, 16.9 ± 4 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 that 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 or more meals (plus snacks) a day; and only 6% had 5 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 in-between, and the remaining 6% used no fluoride.

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

At baseline, there were no significant differences between the groups. At follow-up, the total number of teeth available was almost the same in both groups (test, 20.9 ± 6.1; control, 20.4 ± 6.7). 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 DDFS index, both clinically and radiographically, with a higher increment in the control group.

The clinical, radiographic, and clinical plus radiographic DDFS (incidence) are shown in Figure 3. Compared with the control group patients had more than 7 times the clinical DDFS (P < 0.001), more than 3 times the radiographic DDFS (P < 0.001), and more than 5 times the clinical plus radiographic DDFS (P < 0.001), with PF values of 87%, 78%, and 85%, respectively.

Baseline and follow-up clinical plus radiographic DDFS (total) and DDFS (incidence) compliance are shown in Table II. The patients with “very good” compliance had lower DDFS 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 DDFS 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.

It is possible to speculate that the factor that is most important, but it is not possible to identify a specific one that made our test patients develop significantly fewer caries. Based on these results, no test group patients scored 0 for compliance, and all 51 patients followed at least 1 of our oral hygiene instructions. Those with “very good” compliance had fewer caries (incidence) compared with those with “good” compliance. Duckworth et al proposed that the fluoride concentration in saliva after brushing vanished rapidly as a result of thorough rinsing. Chou et al showed that the water-rinsing pattern of children after brushing influences the cariostatic effect of fluoride toothpaste. They concluded that children who did not use water because for rinsing had a significantly lower (16%) caries incidence during a 3-year period than those who used water. Squires and Squires et al studied different types of postbrushing behavior; they also evaluated the caries-reducing effect of a technique similar to the one used in this study.

They concluded that mouth rinsing with the toothpaste foam-water slurry after brushing elevates the concentration of fluoride in saliva for a longer time compared with tooth brushing followed by a single or double water rinse; children who used the MPTT developed fewer DDFS. These observations agree with our study results; our test group patients had significantly lower mean caries incidence than did the control group.

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 encourage optimal 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. Any rinsing with the toothpaste 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 toxicologic point of view.

Orthodontists must be aware that the MPTT technique studied was used for patients with a high risk for caries. The caries prevalence among teenagers and adolescents in KSA is high. Saud children have high sugar intake and poor knowledge of oral hygiene. The large difference found in the DDFS between the test and control group patients in KSA would not be expected in other countries with a low DDFS 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.