

Mechanical Devices Versus Antimicrobial Rinses in Plaque and Gingivitis Reduction

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Controlling the severity of gingivitis is an important factor in the etiology and pathogenesis of periodontitis. While all cases of gingivitis do not progress to periodontitis, it is rare for periodontitis not to be preceded by gingivitis. Controlling gingivitis can be accomplished to various degrees by using mechanical cleaning devices that disrupt or remove bacterial plaque and by using chemical agents that retard plaque formation. Although clinical studies report¹⁻⁵ the effectiveness of each of these therapeutic modalities, no study has compared them directly. The present clinical study was undertaken to compare the effectiveness of two interdental, mechanical oral hygiene devices and two antimicrobial oral rinses in reducing plaque and gingivitis levels over a 3-month period.

MATERIALS AND METHODS

Subjects were randomly assigned to one of five test groups that would use either a wooden interdental cleaner (Stim-U-Dent,TM Johnson & Johnson, New Brunswick, New Jersey), a waxed dental floss (Waxed Dental Floss, Johnson & Johnson), an essential oil mouthrinse (ListerineTM Antiseptic, Warner-Lambert Co., Morris Plains, New Jersey), a cetylpyridinium chloride (CPC) mouthrinse (CepacolTM, Merrell Dow Pharmaceuticals Inc., Cincinnati, Ohio), or toothbrushing alone

ABSTRACT—The effectiveness of mechanical oral cleaning and oral antimicrobial rinses was compared for gingivitis and bacterial plaque control in 158 subjects. Teeth were brushed *ad lib* throughout; four of the five groups used either an interdental cleaner, dental floss, an essential oil mouthwash or a cetylpyridinium mouthwash. Gingival bleeding (EIBI), visual inflammation (VGI), and tooth plaque coverage were evaluated at zero, six and 12 weeks of product use. After six weeks, bleeding reduction was 42% greater for the interdental cleaner and 21% greater for the dental floss than for the control. All groups showed a further decrease after 12 weeks, but only the 49% reduction of the interdental cleaner was significantly greater than the control. The rinses showed no more reduction in bleeding sites than the control throughout the study. VGI scores were no different from the control for any of the groups. However, the EIBI proved much more sensitive than the visual method finding three times as many inflamed sites. Plaque was reduced by both antimicrobial rinses 27% more than the control over 12 weeks; the interdental cleaner and dental floss groups showed no significant incremental plaque reductions. The results suggest antimicrobial rinses reduce plaque on visible tooth surfaces, but do not penetrate sufficiently between teeth to affect interdental plaque and thus interdental inflammation. However, by disturbing interdental plaque, both dental floss and the interdental cleaner have little effect on visible tooth surface plaque accumulation, yet produce a significant reduction in gingival inflammation.

as the control. Each product was used according to the manufacturer's directions. All subjects brushed their teeth *ad lib* and no other oral hygiene measures were permitted.

Subjects were scored at baseline, after six weeks, and after 12 weeks of the test. They presented with an overnight accumulation of plaque and were scored by three methods in the following sequence: 1) Löe-Silness Gingival Inflammation Index (VGI)⁶ modified to include visual assessment only; 2) Eastman Interdental Bleeding Index (EIBI)⁷; and 3) the Global Plaque Index.⁴

Statistical analyses were based on the subjects' whole-mouth averages for each type of measurement. For the EIBI, an Analysis of Variance (ANOVA) was calculated and comparisons between test treatments and the control were made with the Dunnett adjusted t-test. For the VGI, an ANOVA technique was also used. For the Global Plaque Scores, whole-mouth averages of the log-transformed scores were calculated before conducting the ANOVA calculation. The results were back-transformed before calculating percent changes from baseline. Separate calculations were made for the 6-week and 12-week data for each test method.

Subject Population

From a population of over 10,000 volunteers, 174 adult subjects were selected who had previously participated in dental clinical studies conducted by the Institutional Service company, Northfield, New Jersey. The subjects qualified for participation in the study on the basis of having at least 20 natural uncrowned teeth, no removable prostheses, no gross oral pathology, and a commitment to adhere to the test protocol. They were also not to have had the dental prophylaxis in the past three months and to be occasional flossers (one to three uses per week). In addition, all

subjects had to have at least ten interdental bleeding sites at the baseline examination as judged by the EIBI scoring system.⁷

RESULTS

Of the 174 subjects who were originally screened for the study, 161 (92%) qualified on the basis of having 10 or more bleeding sites. Eight of the 174 subjects (5%) had one to nine bleeding sites, while only five subjects (3%) had none. Thus, the prevalence of gingival inflammation in this population was 97%. Of the original 161 subjects, 158 completed the entire 12-week test.

