J Clin Periodontol 2001; 28: 319–324
Printed in Denmark . All rights reserved

Journal of Clinical Periodontology
ISSN 0303-6979

The erosive effects of some mouthrinses on enamel

A study in situ

H. Pontefract[1], J. Hughes[1], K. Kemp[2], R. Yates[1], R. G. Newcombe[3] and M. Addy[1]

[1]Division of Restorative Dentistry, Dental School, Bristol, UK; [2]Alcide Corporation, Redmond, WA, USA; [3]Department of Medical Statistics, University of Wales College of Medicine, Cardiff, UK

Pontefract H, Hughes J, Kemp K, Yates R, Newcombe RG, Addy M: The erosive effects of some mouthrinses on enamel. A study in situ. J Clin Periodontol 2001; 28: 319–324. © Munksgaard, 2001.

Abstract

Background: There are both anecdotal clinical and laboratory experimental data suggesting that low pH mouthrinses cause dental erosion. This evidence is particularly relevant to acidified sodium chlorite (ASC) formulations since they have plaque inhibitory properties comparable to chlorhexidine but without the well known local side effects.

Aim: Studies in situ and in vitro were planned to measure enamel erosion by low pH mouthrinses. The study in situ measured enamel erosion by ASC, essential oil and hexetidine mouthrinses over 15-day study periods. The study was a 5 treatment, single blind cross over design involving 15 healthy subjects using orange juice, as a drink, and water, as a rinse, as positive and negative controls respectively. 2 enamel specimens from unerupted human third molar teeth were placed in the palatal area of upper removable acrylic appliances which were worn from 9 a.m. to 5 p.m., Monday to Friday for 3 weeks. Rinses were used 2× daily and 250 ml volumes of orange juice were imbibed 4× daily. Enamel loss was determined by profilometry on days 5, 10 and 15. The study in vitro involved immersing specimens in the 4 test solutions together with a reduced acid ASC formulation for a period of 4 h under constant stirring; Enamel loss was measured by profilometry every hour.

Results: Enamel loss was in situ progressive over time with the 3 rinses and orange juice but negligible with water. ASC produced similar erosion to orange juice and significantly more than the two proprietary rinses and water. The essential oil and hexetidine rinses produced similar erosion and significantly more than water. Enamel loss in vitro was progressive over time, and the order from low to high erosion was reduced acid ASC, ASC, Essential oil, and hexetidine mouthrinses and orange juice.

Conclusion: Based on the study in situ, it is recommended that low pH mouthrinses should not be considered for long term or continuous use and never as prebrushing rinses. In view of the plaque inhibitory efficacy of ASC, short- to medium-term applications similar to those of chlorhexidine would be envisaged.

Key words: enamel; erosion; mouthrinses; soft drinks; clinical trial

Accepted for publication 16 May 2000

Mouthrinses have been used for centuries as part of oral care, (for review, see Fischman (1997)) although only relatively recently have potential benefits been scientifically evaluated (for review, see Addy & Moran (1997)). A cursory inspection of pharmacies and retail outlets reveals a large number of mouthrinse products formulated for a number of oral health benefits. Perhaps most commonly, mouthrinses are perceived to be adjunctive to tooth cleaning with a toothbrush and toothpaste. Unfortunately, relatively few mouthrinse formulations to date have been proven to produce such adjunctive benefits to oral hygiene (for reviews, see Mandel (1988), Addy et al. (1994), Moran (1997)). Of these, chlorhexidine containing formulations are considered the "Gold Standard" and often used as the positive controls whereby to compare potential antiplaque agents (for review, see Jones (1997)). To consider mouthrinses as adjuncts to mechanical oral hygiene measures provides the expectation of long term use. Besides the cost implications of such a practice, the possible side effects of products must be considered. For example, long term use of chlorhexidine is

largely obviated by side effects such as dental staining and perturbation of taste (Flotra et al. 1971). Chlorhexidine mouthrinse use is thus usually indicated in short to medium term regimens when mechanical tooth cleaning is compromised or impossible (for reviews, see Addy (1986), Addy & Moran (1997)).

