

Effects of Amine and Stannous Fluorides on Plaque Accumulation and Gingival Health in Orthodontic Patients Treated With Fixed Appliances: A Pilot Study

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Abstract

Aim: The aim of this pilot study was to evaluate the effects of different use of amine and stannous fluoride (AmF/SnF₂)-containing toothpaste *with* and *without* a mouthrinse (Meridol®) on plaque accumulation and gingival health after four weeks' use in patients wearing fixed orthodontic appliances. **Methods:** Plaque accumulation and periodontal variables were recorded in 40 volunteers (mean age: 20.1±5.6 years), who were randomly divided into two groups. They refrained from oral hygiene two days before each assessment. The test group brushed with AmF/SnF₂ toothpaste twice daily for three minutes and rinsed with an AmF/SnF₂ mouthrinse for 30 seconds. The control group used only the AmF/SnF₂ toothpaste twice daily, toothbrushing for three minutes. **Results:** Baseline values for plaque index (PI) and gingival index (GI) were 2.21±0.52 and 1.98±0.58 (mean±SD) in the test group, 2.29±0.42 and 2.02±0.44 in the control group. After four weeks, PI and GI were 1.32±0.42 and 0.93±0.59 in the test group, and 1.27±0.52 and 1.09±0.51 in the control group, respectively. Bleeding on probing at baseline was 40% in the test group and 37.5% for the controls; at the final evaluation, these values were 10.1% and 12.7%, respectively. All of the indices were reduced significantly in both groups. There was no statistically significant difference between the groups ($P<0.05$). **Conclusions:** Based on the findings of this pilot study, it is suggested that the use of AmF/SnF₂-containing products resulted in beneficial clinical effects on plaque accumulation and gingival health after placement of fixed orthodontic appliances. These beneficial effects may be more pronounced after long-term and combined use of these products. A six-month duration study with a larger sample of participants is needed to confirm the promising results from this pilot.

Key Words: Oral Hygiene, Amine and Stannous Fluoride Toothpaste, Amine and Stannous Fluoride Mouthwash, Prevention in Orthodontics

Introduction

Prevention of chronic gingivitis is based on the achievement of adequate supragingival plaque control, which is especially problematic in orthodontic patients treated with fixed appliances [1]. With conventional fixed orthodontic appliances, increased plaque accumulation occurs mainly on the labial or buccal surfaces of the teeth between the brackets or posterior bands and the gingival margins [2]. Because it is difficult to obtain adequate plaque control in such patients by routine mechanical methods, there is a clear indication for their use in

combination with adjunctive chemical agents. The beneficial effects of amine fluorides are well known as protective agents against caries and dental plaque accumulation [3]. Since the late 1970s, 0.4% stannous fluoride (SnF₂) gels have been widely used to reduce chronic gingivitis [4,5]. The positive effects of SnF₂ and amine fluoride/stannous fluoride (AmF/SnF₂)-containing products on chronic gingivitis and plaque accumulation have been reported in many studies [5-11].

Orthodontic patients treated with fixed appliances represent a high-risk population for chronic