Table 1 and Figures 1 and 2 show the data obtained by using the EIBI. After six weeks of using the test products, the subjects who used the interdental cleaner to supplement their brushing regimen showed a 42% reduction in their bleeding index. This was significantly better than the control group. The group using dental floss also had significantly better results than the control, with a 21% reduction. The essential oil rinse group and the (CPC) rinse group were not significantly different from the brushing-only control group and were only slightly different from their original baselines.

At the conclusion of the 12-week study, all groups showed considerable further reduction in the number of bleeding sites, with the control group (toothbrushing only) showing a 29% reduction. Compared to the control group, neither the rinses nor flossing contributed significantly to the reduction of bleeding sites. Only the interdental cleaner was significantly better than the control at the end of the 12-week study.

The data in Table 2 present the results obtained by using the VGI scoring method. The baseline VGI

Table 1
Eastman Interdental Bleeding Index (EIBI) by Treatment at Each Examination Period

Treatment	Week 0 (Baseline)		Week 6				Week 12			
	(N)	EIBI	(N)	EIBI	Difference v Control	Change From Baseline	(N)	EIBI	Difference v Control	Change From Baseline
Interdental Cleaner	(31)	0.62	(31)	0.33*	42%	47%	(31)	0.21*	49%	66%
Dental Floss	(30)	0.62	(30)	0.45**	21%	27%	(30)	0.36	12%	42%
Essential Oil Rinse	(32)	0.60	(32)	0.58	-2%	3%	(32)	0.45	-10%	25%
CPC Rinse	(33)	0.62	(33)	0.59	-4%	5%	(33)	0.45	-10%	27%
Control	(32)	0.58	(31)	0.57	—	2%	(32)	0.41	—	29%
ANOVA p =	—	0.81	—	0.0001	—	—	—	0.0001	—	—

*Significantly different from control at $p = 0.01$ in Dunnett's multiple comparison t-test.

**Significantly different from control at $p = 0.05$ in Dunnett's multiple comparison t-test. Each treatment accompanies brushing.

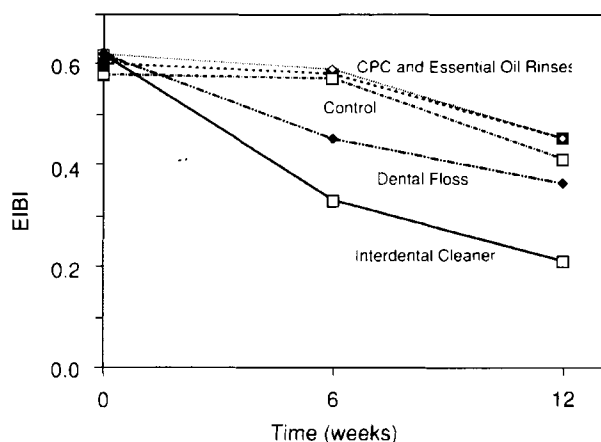


FIG. 1. Eastman Interdental Bleeding Index scores at each examination.

ranged from 0.17 to 0.22, and was reduced to 0.13 to 0.15 at the conclusion of the study. None of the test groups differed significantly from the control group at any time during the study.

The data in Table 3 present the results obtained by using the Global Plaque Index to measure plaque levels. These measurements were taken on subjects with an overnight accumulation of plaque. Only groups who used the two antimicrobial rinses had significantly less plaque than the control group at the conclusion of the 12-week study.

DISCUSSION

The improvement in gingival bleeding scores as evaluated by the EIBI was best for those subjects who included the interdental cleaner along with their normal toothbrushing. In fact, six of the 31 subjects (19%) from this group concluded the study with zero bleeding sites. None of the subjects in the other test groups achieved a zero score. The group using dental floss had the next best score in

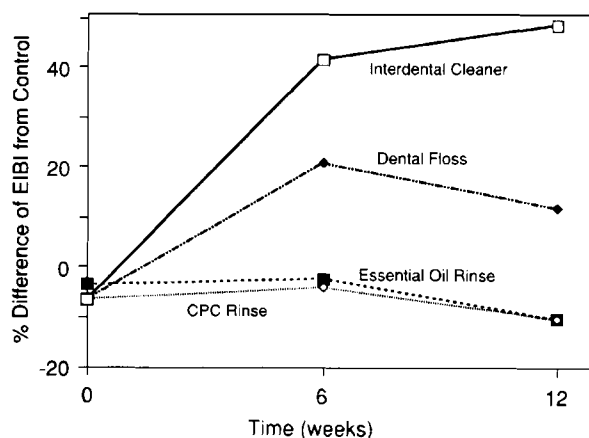


FIG. 2. Performance compared to control at each examination.

reducing bleeding sites, while the antimicrobial rinse groups were not different from the control group. Thus, the use of the essential oil and CPC rinses had no incremental benefit over toothbrushing alone in reducing the number of interdental bleeding sites.