Recently, acidified sodium chlorite (ASC) mouthrinse formulations, based on the interaction of sodium chlorite with a protic acid to produce higher oxidant species, were found to show the same substantivity and plaque inhibitory properties as chlorhexidine (Yates et al. 1997). These same formulations showed no evidence of taste perturbation or staining of teeth. In ASC systems, sodium chlorite generates the microbially active species at an exponentially increasing rate as the pH is lowered. From empirical calculation, an ASC solution at pH 3.0 has only 8.5% of the chlorite available as chlorous acid whereas at pH 2.8 the concentration increases to 12.5% (Gordon et al. 1972). Thus, when considering the acid-optimization of ASC formulations for potential therapeutic uses, a pH reduction of 0.2 units results in almost 50% greater concentration of the microbially active species. However, to achieve this pH drop, the total titratable acidity must be increased almost 10 fold to that required for a pH 3.0 ASC formulation. Dental erosion must therefore be considered as a potential sequel to treatment with such acid-optimized ASC formulations.

The possibility that mouthrinses can cause dental erosion is not new. Indeed, considerable adverse media attention in the UK was directed towards mouthrinses with pH values below 5.5. Evidence that mouthrinses do cause erosion, at least of dentine and in vitro is available (Addy et al. 1991, West et al. 1998, 1999, Hughes et al. 1999a, b). Unfortunately and unlike for soft drinks, there are no data derived from controlled clinical investigations of the dental erosive effects of mouthrinses. The aim of the present study in situ was to evaluate the erosive potential of three low pH mouthrinses, including ASC, by comparison with orange juice, as a positive control (West et al. 1999) and water as a negative control. A comparison of the data generated in this study could then be made with information generated separately in vitro to determine if any correlation exists between the outcomes of current test methodologies. In particular, it was hoped the data would guide the clinical regimens of use for ASC to optimise the benefits of this apparently most effective agent (Yates et al. 1997), and minimise the only potential side effect, namely dental erosion.

Method and Materials

The study in situ was a 5 treatment, randomised, single examiner blind, crossover design balanced for residual effects and involving 15 healthy volunteers. Approval for the study was provided by the University of Bristol Healthcare Trust Ethics Committee. Subjects were provided with verbal and written information concerning the study and gave signed consent to participate. The subjects had to be dentate and dentally fit without removable dental prostheses or fixed or removable orthodontic appliances. Subjects also had to have no clinical evidence of excessive tooth wear or a history of recurrent oral ulceration. Removable upper acrylic appliances were constructed for each subject based on plaster models from alginate impressions of the upper arches. The appliances were designed to retain two enamel specimens embedded in epoxy resin and measuring 8×5×2 mm. The enamel specimens were derived from unerupted human third molar teeth prepared to have a flat surface with a profile tolerance of ±0.3 μm measured on a profilometer. After baseline profiles the enamel/resin specimens were taped with PVC adhesive tape to expose a window of enamel 2 mm×5 mm. Detailed descriptions of appliances, specimen preparation, measurement method and operating parameters of the profilometer are provided in previous publications (West et al. 1999, Hughes et al. 1999a).

The test agents and pH values and titratable acidity (TA) were as follows:

A acidified sodium chlorite mouthrinse* (pH 3.02 TA 3.0)
B essential oil mouthrinse** (pH 3.95 TA 0.02)
C 0.1% hexetidine mouthrinse† (pH 3.75 TA 0.13)
D orange juice‡ (pH 3.69 TA 0.4)
E Mineral Water§ (pH 6.9 TA)

* Alcide Corporation, Redmond, WA, USA.
** Listerine, Warner Lambert, Morris Plains, NJ, USA.
† Oraldene, Warner Lambert, Morris Plains, NJ, USA
‡ Sainsbury's PLC, London, UK.
§ Volvic, Danone, London, UK.

