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Erosion-protecting effect of oral-care products available on the Swiss market

A pilot study

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SUMMARY

The present study sought to test oral-care products available on the Swiss market, such as toothpastes and gels, with respect to the protection of enamel against erosive tooth wear. A total of 56 enamel specimens were divided into 7 groups (n=8): F-**TP** = Migros Budget Anti-Caries Toothpaste (Negative Control); F+Sn_{3500}-**TP** = Elmex Erosion Protection Toothpaste (Positive Control); F-**TP** + F+Oligopep-**Gel** = Migros Budget Anti-Caries Toothpaste + Emofluor Protect Gel Professional; F+Sn_{3120}-**Gel** = Emofluor Gel Intensive Care; F+Oligopep-**TP** = Candida Protect Professional Toothpaste; F+Sn_{1260}-**TP** = Emoform-F Protect Toothpaste; and F+Sn_{3440}-**TP** = Sensodyne Repair & Protect Toothpaste. The specimens were incubated in artificial saliva for 30 min and then brushed in a toothbrushing machine (10 s brushing; total 2 min exposure to the product). After the toothbrush abrasion, the specimens were rinsed, dried and submitted to an erosive challenge (2 min; 1% citric acid; pH 3.6). This sequence was repeated 4 times, and the total enamel surface loss was calculated using indentation measurements before and after the brushing period. All groups presented progressive surface loss throughout the experiment; after 4 cycles, total surface loss values ranged from 0.11 µm (F+Sn_{3120}-**Gel**) to 0.89 µm (F+Sn_{1260}-**TP**). Regarding the total surface loss values (median; interquartile range), F-**TP** (0.54; 0.42–0.59) presented no significant differences compared to any of the other groups. F+Sn_{3500}-**TP** (0.33; 0.30–0.40), F-**TP** + F+Oligopep-**Gel** (0.34; 0.29–0.42) and F+Sn_{3120}-**Gel** (0.11; 0.09–0.15) presented lower surface loss than F+Oligopep-**TP** (0.75; 0.59–0.98), F+Sn_{1260}-**TP** (0.89; 0.68–1.13) and F+Sn_{3440}-**TP** (0.69; 0.66–0.78). Conclusion: Although some of the oral-care products containing stannous ions or oligopeptide-104 presented numerically lower SL values, they did not present significantly better protection than a regular fluoride toothpaste. The gels showed a general trend of better enamel protection against ETW.

Introduction

Erosive tooth wear (ETW) is the loss of dental hard tissue due to chemical and mechanical forces, and its progression can change tooth morphology and interfere with patients' dentition throughout their lives (Lussi & Carvalho 2014). This condition is multifactorial, thus a broad treatment approach must be realized in order to stop its progression and avoid new lesion formation (Ganss et al. 2012b). Studies have shown that fluoride has limited action on enamel protection against ETW and other agents have been searched with this goal (Lussi & Carvalho 2015). Several oral-care products available on the market also have, besides fluoride, different active ingredients and claim to help protect teeth against ETW and/or to alleviate dentine hypersensitivity (Kato et al. 2010). Among these oral-care products, we focused our study on those containing stannous ions or peptides.

Products containing stannous ions, including stannous fluoride or stannous chloride, have generally shown a good protective effect on dental enamel (Huysmans et al. 2014). Stannous can adsorb onto the surface of the enamel and eventually incorporate into the demineralized enamel layer, thus creating a stannous-rich layer that serves as a barrier against erosive acids (Schlueter et al. 2009a; Huysmans et al. 2014). The protection of this layer against ETW is enhanced when stannous is combined with chitosan, which is a natural polysaccharide (Lussi & Carvalho 2015).

Oligopeptide-104 (Oligopep-104), commercially known as part of the Curolox® technology, is another active ingredient that showed a protective effect against dental caries (Savas et al. 2016; Kirkham et al. 2007; Silvertown et al. 2017), and it is also being tested against enamel erosion (Ceci et al. 2016). This oligopeptide is a synthetic self-assembling peptide with high affinity for tooth mineral. Regarding the caries process, it enhances enamel remineralization by promoting hydroxyapatite deposition within the subsurface lesion (Kirkham et al. 2007). However, its effect on ETW is still not clear.

