Reduced Plaque Formation by the Chloromethyl Analogue of Victamine C

by

SAMUEL TURESKY
NEVILLE D. GILMORE
IRVING GLICKMAN

THE CHLOROMETHYL ANALOGUE of Victamine C,* a cationic surface-active agent, reduces the formation of dental calculus in humans.1,2 This chemical prevents crystallization of calcium phosphate in calculus smears in vitro,3 but the mechanism whereby it inhibits calculus formation in vivo is not known. The following study was conducted to determine whether the chloromethyl analogue of Victamine C reduces the formation of dental plaque considered a precursor of calculus.4-6

EXPERIMENTAL METHOD

Plaque formation during a three-day experimental period was compared in six male dental students, ages 22-25, using a test aqueous mouthwash containing Victamine C analogue (0.1 percent-pH 6.0) and a control mouthwash of 0.26% aqueous solution of quinine sulfate (pH 6.0), which simulated the taste of the Victamine C analogue. For the purpose of this study, plaque was considered to be a soft concrescent deposit on the teeth which stains red following a 15-second rinse with 10 ml of 0.18 percent basic fuchsin solution (six drops of six percent alcoholic basic fuchsin in 10 ml of tap water) followed by a five second rinse with 10 ml of tap water.7,8 A three-day experimental period was used because a measurable amount of plaque is formed during this time.9,10

The teeth of all subjects were cleaned free of plaque and calculus corroborated by disclosure with the standard basic fuchsin. This was followed by a three-day period without brushing or mouthwash at the end of which plaque was disclosed with fuchsin and scored. This provided a base line for plaque formation in each subject.

After the base-line period each subject was assigned another blank control period and two periods each on test and control mouthwashes in a sequence unknown to the examiners. Each trial period was preceded by an oral prophylaxis to remove plaque and calculus.

During each three-day trial period, with the exception of the two blank control periods, the subjects were instructed to use 20 ml of mouthwash as a rinse for one minute four times a day, after meals and before retiring, and follow it by two brief rinses with tap water. The subjects were given the mouthwash and a cup marked at the 20 ml level, but the use of the mouthwash was not supervised. They were also instructed to follow their normal diet but not to brush their teeth or use any other oral hygiene measures. The intervals between trials ranged from 4 to 18 days, during which usual oral hygiene measures were practiced.

Disclosed plaque was scored by the method of Quigley and Hein.9 A score of 0 to five was assigned to each facial and lingual nonrestored surface of all the teeth except third molars, as follows:

0 = No plaque.
1 = Separate flecks of plaque at the cervical margin of the tooth.
2 = A thin continuous band of plaque (up to one mm) at the cervical margin of the tooth.
3 = A band of plaque wider than one mm but covering less than one-third of the crown of the tooth.
4 = Plaque covering at least one-third but less than two thirds of the crown of the tooth.
5 = Plaque covering two-thirds or more of the crown of the tooth.

An index for the entire mouth was determined by dividing the total score by the number surfaces examined.

At the end of each three-day period, prior to the use of disclosing solution, the mouth was examined for mucous membrane changes. The subjects were questioned regarding side effects after scoring for plaque.

Plaque was scored at random by either of two investigators according to their availability. Neither examiner was aware of the nature of the trial period at the time of scoring. A high degree of consistency within and between the examiners was established in trials involving 100 observations. Where a single examiner made both the observations for similar trial periods, the correlation coefficient (r) was 0.8723 (df = 27) for one examiner and 0.8935 (df = 17) for the other, and where each examiner made one of the two observations the correlation coefficient was 0.8071 (df = 23) with a difference between them of only 4.26 percent. Because of the consistency within and between examiners, and because the pattern of examiner-subject observations bore no relation to the experimental design, data are treated as coming from one examiner source.
TABLE 1
Whole Mouth Plaque Index Scores for Control and Test Trials

<table>
<thead>
<tr>
<th>Subject</th>
<th>Blank Control 1</th>
<th>Blank Control 2</th>
<th>Plaque Index</th>
<th>Active Control 1</th>
<th>Active Control 2</th>
<th>Test 1</th>
<th>Test 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.77</td>
<td>2.29</td>
<td>2.39</td>
<td>2.38</td>
<td>0.46</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>2.06</td>
<td>2.02</td>
<td>2.06</td>
<td>2.42</td>
<td>1.40</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>3.25</td>
<td>2.61</td>
<td>2.46</td>
<td>2.84</td>
<td>1.86</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2.71</td>
<td>2.50</td>
<td>1.96</td>
<td>2.79</td>
<td>1.45</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>2.48</td>
<td>2.37</td>
<td>1.89</td>
<td>1.74</td>
<td>1.22</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>2.62</td>
<td>3.25</td>
<td>3.55</td>
<td>3.19</td>
<td>2.04</td>
<td>2.58</td>
<td></td>
</tr>
</tbody>
</table>