Formulations A, B, C and E were used as rinses 2× daily at 9.00 am and 3.00 pm. Orange juice, D, was used as a 250 ml drink 4× a day at 9.00 am, 11.00 am, 1.00 pm and 3.00 pm. Rinse A was supplied in 2× 236 ml bottles with 7.5 ml from each mixed and used immediately for 60 s. Rinses B and C were provided in 1.5-litre bottles and rinsed according to the manufacturers instructions as 20 ml for 30 s. The mineral water was also supplied in 1.5-litre bottles and used with 15 ml rinsed for 60 s. Orange juice was supplied in 1 litre cartons and the 250-ml volumes sipped over a monitored 10-min period. All rinsing and drinking was supervised by a research assistant not otherwise involved in the study. Each study period extended over 15 working days (Monday to Friday) within a 3-week period. Subjects wore their upper appliances holding the enamel specimens from 9.00 am to 5.00 pm each day, with the appliance removed during the 1-h lunch break. Except for tea, coffee or water, no other foods or drinks were to be consumed during appliance wearing. Each day, enamel samples were placed into a 0.2% chlorhexidine mouthrinse solution§§ for 3 min immediately before and after appliance wearing at 9.00 am and 5.00 pm, respectively. Duplicate profilometer measurements, to determine enamel loss, were made on days 5, 10 and 15 of each study period. After profilometry measurements on days 5 and 10, specimens were also disinfected before replacement in appliances by soaking in 0.5% chlorhexidine in 70% spirit base§ for at least 30 min. Appliances and specimens were stored in saline overnight.

At the start of each study period, fresh untreated specimens were allocated to each subject. A washout period between each 15-day study period of at least 2 days was allowed. A safety limit of 2 μm enamel loss was set which, if approached by days 5 or 10, subjects were to be removed from that leg of the study.

The study in vitro used the same type of enamel specimens as the study in situ with 4 specimens allocated to each treatment. Numerous experiments in vitro (West et al. 1997) showed no effects of water and therefore this control was

§§ Corsodyl, SmithKline Beecham, Weybridge, Surrey, UK.
§ Eye Hospital Pharmacy, University of Bristol Healthcare Trust, Bristol, UK.

not used in this study in vitro. However a reduced acid ASC1 mouthrinse was added into the experiment (pH 3.14 TA 0.4). The taped specimens were placed into the test solutions for 4 periods of 1 h with constant stirring. Specimens were measured each hour on the profilometer as for the study in situ.

Statistical methods

Averages of the 4 readings, obtained from the two specimens per subject, for each treatment at the 4 time points (baseline included) were calculated. Increments from baseline were then used as the unit for analysis. As in previous studies, there was considerable heterogeneity of standard deviation with the variation in the degree of erosion increasing with the degree of erosion produced. This contra-indicated analysis of variance as usually employed for multitreatment crossover design studies. However to analyse for subject and period effects, 3-way analysis of variance was performed. The main analysis was based on paired comparisons based on a prestudy selection of pairs of interest namely acidified sodium chlorite with the other rinses and orange juice and the 2 proprietary rinses and water. Analyses used paired *t*-tests together with the construction of 95% confidence intervals. Moreover because of the skewed distribution of the data, the parametric tests were supplemented with corresponding non-parametric Wilcoxon tests with calculated confidence intervals. For the study in vitro averages of the 8 readings from the 4 samples were calculated for each of the 5 time points, including baseline. The data in vitro were normally distributed and for the 4-h time point differences between treatments were assessed by Analysis of Variance. To avoid multiple pairwise comparisons a pre-study selection of comparisons of interest was made and unpaired *t*-tests performed between the 2 ASC formulations and the other treatments at the 4-h time point only.

Results

Study in situ

The 15 subject group comprised 11 females and 4 males aged between 22 and 49 years (mean 29.5 years). Subject 8 exceeded the 20 μm limit on the posterior specimen by day 5 of period 3 (ASC mouthrinse) and was withdrawn from that period. Data for this subject were entered as 20 μm for the period. However, because this subject had an upper respiratory tract infection requiring medication for a significant part of the study, analyses were performed with and without data from this subject. Subject 5 did not contribute data for Period 5 due to illness. Data were lost for subject 12, period 5, day 10, posterior specimen and subject 9, period 4, day 10 and 15, anterior specimen. Finally, subject no. 2, period 4, day 15, the posterior specimen was found to be damaged and no data were recorded.