In addition to the active ingredients themselves, the vehicle used to deliver these ingredients is also important. The most common oral-care vehicles are toothpastes, gels and mouth rinses. Toothpastes are the most complex products, since they have a wide range of other ingredients that may interfere with the bioavailability of the active ingredients (Lippert 2013). Owing to the many different components used in the manufacture of toothpastes, as well as the large variety available on the market, toothpastes should undergo continuous testing to assess their effect on enamel wear, particularly when mechanical (brushing) forces are present (Ganss et al. 2017). In addition to toothpastes, gels should also undergo such tests; they are also available as oral-care products and contain lower amounts of abrasives (Ganss et al. 2016) that will influence enamel wear.

The present pilot study sought to evaluate the effect of some oral-care products available on the Swiss market on enamel abrasion and erosion. Our hypothesis was that the products containing the above-mentioned active agents (stannous ions or oligopeptide-104) would provide better protection than the regular fluoridated toothpaste (negative control).

Materials and Methods

Specimen preparation

A total of 56 enamel specimens were prepared from human molars. The teeth were randomly selected from a pool of extracted teeth stored in 2% chloramine solution for no longer than one year. Patients had been previously informed about the possible use of their teeth for research purposes. Ethical approval was not necessary as the teeth were taken from a pooled bio-bank, and the local ethics committee (Kantonale Ethikkommission: KEK) categorizes these teeth as "irreversibly anonymized". The teeth were cut into buccal and/or lingual surfaces, which were embedded in acrylic resin (Paladur, Heraeus Kulzer GmbH, Hanau, Germany) and serially abraded (LabPol 21, Struers, Ballerup, Denmark) with water-cooled silicon carbide paper discs (grits #1000; #2400 and #4000) in order to obtain a smooth flat enamel surface. This procedure eliminated the top 200 µm of the enamel surface layer. Then, the specimens were polished for 60 s (LabPol 6, Struers) with felt paper and 3 µm grain diamond paste under constant cooling (DP-Stick P, Struers) and stored in a mineral solution (1.5 mmol/l $CaCl_2$, 1.0 mmol/l KH_2PO_4, 50 mmol/l NaCl, pH = 7.0) (Zero et al. 1990). Immediately prior to the experiment, the specimens underwent a further 60 s of polishing with felt paper and 1 µm grain diamond paste under constant cooling (Lussi et al. 2008).

Experimental groups

Using an effect size of 1.4, power of 80% and significance of 5%, a sample size of 8 specimens per group was determined. The enamel specimens were randomly distributed into 7 groups (n = 8/group) according to the test products used: F-**TP** = Migros Budget Anti-Caries Toothpaste (Negative Control); F+Sn$_{3500}$-**TP** = Elmex Erosion Protection Toothpaste (Positive Control); F-**TP** + F+Oligopep-**Gel** = Migros Budget Anti-Caries Toothpaste + Emofluor Protect Gel Professional; F+Sn$_{3120}$-**Gel** = Emofluor Gel Intensive Care; F+Oligopep-**TP** = Candida Protect Professional Toothpaste; F+Sn$_{1260}$-**TP** = Emoform-F Protect Toothpaste; and F+Sn$_{3440}$-**TP** = Sensodyne Repair & Protect Toothpaste. Details of the different products are presented in Table I.

Toothpaste slurries were prepared by mixing 25 g of toothpaste with 50 g of artificial saliva. The slurry for group F+Sn$_{3120}$-**Gel** was prepared by mixing the gel with artificial saliva in the same proportion as that for the toothpaste slurries (1:2 w/w). The artificial saliva was prepared in the laboratory (1.45 mM $CaCl_2$, 5.43 mM KH_2PO_4, 6.57 mM NaCl, 14.85 mM KCl and 2.20 g/L gastric mucin from porcine stomach, Type II; pH = 7 [Kirkham et al. 2007]) and was stored at −20 °C. A fresh aliquot was thawed daily at 25 °C and used to incubate the specimens and to prepare the slurries. The pH of the product slurries was measured using a pH meter right after their preparation. Since pH can only be measured in solutions, the Emofluor Protect Gel Professional was mixed with deionized water in the same proportion as the slurries of the toothpastes (1 part of the gel with 2 parts of deionized water; w/w).