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gingivitis. It has been suggested that placement of fixed orthodontic appliances has an influence on clinical periodontal parameters and these changes are only partly normalised three months after the removal of an appliance [12]. The SnF₂ or AmF/SnF₂-containing products have virtually no side-effects, even when used for a long time. These products are available as Meridol® toothpaste (GABA International, Therwil, Switzerland) containing 1400 ppm fluoride (AmF and SnF₂) and Meridol® mouthrinse (GABA International, Therwil, Switzerland) containing 250 ppm fluoride (AmF and SnF₂). Few investigations appear to have been performed into the effects of AmF or SnF₂ or their combined use in orthodontic patients. Dénes and Gábris (1991) reported the results of a three-year study of children treated with fixed orthodontic appliances [13]. Patients (mean age 13.9 years) used fluoride-free toothpaste as a control and AmF-containing products (fluid and gel). Beneficial effects on plaque accumulation and gingival health were noted for both groups, especially in the group that used the gel, compared with the control group. Boyd and Chun (1994) performed an 18-month study on the effects of 0.4% SnF₂ gel on gingivitis in adolescents treated with fixed orthodontic appliances [14]. The SnF₂ gel group had significantly lower scores for plaque index ($P<0.05$), gingival index ($P<0.05$), and bleeding tendency ($P<0.05$) than the control group using a toothbrush with only standard fluoride toothpaste. During treatment with fixed orthodontic appliances, Øgaard *et al.* (1980) investigated the plaque-inhibiting effect of a dentifrice containing stannous fluoride/stannous pyrophosphate, compared with a monofluorophosphate toothpaste and paste without fluoride or tin [10]. This double-blind, cross-over study, including 21 subjects with orthodontic appliances placed more than 1.5 mm from the gingival margin, showed statistically significant plaque inhibition after a three-week test period ($P<0.05$). Plaque reduction on teeth with appliances placed close to the gingival margin was not statistically significant ($P>0.05$), and there was no statistically significant improvement in the gingival condition. During a nine-month study, Boyd *et al.* (1988) noted that the group using a low-availability Sn²⁺ gel showed no significant differences in gingival index or bleeding tendency scores compared to the control group, whereas the group using a high-availability Sn²⁺ gel (twice daily) had significantly lower values than did the group of adolescents undergoing ortho-

dontic treatments with fixed appliances [15]. None of the treatment groups showed significant differences compared with the control group as regards plaque index. Øgaard *et al.* (2006) examined the effect of the combined use of AmF/SnF₂ toothpaste/mouthrinse compared with sodium fluoride in relation to maxillary anterior teeth, during fixed orthodontic treatment [16].

There would appear to be no prior short-term investigation of the effects on periodontal parameters with the different use of products (toothpaste with or without mouthrinse) containing the same active ingredients in orthodontic patients wearing fixed appliances.

Aims

Against this background, the objective of this pilot study was to evaluate the effects of different use of AmF/SnF₂-containing products (Meridol® toothpaste with and without mouthrinse) on plaque accumulation and gingival health in patients wearing fixed orthodontic appliances.

Methods

Subjects

Forty volunteers (who were new orthodontic patients needing fixed appliance therapy), of whom 26 were female and 14 male, aged 14-32 years (mean age: 20.1±5.7 years), participated in the study. They were treated with fixed appliances in their upper or lower dental arches. According to the exclusion criteria, they were without relevant medical history or exposure during the previous six months to antibiotics or immunosuppressive therapy or to other drugs that might influence the oral flora or gingival health, and they were non-smokers. At baseline, both groups had similar scores for the periodontal parameters of plaque index, gingival index and bleeding on probing. The participants were asked to refrain from oral hygiene for two days prior to baseline and before the final examinations, and to present without having eaten breakfast on the evaluation days. Participants were not allowed to use any oral hygiene products (including dental floss) other than those supplied by the investigators during the study. One patient was excluded because she had performed routine oral hygiene before the second (control) examination, thus 39 participants completed the study.

Assessments were performed at the Department of Paedodontics and Orthodontics (Faculty of Dentistry, Semmelweis University, Budapest,

Hungary), in a dental chair, with a World Health Organization pattern periodontal probe (Astir Intermedica, London, UK) under artificial light by the same investigator (MM). Consistency of the assessments was checked between a calibrated dentist and the investigator (MM). The inter-examiner agreement for the parameters investigated yielded a mean kappa value of 0.85. For the intra-examiner agreement the mean kappa value was 0.87. The examined variables were: bleeding on probing (BoP), plaque index (PI), and gingival index (GI) [17,18].

After baseline examination and professional tooth cleaning with fluoride-free pumice, the fixed appliance (bands for the first molars and conventional metal brackets [Unitek™ Gemini brackets, 3M Unitek Orthodontic Products] for the other teeth) was applied to the teeth labially, on the middle of the tooth surface, meaning that the brackets were placed more than 1.5 mm from the gingival margin. Excess bonding adhesive was removed during the bonding procedure. The participants then were randomly allocated into the two groups. To ensure the equal sample sizes, block randomisation was applied.