The mean and standard deviation of the incremental loss of enamel from baseline at 5, 10 and 15 days for each treatment, with and without subject 8 included are shown in Table 1. Analysis of variance showed significant differences between subjects ($p=0.008$), but not periods ($p=0.52$) and highly significant treatment effects ($p<0.001$). Observationally, when subject 8 data are included, ASC produces more erosion than orange juice. Both these treatments produce considerably more erosion than the two proprietary rinses where the essential oil rinse (B) is marginally more erosive than the hexetidine rinse (C). Water (E) shows little effect on enamel. Exclusion of subject no. 8 data reveals very similar erosion for ASC and orange juice and for the essential oil and hexetidine rinses.

Table 2 shows the result of the parametric and non-parametric statistical tests for the preselected paired comparisons again for data sets with and without subject no. 8. The findings are similar with both analysis methods albeit a clearer picture is apparent with the more appropriate non-parametric tests. Thus, with or without subject no. 8 data, ASC is more erosive than orange juice but the differences do not reach significance at any time point. ASC overall is significantly more erosive than either of the two proprietary rinses at these time points particularly when data from subject no. 8 are excluded. The 2 proprietary rinses (B and C) are significantly more erosive than water at all time points, again particularly when subject no. 8 is excluded from the data base.

Study in vitro

The mean and standard deviation of the profiles for the specimens at baseline and the 4-h time points for each treatment group are shown in Table 3. There was no significant difference for baseline data. The rank order for erosion from lowest to highest at 4 h was reduced acid ASC rinse, ASC rinse, Essential oil rinse, hexetidine rinse and orange juice. Analysis if variance showed highly significant differences between treatments ($p<0.0001$). Preselected comparisons showed that the reduced acid ASC rinse was significantly less erosive than all other rinses and orange rinses and orange juice (p ranged <0.03–<0.0001). The ASC rinse was not significantly different from the essential oil rinse ($p>0.05$) but significantly less erosive than the hexetidine

Table 1. Mean (standard deviation) incremental loss of enamel from baseline at days 5, 10 and 15 for each treatment with and without subject 8

			With 8		Without 8	
	Treatment	Day	*n*	mean (SD)	*n*	mean (SD)
A	ASC	5	15	1.84 (3.94)	14	0.84 (0.76)
		10	15	3.82 (5.28)	14	2.65 (2.83)
		15	15	5.00 (5.71)	14	3.92 (4.01)
B	essential oil	5	15	0.72 (1.93)	14	0.22 (0.18)
		10	15	1.03 (2.03)	14	0.52 (0.42)
		15	15	1.44 (2.23)	14	0.88 (0.56)
C	hexetidine	5	15	0.27 (0.19)	14	0.29 (0.19)
		10	15	0.63 (0.62)	14	0.63 (0.64)
		15	15	0.96 (0.86)	14	0.93 (0.88)
D	orange juice	5	14	1.27 (1.97)	13	0.85 (1.25)
		10	14	3.04 (5.02)	13	2.69 (5.04)
		15	14	3.95 (4.47)	13	3.44 (4.20)
E	water	5	15	0.02 (0.05)	14	0.03 (0.05)
		10	15	0.05 (0.08)	14	0.06 (0.09)
		15	15	0.09 (0.12)	14	0.09 (0.12)

Table 2. Parametric and non-parametric statistical analyses of preselected pairs of treatments (ASC versus others, proprietary rinses versus water) *p*-values with and without subject no. 8

		With 8		Without 8	
Comparison	Day	*t*-test	Wilcoxon	*t*-test	Wilcoxon
A versus B	5	0.06	0.002	0.017	0.004
	10	0.013	0.001	0.017	0.002
	15	0.008	0.004	0.016	0.007
A versus C	5	0.15	0.01	0.027	0.017
	10	0.035	0.007	0.019	0.012
	15	0.015	0.008	0.016	0.014
A versus D	5	0.40	0.35	0.00	0.58
	10	0.52	0.17	0.93	0.30
	15	0.34	0.66	0.59	1.0
A versus E	5	0.097	<0.001	0.002	0.001
	10	0.016	<0.001	0.005	0.001
	15	0.005	<0.001	0.004	0.001
B versus E	5	0.19	0.003	0.002	0.005
	10	0.084	0.001	0.001	0.001
	15	0.035	0.001	<0.001	0.001
C versus E	5	<0.001	0.001	<0.001	0.001
	10	0.003	0.001	0.006	0.001
	15	0.002	0.001	0.004	0.001