Abrasion-erosion cyclic treatment

The specimens were submitted to a 4-day abrasion-erosion cyclic treatment, with one cycle/day (Carvalho & Lussi 2014). One experimental cycle consisted of, first, individually incubating the specimens in artificial saliva (30 min, 25 °C, in a shaking water bath, 70 rpm, travel path 50 mm). The specimens were then washed in distilled deionized water (DDW), dried with oil-free air and individually brushed in an automatic brushing machine (Syndicad Ingenieurbüro, Munich, Germany) with freshly made slurry according to the experimental groups. The specimens remained immersed in the slurry for 2 min at room temperature and, during this time, 20 toothbrush strokes (10 s brushing) were applied with American Dental Association (ADA) reference

Tab. I Description of products tested

Product	Symbol	Ingredients	Active Agents	LOT Number	pH*
Migros Budget Anti-Caries Toothpaste[a]	F-**TP**	Aqua, hydrated silica, sorbitol, cellulose gum, sodium lauryl sulfate, aroma, sodium saccharin, allantoin, methylparaben, CI 77891	1350 ppm F^- (as sodium fluoride)	61372601 (resp. 61646801 for W56)	6.83 4.70
Elmex Erosion Protection Toothpaste[b]	F+Sn$_{3500}$-**TP**	Aqua, glycerin, sorbitol, hydrated silica, hydroxyethylcellulose, aroma, cocamidopropyl betaine, sodium gluconate, alumina, sodium saccharin, potassium hydroxide, hydrochloric acid, CI 77891	1400 ppm F^- (as amine fluoride and sodium fluoride) **3500 ppm Sn^{2+} (as stannous chloride)** **0.5% chitosan**	6082GB3421	4.70
Emofluor Protect Gel Professional[c]	F+Oligopep-**Gel**	Hydrogenated starch hydrolysate, aqua, hydrated silica, PEG-8, cellulose gum, aroma, sodium saccharin, citric acid, sodium hydroxide, dicalcium phosphate, calcium glycerophosphate, sodium chloride, sodium sulfate, limonene, cinnamal, CI 42090	900 ppm F^- (as sodium monofluorophosphate) **Oligopeptide-104** (Curolox Technology)	1606916	7.20**
Emofluor Gel Intensive Care[c]	F+Sn$_{3120}$-**Gel**	Aqua, glycerin, propylene glycol, PEG-40-hydrogenated castor oil, cellulose gum, PEG-8, phosphocolamine, aroma, sodium saccharin	1000 ppm F^- **3120 ppm Sn^{2+}** (as stabilized stannous fluoride)	6015912	4.79
Candida Protect Professional Toothpaste[a]	F+Oligopep-**TP**	Hydrogenated starch hydrolysate, aqua, hydrate silica, PEG-8, cocamidopropyl betaine, aroma, cellulose gum, sodium saccharin, sodium chloride, citric acid, sodium hydroxide, dicalcium phosphate, glycerin, calcium glycerophosphate, limonene, linalool, CI 77891	1450 ppm F^- (as sodium monofluorophosphate) **Oligopeptide-104** (Curolox Technology)	61742101	6.91
Emoform-F Protect Toothpaste[c]	F+Sn$_{1260}$-**TP**	Glycerin, silica, aqua, xylitol, PEG-40-hydrogenated castor oil, cocamidopropyl betaine, PEG-8, cellulose gum, aroma, rebaudioside A, titanium dioxide	1400 ppm F^- (420 ppm as **stannous fluoride** and 980 ppm as sodium fluoride) **1260 ppm Sn^{2+}** (as stannous fluoride)	510954	5.21
Sensodyne Repair & Protect Toothpaste[d]	F+Sn$_{3440}$-**TP**	Glycerin, PEG-8, hydrated silica, pentasodium triphosphate, aroma, sodium lauryl sulfate, titanium dioxide, carbomer, sodium saccharin, cocamidopropyl betaine, limonene	1100 ppm F^- and **3440 ppm Sn^{2+}** (as stannous fluoride)	BN066D G1	6.72

Superscript letters indicate manufacturer, city, and country:
[a] Migros, Zurich, Switzerland; [b] GABA, Therwil, Switzerland; [c] Wild, Muttenz, Switzerland; [d] GSK, Switzerland

* pH measurement of the slurries (1 part of the product with 2 parts of artificial saliva; w/w)
** pH can only be measured in solutions, so the gel was mixed with deionized water (1 part of the gel with 2 parts of deionized water; w/w).

manual toothbrushes (load force of 200 g, reciprocating motion, 120 strokes/min, velocity 80 mm/s, travel path 40 mm). Because the Emofluor Protect Gel Professional is indicated to be left on the tooth surface, we first brushed the specimens from group F-**TP** + F+Oligopep-**Gel** with the regular toothpaste (Migros Budget Anti-Caries: 10 s; totalizing 20 s of slurry exposition), and then rinsed and dried them. We then applied the Emofluor Protect Gel Professional, leaving it on the enamel surface for 1 min and 40 s.