- **Group 1 (test group: paste and rinse):** The participants used AmF/SnF₂-containing toothpaste (Meridol®) and a Meridol® toothbrush with the Bass method for twice-daily toothbrushing for three minutes (before breakfast, morning, and evening before retiring). After toothbrushing, they rinsed with 10 ml AmF/SnF₂-containing (Meridol®) mouthrinse for 30 seconds.
- **Group 2 (control group: paste only):** the participants used AmF/SnF₂-containing (Meridol®) toothpaste and a Meridol® toothbrush for twice daily toothbrushing for three minutes (before breakfast, morning, and evening before retiring). Participants used the products according to the manufacturer's guidelines (method, time, frequen-

cy). Patient compliance in use of the products was measured by a questionnaire, available at the time of the study from the GABA website (<http://www.gaba.com>; accessed 2005 Feb 12). After four weeks, the patients were re-assessed. The three periodontal variables were compared with those at baseline and differences were statistically analysed.

The study was approved by the Ethical Board of Semmelweis University, Budapest (TUKEB Semmelweis University Budapest 169/2005). All subjects voluntarily signed informed consent, using a form previously approved by the Institutional Committee (protocol number: 169/05).

Statistical analysis

Analysis was performed applying descriptive statistics, using statistical software (Statistical Package for the Social Sciences for Windows, version 18.0; SPSS Inc, Chicago, USA). A Wilcoxon paired *t*-test was used to compare within-group changes from baseline and a Mann-Whitney U test was used for the comparisons between groups. Differences between the results of basic and final examinations for test and control groups were considered as statistically significant at the $P < 0.05$ level.

Results

AmF/SnF₂ (toothpaste only and combined use of toothpaste with mouthrinse) significantly decreased plaque accumulation and improved gingival health. Both plaque index and gingival index were reduced significantly during the study (*Table 1*). Improvement was significant for both groups ($P < 0.05$). Comparing the different use of amine fluoride products, there was no significant difference in PI and GI values between the test group (using toothpaste and mouthrinse) and the controls (using only toothpaste) ($P > 0.05$) during the examination period (*Table 1*).

Table 1. Plaque Index (PI) and Gingival Index (GI) After Four Weeks' Use of Different Amine Fluoride/Stannous Fluoride-Containing Products (Mean \pm SD)

Study group	PI			GI		
	Baseline n=20	4 weeks n=19	<i>P</i>	Baseline n=20	4 weeks n=19	<i>P</i>
Using Meridol® toothpaste only (control)	2.29 \pm 0.42	1.27 \pm 0.52	<0.05 (<i>P</i> =0.00)	2.02 \pm 0.44	1.09 \pm 0.51	<0.05 (<i>P</i> =0.00)
Using Meridol® toothpaste + mouthrinse (test)	2.21 \pm 0.52	1.32 \pm 0.42	<0.05 (<i>P</i> =0.00)	1.98 \pm 0.58	0.93 \pm 0.59	<0.05 (<i>P</i> =0.00)

Table 2. Frequency of Bleeding on Probing (BoP) After Four Weeks' Use of Different Amine Fluoride/Stannous Fluoride-Containing Products (%)

Study group	BoP	Baseline n=20	4 weeks n=19	P
Using Meridol® toothpaste only (control)	Negative Positive	62.5% 37.5%	87.3% 12.7%	<0.05 (P=0.00)
Using Meridol® toothpaste + mouthrinse (test)	Negative Positive	60.0% 40.0%	89.9% 10.1%	<0.05 (P=0.00)

Bleeding on probing (BoP) was reduced significantly in both groups ($P<0.05$). There was no statistically significant difference between the two study groups ($P>0.05$) (Table 2).

No participant had any complaints about the use of the toothpaste or the mouthwash. No alterations in taste or staining of oral tissues were observed during or after the examination period.