Table 3. The mean (standard deviation) profilometer readings (μm) from enamel specimens taken at baseline and after treatment in vitro with reduced acid ASC, ASC, essential oil and hexetidine mouthrinses and orange juice for 4, 1-h periods

	Reduced acid ASC	ASC	Essential oil	Hexetidine	Orange juice
Baseline	0.18 (0.10)	0.17 (0.07)	0.05 (0.12)	0.15 (0.07)	0.18 (0.05)
1 h	0.02 (0.20)	0.45 (0.19)	0.24 (0.07)	0.59 (0.14)	2.66 (0.13)
2 h	0.15 (0.13)	0.65 (0.23)	1.00 (0.40)	1.77 (0.33)	7.29 (1.75)
3 h	0.11 (0.07)	0.88 (0.43)	1.63 (0.35)	2.50 (0.51)	9.47 (0.60)
4 h	0.04 (0.01)	1.55 (1.06)	2.65 (0.48)	3.35 (1.03)	13.39 (1.04)

rinse and orange juice ($p<0.05$ and <0.0001, respectively).

Discussion

Previous studies indicated that ASC mouthrinses possessed the same antimicrobial substantivity and plaque inhibitory properties as 0.2% chlorhexidine rinse (Yates et al. 1997). Encouragingly, the ASC rinses did not appear to produce the local side effects of taste alteration or dental staining associated with cationic antiseptics such as chlorhexidine (Flotra et al. 1971). Nevertheless, the low pH of these rinses suggested that dental erosion could occur, as recently proven for some soft drinks with comparable pH values (West et al. 1998, 1999, Hughes et al. 1999a, b). However, studies in vitro and in situ on the erosive effects of organic acids and soft drinks reveal that pH values are not the only variable in dental erosion (West et al. 1999, Hughes et al. 1999a, b, 2000, for review, see Zero 1996). Moreover, effects in vitro are magnified many times over compared to effects in situ (West et al. 1999). With the very limited data on erosion of dental tissues by mouthrinses entirely drawn from laboratory studies (Addy et al. 1991), it was felt unsafe to assume that low pH mouthrinses would necessarily behave like soft drinks. In the event the present studies proved this concern well founded since the study in vitro did not correlate with the study in situ, unlike studies with soft drinks (Hughes et al. 1999a, b, West et al. 1999). Thus, the latter authors reported that studies in vitro produced the same ranking order for soft drinks as for studies in situ. In the present study the ranking order was different with ASC producing the least erosion in vitro but the most in situ. Interestingly, the ranking would have been comparable had not ASC been included. An explanation for the reduced erosion for ASC and almost total lack of erosion by the reduced acid ASC cannot yet be explained but preliminary work by this group suggests the lack of pellicle in the laboratory model is relevant.

The more important study in situ, using a now established and very sensitive methodology to detect enamel erosion (West et al. 1998), showed that ASC produced effects at least similar to orange juice. The two low pH proprietary rinses produced erosion albeit considerably less than either orange juice or ASC. It has been shown that, with organic acids and soft drinks, modifications can be made to markedly reduce erosive potential (Hughes et al. 1999a, b, 2000). Thus, with modest increases in pH values and decreases in titratable acidity, together with the addition of calcium, erosion can be reduced to clinically insignificant levels (Hughes et al. 1999a, b). In this study, it would appear that pH and titratable acidity were dominant factors in the erosion and the mouthrinse formulations did not contain ingredients which might have modified the erosion. Essentially, the order of erosivity namely ASC, orange juice, essential oil rinse and hexetidine rinse was in line with the order of increasing pH and decreasing titratable acidity. Furthermore there appeared no evidence that the mouthrinses had indirect effects, such as salivary buffering, which might have limited their erosive action.