Surface loss was calculated using indentation measurements before and after the brushing period. Later, the specimens were submitted to an erosive demineralization challenge by individually immersing them in 1% citric acid (2 min, pH 3.6, 25°C, in a shaking water bath, 70 rpm, travel path 50 mm). They were also washed with DDW (20 s) and dried (5 s). The specimens were kept in a humid chamber at room temperature between the experimental procedures and until the next experimental cycle.

Calculated enamel surface loss

Before each abrasive challenge, we made six Knoop indentations on the enamel surface with a load of 200 g and a dwell time of 10 s (UHL VMHT Microhardness Tester). We measured the lengths of the same indentations before and immediately after the toothbrush abrasion. Using these length values (L), we calculated the depth (D) of each indentation before and after each abrasion according to the equation $D = L/2 \cdot \tan \alpha$, where $\alpha = 3.75^\circ$, a constant parameter of the diamond indenter. The difference between depth values before and after the tooth

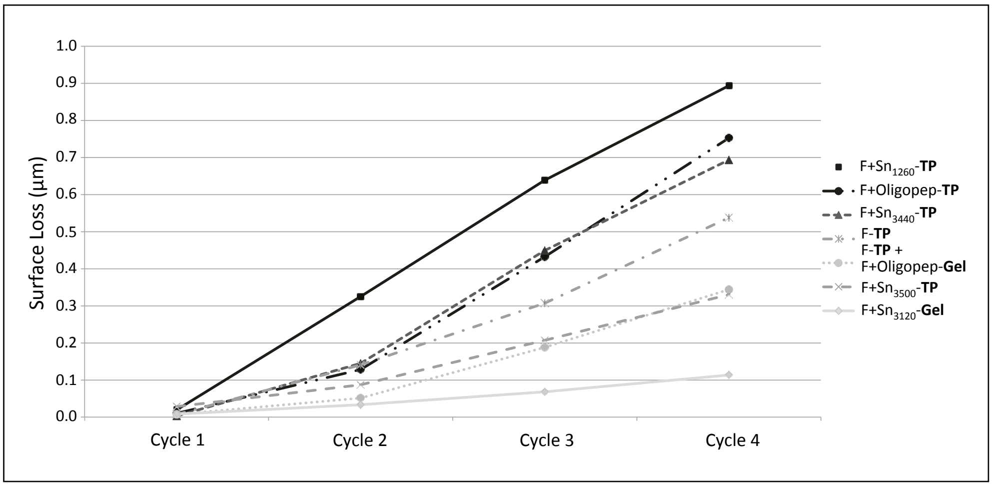

Fig. 1 Enamel surface loss (µm) for each group over the 4-day experiment.