Discussion

Oral hygiene is particularly important for patients undergoing fixed orthodontic appliance therapy [19]. AmF/SnF₂-containing products seem to be effective in helping to maintain effective oral hygiene in high-risk groups.

The beneficial effects of AmF/SnF₂-containing (Meridol®) products in orthodontic patients were observed by Øgaard *et al.* (2006). They concluded that the combined use of these products had a slightly more inhibitory effect on plaque and gingivitis on maxillary anterior teeth during orthodontic treatment with fixed appliance compared with sodium fluoride [16].

Other studies have evaluated the effects of other mouthrinses in orthodontic patients. Anderson *et al.* (1997) found that the use of chlorhexidine (CHX), in addition to regular oral hygiene, was effective in reducing plaque and gingivitis in adolescents undergoing orthodontic treatment [20]. Similar beneficial effects of CHX were described by Olympio *et al.* (2006), who investigated the effect of 1100 ppm F, NaF alone, with and without 0.95% CHX in relation to dental plaque, gingivitis, bleeding, calculus and enamel extrinsic staining development, after 6, 12, and 24 weeks [21]. Although most of the patients did not show stain, the chlorhexidine dentifrices significantly increased the mean stain index. Oltramari-Navarro *et al.* (2009) compared the effects of 1100 ppm F, NaF, 0.50% CHX, and 0.75% CHX on gingivitis, bleeding and dental plaque and considered the staining risk [22]. They

found that the use of dentifrices with a lower concentration of CHX could reduce the risk of tooth staining without compromising its effectiveness in controlling gingivitis. Tufekci *et al.* (2008) concluded that adding Listerine® to the standard oral hygiene regimen after six months may be beneficial for those undergoing orthodontic treatment [23]. Both of these mouthrinses showed beneficial effects in maintaining adequate oral hygiene of orthodontic patients wearing fixed appliances. The main problem in the case of chlorhexidine remained the staining, whereas in Listerine® products the alcohol content may be a problem. None of these were experienced in the case of AmF/SnF₂ products.

In the present short-term (four-week) pilot study, the effects of the different use of AmF/SnF₂-containing products (toothpaste with and without mouthrinse) on plaque accumulation and gingival health were evaluated in young adult patients undergoing fixed appliance therapy. The results are close to those of the earlier, above-mentioned study of Øgaard *et al.* (2006), which involved comparison of the effects of combined use of AmF/SnF₂ containing toothpaste and mouthrinse with similar administration of neutral NaF rinse and toothpaste. Both studies found better oral health in the tested groups using AmF/SnF₂ products daily. In our study, this difference was evident even after four weeks. The control groups were different in the aforementioned studies: controls used neutral NaF products in the study of Øgaard *et al.* (2006), whereas in our study they used only the same AmF/SnF₂ toothpaste. The other difference between the results of these two studies is regarding the oral hygiene and gingival indices. We found a significant reduction in both experimental groups, while these parameters were slightly (but not significantly) higher in the test group in the other study. These results show the same beneficial effects of AmF/SnF₂-containing oral hygiene products during orthodontic treatment, despite the small differences, which could be explained by the different experimental intervals and controls.

Conclusions

Based on the findings of this pilot study, it is suggested that the use of AmF/SnF₂-containing products resulted in beneficial clinical effects on plaque accumulation and gingival health after placement of fixed orthodontic appliances. These beneficial effects may be more pronounced after long-term and combined use of these products. A study with a six-month duration and a larger sample of participants is needed to confirm the promising results from this pilot.

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Contributions of each author

- MM participated in the design, performing the examinations, coordination of the study, and drafted the manuscript.
- JB participated in the design, coordination and supervision of the study.
- SM and MK Jr. participated in the statistical analysis.
- GG participated in the coordination of the study.
- GN participated in the design, coordination and supervision of the study and drafted the manuscript.
- All authors read and approved the final manuscript.

Statement of conflict of interest

The authors disclose no possible conflict of interest.

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