The majority of medicinal formulations, if not all, have some side effects whether these be local or systemic. In each case, it is important to assess the benefit: risk ratio. The risk clearly will be influenced by the likely incidence and severity of the side effect. In the case of dental erosion, the regimen and duration of use of a potentially erosive agent will be critical to the outcome. Mouthrinses in general have similar regimens of use namely 10–20 ml volumes rinsed twice a day for 30–60 s. How the duration of each rinsing might influence the outcome cannot be determined from the present study because

of other variables. Thus for example, although the essential oil and hexetidine rinses were used for 30 s and caused less erosion than the ASC rinse used for 60 s, they also had higher pH values. However, what certainly would be relevant to the loss of tooth substance would be the timing of rinsing in relation to tooth brushing. Thus, studies in vitro have shown that enamel and dentine challenged by orange juice prior to brushing with toothpaste showed markedly increased tissue loss compared to either orange juice or brushing alone (Davis & Winter 1980). Mouthrinses have been formulated both as pre and post brushing products. These data in vitro from soft drinks therefore would suggest that low pH mouthrinses should not be used before brushing.

Perhaps the most important aspect of the rinsing regimen would be the period of use of any product. Studies, including the present investigation, indicate that erosion is progressive with time of use of the erosive agent (West et al. 1998). Thereby, the prolonged use of low pH mouthrinses would appear contraindicated particularly when they would represent yet another erosive insult, in what appears to be an increasing environment of high extrinsic acid intake by many individuals (for review, see Lussi (1996)). At present the sales of mouthrinses in the UK are >£ 50 million suggesting approximately 20 million bottles sold. This would appear a small per capita use of mouthrinses. Indeed, the dental profession would probably tend not to recommend continuous or long term use of mouthrinses, not the least by virtue of the poor cost benefit of such products to oral hygiene and gingival health (for review, see Moran (1997)). For chlorhexidine, the considered Gold Standard antiplaque agent, the favoured approach has been in short to medium term use (for review, see Jones (1997)). For ASC, a rinsing agent which appears at least equal to chlorhexidine for plaque inhibition (Yates et al. 1997), a similar recommendation or prescription would be envisaged and supervised by a professional.

In conclusion, the 3 low pH mouthrinses used in the present study in situ showed variable potential to cause erosion of enamel. In the case of ASC this was similar to that of orange juice imbibed at 1 litre per day. The data however suggest, that even for ASC, the erosion would only be of clinical significance were the mouthrinses employed as long term adjuncts to oral hygiene; a practice which would appear a divergence from the norm. It is recommended that low pH mouthrinses should be used as short to medium term adjuncts to oral hygiene and never as prebrushing rinses.

Zusammenfassung

Der erosive Effekt von einigen Mundspülungen auf den Schmelz: eine in situ Studie

Basis: Es existieren sowohl anektodische klinische als auch experimentelle Labordaten, die suggerieren, daß Mundspülungen mit niedrigem pH dentale Erosionen verursachen. Diese Annahme ist besonders auf saure Natriumchlorit (ASC) Rezepturen bezogen, da sie Plaque inhibitorische Eigenschaften haben, verglichen mit Chlorhexidin, aber ohne die gut bekannten lokalen Nebenwirkungen.

Ziel: Studien in situ und in vitro wurden geplant, um die Schmelzerosion durch Mundspülungen mit niedrigem pH zu messen. Die Studie in situ maß die Schmelzerosion durch ASC, einem ätherischen Öl und Chlorhexidin Mundspülungen über eine 15 Tage Studienperiode. Die Studie bestand aus 5 Behandlungen mit einem einfachen blinden Überkreuzdesign, die 15 gesunde Personen einbezog, die Orangensaft zum Trinken und Wasser als Spülung als positive und negative Kontrollen nutzten. 2 Schmelzproben von nicht durchgebrochenen menschlichen dritten Molaren wurden in der Gaumenregion auf oberen herausnehmbaren Acrylplatten befestigt, die von 9 Uhr morgens bis 5 Uhr abends von Montag bis Freitag über 3 Wochen lang getragen wurden. Die Spülungen wurden 2× täglich durchgeführt, und 250 ml Orangensaft wurden 4 mal täglich getrunken. Der Schmelzverlust wurde profilometrisch an den Tagen 5, 10 und 15 bestimmt. Die in vitro Studie bezog Proben ein, die in die 4 Testlösungen zusammen mit einer reduzierten sauren ASC Mischung für eine Periode von 4 Stunden unter konstanter Bewegung eingetaucht wurden. Der Verlust an Schmelz wurde profilometrisch jede Stunde gemessen.