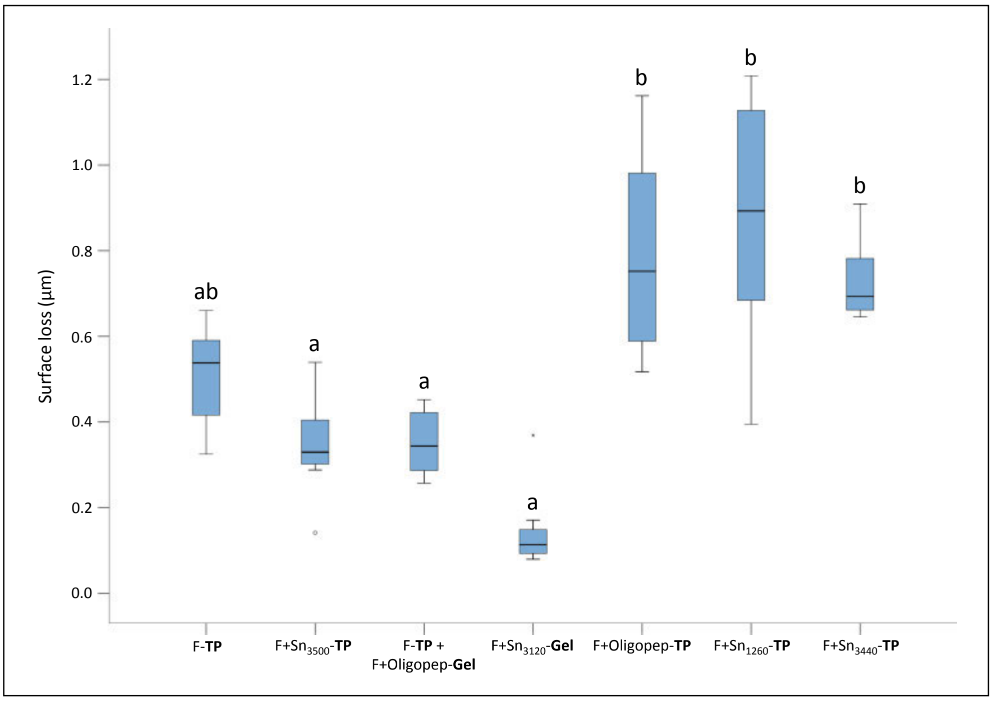

Fig. 2 Total enamel surface loss (µm) after 4 cycles of abrasion and erosion. Groups presenting the same letters are not significantly different.

brush abrasion represents the enamel surface loss (in µm) for the specific cycle (Shellis et al. 2011; Carvalho & Lussi 2014). The average of the 6 calculated values was considered as the enamel surface loss for one particular cycle.

Statistical methods

The total amount of surface loss after 4 cycles was statistically analyzed. The Shapiro-Wilk test was performed to check for normality of data ($p<0.05$), and non-parametric analyses were performed using the Kruskal-Wallis test with a post-hoc Dunn's test and Bonferroni correction (significance level set at 0.05). The analyses were performed with IBM SPSS Statistics v.24.

Results

All groups presented progressive surface loss throughout the experiment (Fig. 1). After 4 cycles (Fig. 2), the median of the total surface loss values ranged from 0.11 µm (F+Sn_{3120}-**Gel**) to 0.89 µm (F+Sn_{1260}-**TP**). The groups F+Oligopep-**TP**, F+Sn_{1260}-**TP** and F+Sn_{3440}-**TP** presented more variation in the results among the specimens, due to the higher amount of softened enamel removed than the other groups that did not present great variation. The negative control group (F-**TP**) presented intermediate results and was not significantly different from any of the other groups ($p>0.05$). Groups F+Sn_{3500}-**TP**, F-**TP** + F+Oligopep-**Gel** and F+Sn_{3120}-**Gel** were not different from each other ($p>0.05$), but they presented significantly lower surface loss than groups F+Oligopep-**TP**, F+Sn_{1260}-**TP** and F+Sn_{3440}-**TP** (not significantly different from each other; $p>0.05$).

Discussion

Many studies have investigated suitable active agents with anti-erosion properties. Combinations of fluoride with polyvalent metal ions, proteins or polymers have all presented good results (Lussi & Carvalho 2015). However, with the large variety of products on the market, further studies are still necessary to help dentists and patients choose a suitable oral-care product for ETW. One study investigated the mechanical effects of different toothpastes available in the Swiss market on dentine (Tawakoli et al. 2015). Our study was conducted also to evaluate different oral-care products available on the Swiss market, but on enamel. The products chosen either claimed to have an anti-erosive effect or contained active ingredients with the potential to protect the dental enamel against acid challenges.

As a negative control (F-**TP**), we used a regular sodium fluoride toothpaste. Fluoride compounds act mainly through the deposition of calcium fluoride-like precipitates on tooth surfaces (MAGALHÃES ET AL. 2011), but these precipitates quickly dissolve during an acid challenge (LARSEN & RICHARDS 2002; LUSSI ET AL. 2008). Consequently, these toothpastes provide limited protection against enamel erosion. By contrast, we hypothesized that oral-care products containing other active agents would provide better protection against erosion/abrasion, thus presenting better results than the negative control. However, this was not the case in our study. The results showed that the fluoride toothpaste (negative control) was not different from any of the other groups, so we rejected our hypothesis.

