The erosive effects of some mouthrinses on enamel
A study in situ


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
(Flostra et al. 1971). Chlorhexidine
mouthrinse use is thus usually indicated
in short to medium term regimens when
mechanical tooth cleaning is compro-
mised 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 ox-
idant species, were found to show the
same substantivity and plaque inhibi-
atory properties as chlorhexidine (Yates
et al. 1997). These same formulations
showed no evidence of taste pertur-
bation or staining of teeth. In ASC sys-
tems, sodium chlorite generates the
microbiologically active species at an exponen-
tially 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 in-
creases to 12.5% (Gordon et al. 1972). Thus,
when considering the acid-optim-
ization of ASC formulations for poten-
tial 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 mouth-
rinses with pH values below 5.5. Evi-
dence that mouthrinses do cause ero-
sion, at least of dentine and in vitro is
available (Addy et al. 1991, West et al.
1998, 1999, Hughes et al. 1999a, b). Un-
fortunately and unlike for soft drinks,
there are no data derived from con-
rolled clinical investigations of the den-
tal 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 posi-
tive 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 gener-
ated separately in vitro to determine if
any correlation exists between the out-
comes 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 ap-
parently 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, ran-
domised, single examiner blind, cross-
over design balanced for residual effects
and involving 15 healthy volunteers. Ap-
proval for the study was provided by the
University of Bristol Healthcare Trust
Ethics Committee. Subjects were pro-
vided with verbal and written infor-
mation concerning the study and gave
signed consent to participate. The sub-
jects had to be dentate and dentally fit
without removable dental prostheses or
fixed or removable orthodontic appli-
cances. Subjects also had to have no clin-
cal 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 im-
mersions of the upper arches. The appli-
cances 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 toler-
ance of ±0.3 μm measured on a profi-
lometer. After baseline profiles the en-
amel/resin specimens were taped with
PVC adhesive tape to expose a window
of enamel 2 mm×5 mm. Detailed de-
scriptions of appliances, specimen prep-
arration, measurement method and oper-
ating 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 mouth-
rinse* (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.
** Listerner, Warner Lambert,
Morris Plains, NJ, USA.
† Oralden, 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 immedi-
ately for 60 s. Rinses B and C were pro-
vided in 1.5-litre bottles and rinsed ac-
cording to the manufacturers instruc-
tions 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 in-
volved in the study. Each study period
extended over 15 working days (Mon-
toay 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 appli-
cance 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 deter-
mine 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. Ap-
pliances and specimens were stored in sal-
ine overnight.

At the start of each study period,
fresh untreated specimens were allo-
cated 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 vi-
tro (West et al. 1997) showed no effects
of water and therefore this control was
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 multivariate 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 rinse.

<p>| 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 |
| --- | --- | --- | --- |</p>
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day</th>
<th><em>n</em></th>
<th>With 8</th>
<th>Without 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ASC</td>
<td>5</td>
<td>15</td>
<td>1.84 (3.94)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>3.82 (5.28)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td>5.00 (5.71)</td>
<td>14</td>
</tr>
<tr>
<td>B essential oil</td>
<td>5</td>
<td>15</td>
<td>0.72 (1.93)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>1.03 (2.03)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td>1.44 (2.23)</td>
<td>14</td>
</tr>
<tr>
<td>C hexetidine</td>
<td>5</td>
<td>15</td>
<td>0.27 (0.19)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>0.63 (0.62)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td>0.96 (0.86)</td>
<td>14</td>
</tr>
<tr>
<td>D orange juice</td>
<td>5</td>
<td>14</td>
<td>1.27 (1.97)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>14</td>
<td>3.04 (5.02)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14</td>
<td>3.95 (4.47)</td>
<td>13</td>
</tr>
<tr>
<td>E water</td>
<td>5</td>
<td>15</td>
<td>0.02 (0.05)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>0.05 (0.08)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td>0.09 (0.12)</td>
<td>14</td>
</tr>
</tbody>
</table>
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

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

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

<table>
<thead>
<tr>
<th>Reduced acid ASC</th>
<th>ASC</th>
<th>Essential oil</th>
<th>Hexetidine</th>
<th>Orange juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.18 (0.10)</td>
<td>0.17 (0.07)</td>
<td>0.05 (0.12)</td>
<td>0.15 (0.07)</td>
</tr>
<tr>
<td>1 h</td>
<td>0.02 (0.20)</td>
<td>0.45 (0.19)</td>
<td>0.24 (0.07)</td>
<td>0.59 (0.14)</td>
</tr>
<tr>
<td>2 h</td>
<td>0.15 (0.13)</td>
<td>0.65 (0.23)</td>
<td>1.00 (0.40)</td>
<td>1.77 (0.33)</td>
</tr>
<tr>
<td>3 h</td>
<td>0.11 (0.07)</td>
<td>0.88 (0.43)</td>
<td>1.63 (0.35)</td>
<td>2.50 (0.51)</td>
</tr>
<tr>
<td>4 h</td>
<td>0.04 (0.01)</td>
<td>1.55 (1.06)</td>
<td>2.65 (0.48)</td>
<td>3.35 (1.03)</td>
</tr>
</tbody>
</table>

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 appeared particularly when they would represent yet another erosive insult, in what

eroded 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)). 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)). 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)). 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.


Address:
Martin Addy
Division of Restorative Dentistry
Dental School
Lower Maudlin Street
Bristol
BSI 2LY
UK