Ergebnisse: Der Schmelzverlust war in situ über die Zeit bei den 3 Spülungen und dem Orangensaft progressiv, aber unbedeutend bei Wasser. ASC produzierte ähnliche Erosionen wie Orangensaft und signifikant mehr als die 2 Markenspülungen und Wasser. Das ätherische Öl und die Chlorhexidinspülung produzierten ähnliche Erosionen und signifikant mehr als Wasser. Der Schmelzverlust in vitro war progressiv über die Zeit, und die Reihenfolge von wenig zu starker Erosion war reduziertes saures ASC, ASC, ätherisches Öl, Chlorhexidin-Mundspülung und Orangensaft.

Zusammenfassung: Die Ergebnisse der in situ Studie nutzend wird empfohlen, daß Mundspülungen mit niedrigem pH nicht für lange Zeit oder kontinuierlich und niemals als Spülung vor der Zahnreinigung verordnet werden sollten. Aus der Sicht des Plaque inhibitorischen Effektes von ASC könnte man sich kurz- bis mittelzeitige Verwendungen ähnlich zu denen von Chlorhexidin vorstellen.

Résumé

Les effets érosifs de quelques bains de bouche sur l'émail: une étude in situ

Il y a quelques données cliniques anecdotiques et expérimentales de laboratoire qui suggèrent que des bains de bouche au pH faible peuvent causer une érosion dentaire. Cette évidence est particulièrement importante dans les formules de chlorure de sodium acidifié (ASC) depuis qu'elles ont des propriétés d'inhibition de la plaque dentaire comparables à la chlorhexidine mais sans les effets secondaires locaux bien connus. Des études in situ et in vitro ont été planifiées pour mesurer l'erosion de l'émail par des bains de bouche à faible pH. L'étude in situ a mesuré l'érosion de l'émail causé par l'ASC, l'huile essentielle et l'hexetidine durant des périodes de 15 jours. L'étude était un traitement par 5 solutions, croisé en simple aveugle et comprenant 15 sujets sains qui ont bu du jus d'orange et de l'eau comme contrôles positifs et négatifs. 2 échantillons d'émail provenant de dents de sagesse humaines enclavées ont été placés dans l'aire palatine d'appareils en acrylique amovibles qui ont été portés de 9 h à 17 h, du lundi au vendredi et ce durant 3 semaines. Les rinçages ont été effectués 2× par jour et 250 ml de jus d'orange ont été ingurgités 4× par jour. La perte de l'émail à été déterminée par profilométrie aux jours 5, 10 et 15. L'étude in vitro comportait des échantillons immergés dans les 4 solutions testées avec une formulation d'ASC à acidité réduite pour une période de 4 heures avec une agitation constante; la perte d'émail a été mesurée par filométrie toute les heures. La perte d'émail enregistrée in situ progressait avec les 3 types de rinçages et le jus d'orange mais restait négligeable avec l'eau. L'ASC produisait une érosion semblable à celle produite par le jus d'orange et significativement plus importante que les 2 autres rincages et l'eau. L'huile essentielle et l'hexetidine produisaient une érosion semblable et plus significative que celle produite par l'eau. La perte d'émail in vitro était progressive avec le temps et dans l'ordre de la plus faible à la plus forte érosion était l'ASC avec acidité réduite, l'ASC, l'huile essentielle, l'hexetidine et le jus d'orange. Sur base de cette étude in situ il est recommandé que les bains de bouche à faible pH ne dolvent pas être utilisé à long terme ou en continu et jamais comme solution de pré-brossage. Vu l'efficacité d'ihnibition de la plaque dentaire de l'AASC des applications de course ou de moyenne durée pourraient être envisagées comme c'est le cas pour la chlorhexidine.

References

Addy, M. (1986) Chlorhexidine compared with other locally delivered antimicrobials.

A short review. *Journal of Clinical Periodontology* **13**, 957–964.

Addy, M. & Moran, J. M. (1997) Evaluation of oral hygiene products: science is true; don't be misled by the facts. In: Toothpaste, mouthrinse and other topical remedies in periodontics, eds., Addy, M. & Moran, J. M. *Periodontology 2000* **15**, 40–51.