As a positive control, we chose a toothpaste containing fluoride, stannous and chitosan (F+Sn_{3500}-**TP**) because this toothpaste has already presented anti-erosive properties on enamel (GANSS ET AL. 2012A; SCHLUETER ET AL. 2013, 2014; CARVALHO & LUSSI 2014). Other than the effect of stannous already described in the introduction, the chitosan present in this toothpaste also contributes to its erosion-protective effect. Chitosan is a biopolymer that can easily adsorb onto enamel via electrostatic forces (CLAESSON & NINHAM 1992), especially in the presence of mucin, by forming firmly attached multilayers that are able to protect the enamel against erosion-abrasion (DEDINAITE ET AL. 2005). In our experiment, the enamel specimens were first placed in artificial saliva; consequently, a mucin-rich pellicle formed on the enamel surface. During brushing, the chitosan present in the positive control toothpaste probably interacted with the enamel and mucin pellicle, forming a protective layer on the tooth surface (CARVALHO & LUSSI 2014). Additionally, chitosan has a synergetic effect with stannous ions (SCHLUETER ET AL. 2009B; GANSS ET AL. 2012A, 2017; CARVALHO & LUSSI 2014), leading to enhanced protection (GANSS ET AL. 2012A; SCHLUETER ET AL. 2014). This toothpaste has shown a better protection than a sodium fluoride toothpaste when tested with more experimental cycles (CARVALHO & LUSSI 2014). However, in the present study, where we used a protocol for analyzing initial enamel erosion and abrasion, no difference between these two toothpastes was observed. Furthermore, by observing the rate of surface loss throughout the experiment (Fig. 1), we can speculate that more experimental cycles would also eventually lead to differences between F+Sn_{3500}-**TP** and F-**TP** in our results, since the effect of stannous is more pronounced with its continuous use. Interestingly, the present study already showed that the presence of chitosan in the positive control toothpaste led to an advantage over the other stannous-containing toothpastes (F+Sn_{1260}-**TP** and F+Sn_{3440}-**TP**).

The stannous concentrations in toothpastes F+Sn_{1260}-**TP** and F+Sn_{3440}-**TP** are 1260 ppm and 3440 ppm, respectively. Despite the lower concentration in F+Sn_{1260}-**TP**, we have not observed differences in the enamel surface loss between F+Sn_{1260}-**TP** and F+Sn_{3440}-**TP** ($p>0.05$). This may be related to the viability of the ions in the toothpaste slurry during the brushing abrasion process that may be similar in both toothpastes. However, we did not evaluate the free amount of stannous in the toothpaste slurry to confirm this point. The lack of protection observed in both of these groups may be explained by the absence of chitosan, as discussed previously, or by the complex formulations of the toothpastes. The presence of silica can increase the abrasivity of the toothpaste, and it can also bind to the stannous ions (GANSS ET AL. 2011, 2012A), limiting their availability to protect the enamel (SCHLUETER ET AL. 2009A; HUYSMANS ET AL. 2014). Remarkably, the gel containing stannous fluoride (F+Sn_{3120}-**Gel**) demonstrated the lowest values of surface loss (median 0.11 µm). Although F+Sn_{3120}-**Gel** was not significantly different from F-**TP**, F+Sn_{3500}-**TP**, or F-**TP** + F+Oligopep-**Gel**, our findings are in agreement with other studies that indicated a better protective effect when stannous ions are present in gel formulations (SCHLUETER ET AL. 2009A, 2009B; CARVALHO & LUSSI 2014; HOOPER ET AL. 2014). This is probably due to the absence of abrasive particles in gel formulations. As shown in Figure 1, F+Sn_{3120}-**Gel** exhibited a considerably slower rate of surface loss; therefore, we can speculate that more experimental cycles would lead to even greater differences between the groups.

Products containing oligopeptide-104 also claim to protect teeth against erosion, and one study (CECI ET AL. 2016) showed protective effect against enamel erosion. However, this study did not test the product in a cyclic model, and the product was not applied with brushing abrasion forces. In our experiment, we tested two products containing this oligopeptide. When we used the oligopeptide in toothpaste form (F+Oligopep-**TP**), we observed no significant differences compared to the sodium fluoride toothpaste (negative control, F-**TP**). However, when we used the oligopeptide in a gel form after using the sodium fluoride toothpaste (F-**TP** + F+Oligopep-**Gel**), we observed enhanced protection and significantly lower surface loss compared to when using the oligopeptide in toothpaste form (F+Oligopep-**TP**). Moreover, by monitoring the rate of surface loss throughout the experiment (Fig. 1), we observed that F-**TP** + F+Oligopep-**Gel** had very similar values to the positive control (F+Sn_{3500}-**TP**). Therefore, we can speculate that further experimental cycles would eventually lead to differences between F-**TP** + F+Oligopep-**Gel** and F-**TP**, thus suggesting that the oligopeptide gel can bring additional protection to a sodium fluoride toothpaste.

The mode of action of this oligopeptide is still not clear with respect to ETW. In caries lesions, it forms a scaffold within the subsurface lesion, attracting calcium and phosphate ions and enhancing the remineralization process (KIRKHAM ET AL. 2007). Differently, erosion lesions are not "subsurface" phenomena, being limited to the extension of the softened layer, so there is probably less formation of scaffolds. Further experiments are still necessary to elucidate the mode of action, if any, of oligopeptide-104 on eroded dental surfaces.