Mean: 2.48, Standard error: .21

TABLE 2
Comparison of Mean Whole Mouth Plaque Indices for Control and Test Mouthwash Trials

<table>
<thead>
<tr>
<th>Subject</th>
<th>Active Control</th>
<th>Test</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.39</td>
<td>0.85</td>
<td>1.54</td>
</tr>
<tr>
<td>B</td>
<td>2.24</td>
<td>1.26</td>
<td>0.98</td>
</tr>
<tr>
<td>C</td>
<td>2.65</td>
<td>1.72</td>
<td>0.93</td>
</tr>
<tr>
<td>D</td>
<td>2.38</td>
<td>1.43</td>
<td>0.95</td>
</tr>
<tr>
<td>E</td>
<td>1.82</td>
<td>1.12</td>
<td>0.70</td>
</tr>
<tr>
<td>F</td>
<td>3.37</td>
<td>2.31</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Mean: 2.48, Standard error: .49

RESULTS

There were no signs of mucous membrane change after trial periods. Most of the subjects reported a tingling of the mucous membrane for periods up to 45 minutes after using the test mouthwash. There were occasional comments of a "smoother feeling" of the teeth with the test mouthwash.

Analysis of variance (Table 1) indicated no statistical difference in the plaque indices among the four trial periods of the control series (F = 0.11) or between the two test periods (F = 0.06).

In all subjects the plaque index was less with the test than with the control. Differences between the mean indices of control and test trials ranged from 0.70 to 1.54, with an average reduction for the group of 1.03, which is highly significant (t = 9.04, df = 5) (Table 2).

Low plaque scores, representing little or no plaque, were more frequent after use of the test mouthwash than after the control (Table 3). If, for the purpose of statistical analysis, a score of 0 is given for each surface scored "low" (0 or 1) and a score of 1 for each surface scored "high" (2 or more), by totalling the scores and dividing by the surfaces so scored, a value results which represents the proportion of surfaces in each mouth scored as "high" plaque (2 or more). Comparison of mean values for test and control mouthwash trials scored in this way (Table 3-A) indicate that there was a reduction in "high" scores (2 or more) in test trials which ranged from .09 (9.0%) to .38 (73.1%) with a mean reduction of .32 (42.1%). This difference is highly significant (t = 5.61, df = 5).

Accumulation of plaque was not uniform throughout the mouth and a comparison was made of the distribution of high (2 or more) plaque scores in different areas. Comparisons were made between facial and lingual surfaces; between lingual surfaces of the mandible and maxilla; and between anterior (canine to canine inclusive) and posterior (first bicuspid to second molar inclusive) facial and lingual surfaces, shown in Table 4.

*Highly significant (t=9.04, df=5).

**Percentage difference of the means.
These data were analyzed as described above after assigning a score of 0 to the low plaque scores and 1 to the high plaque scores. In all test periods there were significantly more high plaque scores on facial than on lingual surfaces, and on the mandibular lingual than on the maxillary lingual surfaces. There was a tendency for higher plaque scores to occur on posterior rather than anterior surfaces (facial and lingual); this tendency was more pronounced in the test trials than in the controls.

**DISCUSSION**

A 0.1% aqueous mouthwash of chloromethyl Vitamin C, a cationic surface-active chemical, when employed under the conditions of this study reduced the formation of plaque during a three-day experimental period. Chloromethyl Vitamin C has also been shown to reduce calculus formation in vivo during eight-day and 21-day experimental periods.\(^1\)\(^2\) The reduction in calculus formation demonstrated with Chloromethyl Vitamin C may be related to its effect on plaque. The mechanism whereby it reduces plaque and the duration of its effectiveness have yet to be determined. Research into these questions is being pursued in our laboratory.

The findings regarding the distribution of plaque were interesting. Although the accumulation of plaque was reduced by the test mouthwash the distribution pattern remained the same as in the controls. Plaque tended to accumulate more on facial surfaces than on lingual surfaces, more on the lingual surfaces of the mandible than the maxilla, and more on posterior teeth than on anterior teeth. Subjects in this study did not brush their teeth during the experimental periods. It is therefore not feasible to compare the distribution pattern of plaque accumulation in this study with that reported in other studies\(^10\),\(^11\) where subjects may have employed toothbrushing as a routine for oral hygiene.

**CONCLUSION**

A 0.1% aqueous mouthwash of the chloromethyl analogue of Victamine C produced a statistically significant reduction in the formation of disclosable dental plaque during a three-day experimental period.

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**BIBLIOGRAPHY**