Addy, M., Loyn, T. & Adams, D. (1991) Dentine hypersensitivity: Effects of some proprietary mouthwashes on the dentine smear layer. An SEM study. *Journal of Dentistry* **19**, 148–152.

Addy, M., Moran, J. & Wade, W. (1994) Chemical plaque control in the prevention of gingivitis and periodontitis. In: *Proceedings of the 1st European Workshop on Periodontology*, eds. Lang, N. P. & Karring, T. Quintessence Publishing, London, pp. 244–257.

Davis, W. B. & Winter, P. J. (1980) The effect of abrasion on enamel and dentine after exposure to dietary acid. *British Dental Journal* **148**, 253–256.

Fischman, S. (1997) Oral hygiene products: How far have we come in 6000 years. In: Toothpaste, mouthrinse and other topical remedies in periodontics, eds., Addy, M. & Moran, J. M. *Periodontology 2000* **15**, 7–14.

Flotra, L., Gjermo, P., Rolla, G. & Waerhaug, J. (1971) Side-effects of chlorhexidine mouthwashes. *Scandinavian Journal of Dental Research* **79**, 119–125.

Gordon, G., Kieffer, G. & Posenblatt, D. (1972) The chemistry of chlorine dioxide. In: *Progress in inorganic chemistry*, ed. Lippard S. **15**, pp. 201–286. Wiley Inter Science, New York.

Hughes, J. A., West, N. X., Parker, D. M., Newcombe, R. G. & Addy, M. (1999a) Development and evaluation of a low erosive blackcurrant drink 1. Comparison with orange juice. *Journal of Dentistry* **27**, 285–289.

Hughes, J. A., West, N. X., Parker, D. M., Newcombe, R. G. & Addy, M. (1999b) Development and evaluation of a low erosive blackcurrant drink 3. Final drink and concentrate formulae, comparisons in situ and overview of the concept. *Journal of Dentistry* **27**, 345–350.

Hughes, J. A., West, N. X., Parker, D. M., van den Braak, M. H. & Addy, M. (2000) Effects of pH and concentration of citric, malic and lactic acids on enamel in vitro. *Journal of Dentistry* **28**, 147–152.

Jones, C. G. (1997) Chlorhexidine: is it still the gold standard? In: Toothpaste, mouthrinse and other topical remedies in periodontics, eds., Addy, M. & Moran, J. M. *Periodontology 2000* **15**, 55–62.

Lussi, A. (1996) Dental erosion. Clinical diagnosis and case history taking. *European Journal of Oral Sciences* **104**, 191–198.

Mandel, I. D. (1988) Chemotherapeutic agents for controlling plaque and gingivitis. *Journal of Clinical Periodontology* **15**, 488–494.

Moran, J. M. (1997) Chemical plaque control-prevention for the masses. In: toothpaste, mouthrinse and other topical remedies in periodontics, eds., Addy, M. & Moran, J. M. *Periodontology 2000* **15**, 109–117.

West, N. X., Hughes, J. A., Parker, D. M., Newcombe, R. G. & Addy, M. (1999) Development and evaluation of a low erosive blackcurrant drink 2. Comparison with a conventional blackcurrant juice drink and orange juice. *Journal of Dentistry* **27**, 341–344.

West, N. X., Maxwell, A., Hughes, J. A., Parker, D. M., Newcombe, R. G. & Addy, M. (1997) A method to measure clinical erosion: The effect of orange juice consumption on erosion of enamel. *Journal of Dentistry* **26**, 329–336.

Yates, R., Moran, J., Addy, M., Mullan, P. J., Wade, W. & Newcombe, R. (1997) The comparative effect of acidified sodium chlorite and chlorhexidine mouthrinses on plaque regrowth and salivary bacterial counts. *Journal of Clinical Periodontology* **24**, 603–609.

Zero, D. T. (1996) Etiology of dental erosion-extrinsic factors. *European Journal of Oral Sciences* **104**, 162–171.

Address:

Martin Addy
Division of Restorative Dentistry
Dental School
Lower Maudlin Street
Bristol
BS1 2LY
UK