One limitation of the present study is that we do not have the Radioactive Dentine Abrasion (RDA) values for the tested products. Although RDA values generally serve as a measure of the abrasivity of toothpastes, this value is actually calculated with respect to dentine. The present study, however, used enamel specimens, and there is a limited association between RDA values and enamel surface loss (GANSS ET AL. 2016). Moreover, González-Cabezas et al. (GONZÁLEZ-CABEZAS ET AL. 2013) have already stated that the RDA value of toothpastes is one of many factors to be considered when treating patients with ETW, mainly because the latter is a multifactorial condition (LUSSI & CARVALHO 2014).

It is important to bear in mind that ETW has many different patient and nutritional factors (LUSSI & CARVALHO 2014; KANZOW ET AL. 2016). Accordingly, in addition to the type of oral-care products used, other predisposing factors will play major roles in the amount of surface loss caused. Therefore, advice to patients with ETW should not only include information on the oral-care products, but it should be individually tailored with respect to all other predisposing factors affecting the patient.

Conclusion

In conclusion, we observed that none of the oral-care products containing the active ingredients (stannous ions or oligopeptide-104) provided significantly better protection for the enamel than a regular fluoridated toothpaste. The gels showed a general trend of better enamel protection against ETW than toothpastes.

Zusammenfassung

Einleitung

Beim Verlust von Zahnhartsubstanz aufgrund von chemischen und mechanischen Vorgängen spricht man von dentalen Erosionen bzw. «erosive tooth wear». Es sind viele Zahnpflegeprodukte erhältlich, welche vor dentalen Erosionen schützen sollen. Ziel dieser Studie war es, in der Schweiz erhältliche Zahnpflegeprodukte diesbezüglich zu testen.

Material und Methoden

In dieser In-vitro-Studie führten wir erosiv-abrasive Zyklen durch, um verschiedene Inhaltsstoffe mit dem Potenzial für diesen Schutz zu untersuchen. Total wurden 56 Zahnschmelzprobekörper in 7 Gruppen unterteilt (n=8): F-**TP** = Migros Budget Anti-Karies Zahnpasta (Negativ-Kontrolle; 1350 ppm Fluorid als NaF); F+Sn_{3500}-**TP** = Elmex Erosionsschutz Zahnpasta (Positiv-Kontrolle; 1400 ppm Fluorid als AmF und NaF, 3500 ppm Zinn als $SnCl_2$, 0,5% Chitosan); F-**TP** + F+Oligopep-**Gel** = Migros Budget Anti-Karies Zahnpasta (1350 ppm Fluorid als NaF) + Emofluor Protect Gel Professional (900 ppm Fluorid als Natrium Monofluorphosphat, Oligopeptide-104); F+Sn_{3120}-**Gel** = Emofluor Gel Intensive Care (1000 ppm Fluorid und 3120 ppm Zinn als SnF_2); F+Oligopep-**TP** = Candida Protect Professional Zahnpasta (1450 ppm Fluorid als Natrium Monofluorphosphat, Oligopeptide-104); F+Sn_{1260}-**TP** = Emoform-F Protect Zahnpasta (1400 ppm Fluorid als SnF_2 und NaF, 1260 ppm Zinn als SnF_2); F+Sn_{3440}-**TP** = Sensodyne Repair & Protect Zahnpasta (1100 ppm Fluorid und 3440 ppm Zinn als SnF_2). Die Probekörper wurden für 30 min in künstlichem Speichel inkubiert und dann in einer Zahnbürstmaschine (Bürsten während 10 s; total 2 min dem Produkt ausgesetzt) gebürstet. Anschliessend wurden die Probekörper abgespült, getrocknet und mit Zitronensäure 1% erodiert (2 min; pH 3,6). Dieses Prozedere wurde 4-mal durchgeführt und der totale Oberflächenverlust gemessen.

Resultate

Während des Experiments zeigten alle Gruppen zunehmenden Oberflächenverlust. Nach 4 Zyklen schwankte der totale Oberflächenverlust zwischen 0,11 µm (F+Sn_{3120}-**Gel**) und 0,89 µm (F+Sn_{1260}-**TP**). In Bezug auf die Werte des totalen Oberflächenverlusts (Median; interquartiler Bereich) zeigte F-**TP** (0,54; 0,42–0,59) keinen signifikanten Unterschied zu allen anderen Gruppen.

F+Sn_{3500}-**TP** (0,33; 0,30–0,40), F-**TP** + F+Oligopep-**Gel** (0,34; 0,29–0,42) und F+Sn_{3120}-**Gel** (0,11; 0,09–0,15) zeigten einen klar kleineren Oberflächenverlust als F+Oligopep-**TP** (0,75; 0,59–0,98), F+Sn_{1260}-**TP** (0,89; 0,68–1,13) und F+Sn_{3440}-**TP** (0,69; 0,66–0,78).

Diskussion

Obwohl einige Zahnpflegeprodukte, die Zinn-Ionen oder Oligopeptide-104 enthalten, einen zahlenmässig niedrigeren Oberflächenverlustwert aufwiesen, bieten sie keinen signifikant besseren Schutz als eine normale Fluorid-Zahnpasta. Die Gele zeigten einen Trend zu einem besseren Schmelzschutz vor dentalen Erosionen (erosive tooth wear).

Résumé

Introduction

L'érosion dentaire (erosive tooth wear) est associée à une perte de l'émail suite à des phénomènes chimiques et mécaniques. Il existe beaucoup de produits de soins dentaires supposés protéger contre l'érosion dentaire. Cette recherche avait pour but de tester les pâtes et gels dentifrices disponibles sur le marché suisse dans leur efficacité de protection de l'émail contre l'érosion dentaire.

Matériel et méthode

Dans cette étude in vitro, des cycles érosifs-abrasifs ont été utilisés sur 56 échantillons d'émail afin de tester le potentiel protecteur de sept différents produits: F-**TP** = pâte dentifrice Migros Budget Anti-caries (contrôle négatif; 1350 ppm de NaF); F+Sn_{3500}-**TP** = pâte dentifrice Elmex Protection Erosion (contrôle positif; 1400 ppm de NaF et AmF, 3500 ppm $SnCl_2$, 0,5% chitosane); F-**TP** + F+Oligopep-**Gel** = pâte dentifrice Migros Budget Anti-caries (1350 ppm de NaF) + Emofluor Protect Gel Professional (900 ppm monofluorophosphate de Na, oligopeptide-104); F+Sn_{3120}-**gel** = pâte dentifrice Emofluor Gel Intensive Care (1000 ppm fluorure et 3120 ppm de $SnCl_2$); F+Oligopep-**TP** = pâte dentifrice Candida Protect Professional (1450 ppm fluorure et monofluorophosphate de Na, oligopeptide-104); F+Sn_{1260}-**TP** = pâte dentifrice Emoform-F Protect (1400 ppm de SnF_2 et NaF, 1260 ppm de SnF_2); F+Sn_{3440}-**TP** = pâte dentifrice Sensodyne Repair & Protect (1100 ppm de fluorure et 3440 ppm de SnF_2). Les échantillons ont été incubés durant 30 minutes dans de la salive artificielle, puis brossés dix sec et exposés au produits durant deux minutes. Après rinçage et séchage, les échantillons ont été érodés durant deux minutes avec de l'acide citrique 1% (pH = 3,6). L'ensemble de la procédure était répétée quatre fois, puis la perte totale de surface de l'émail mesurée.

Résultats

Tous les groupes ont montré des pertes de substances durant l'expérimentation. Après quatre cycles, la perte totale de surface d'émail variait entre 0,11 µm (F+Sn_{3120}-**gel**) et 0,89 µm (F+Sn_{1260}-**TP**). Lors de comparaisons au niveau médian de la perte totale de surface d'émail, le groupe F-**TP** (0,54; 0,42–0,59) ne montrait pas de différence significative par rapports aux autres groupes.

La perte de surface pour F+Sn_{3500}-**TP** (0,33; 0,30–0,40), F-**TP** + F+Oligopep-**Gel** (0,34; 0,29–0,42) et F+Sn_{3120}-**Gel** (0,11; 0,09–0,15) était nettement inférieure à F+Oligopep-**TP** (0,75; 0,59–0,98), F+Sn_{1260}-**TP** (0,89; 0,68–1,13) et F+Sn_{3440}-**TP** (0,69; 0,66–0,78).

Discussion

Bien que les produits contenant des ions Sn ou des oligopeptides-104 ont montré des valeurs d'érosion inférieures, ceux-ci ne protègent pas significativement mieux que les pâtes dentifrices normales fluorées. Les gels ont montré une tendance générale de meilleure protection de l'émail contre l'érosion dentaire que les pâtes dentifrices.

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