When the modified Löe-Silness GI Index (VGI) was used to measure changes in gingivitis, none of the test groups was significantly different from the control at either the 6-week or 12-week examination. This result was not surprising since the baseline VGI scores were initially low. Thus the potential for a substantial treatment effect was minimized. It should be noted, however, that despite their low VGI scores, all subjects in this study started with at least 10 bleeding sites. The baseline VGI ranged from 0.17 to 0.22, which indicates approximately 20% of the examined surfaces were inflamed. In contrast, the baseline EIBI ranged from 0.58 to 0.62, indicating approximately 60% of the examined sites were inflamed. These observations

Table 2
Visual Gingival Index (VGI) by Treatment at Each Examination Period

Treatment	Week 0 (Baseline)		Week 6				Week 12			
	(N)	GI	(N)	GI	Difference v Control	Change From Baseline	(N)	GI	Difference v Control	Change From Baseline
Interdental Cleaner	(31)	0.17	(31)	0.14	0%	18%	(31)	0.13	13%	24%
Dental Floss	(30)	0.18	(30)	0.15	-7%	17%	(30)	0.13	13%	28%
Essential Oil Rinse	(32)	0.22	(32)	0.18	-29%	18%	(32)	0.13	13%	41%
CPC Rinse	(33)	0.20	(33)	0.15	-7%	25%	(33)	0.13	13%	35%
Control	(32)	0.19	(31)	0.14	—	26%	(32)	0.15	—	21%
ANOVA p =	—	0.74	—	0.59	—	—	—	0.85	—	—

Each treatment accompanies brushing.

Table 3
Geometric Mean of Plaque Coverage (%PQ) by Treatment at Each Examination Period

Treatment	Week 0 (Baseline)		Week 6				Week 12			
	(N)	%PQ	(N)	%PQ	Difference v Control	Change From Baseline	(N)	%PQ	Difference v Control	Change From Baseline
Interdental Cleaner	(31)	12.6	(31)	7.9	0%	37%	(31)	5.8	2%	54%
Dental Floss	(30)	12.2	(30)	7.5	5%	39%	(30)	5.5	7%	55%
Essential Oil Rinse	(32)	11.7	(32)	5.7*	28%	51%	(32)	4.3*	27%	63%
CPC Rinse	(33)	11.7	(33)	6.1	23%	48%	(33)	4.3*	27%	63%
Control	(32)	12.3	(31)	7.9	—	36%	(32)	5.9	—	52%
ANOVA p =	—	0.94	—	0.05	—	—	—	0.04	—	—

*Significantly different from control at $p = 0.01$ in Dunnett's multiple comparison t-test. Each treatment accompanies brushing.

suggest the EIBI method is three times as sensitive and capable of diagnosing significantly more gingival disease than the VGI.

The reduction in tooth surface plaque accumulation was considerable for all test groups and ranged from 36% to 51% at the 6-week examination and 52% to 63% at the 12-week examination. However, at the 6-week examination, only the essential oil rinse group had significantly better results than the control, while at the 12-week examination, only the essential oil and the CPC rinse group were lower in surface plaque accumulations than the control group. In spite of these significant plaque reductions, no significant reduction in the number of bleeding sites was evident for either of these antimicrobial rinse groups. Since neither of these two treatments was more effective than the brushing-only control in reducing gingival bleeding, it appears that the antimicrobial rinses did not alter the interproximal plaque sufficiently to have a clinically detectable effect on gingivitis.

It is interesting to compare these results with similar findings from a study on antimicrobial rinses published in 1986 by Wennström and Lindhe.⁸ In their 4-week study in which the subjects rinsed twice a day with either 0.2% chlorhexidine or 0.01% sanguinarine, the researchers observed significant reductions of supragingival plaque but no changes in gingivitis (bleeding on probing). They concluded that neither rinse product effectively penetrated into the gingival pocket and were therefore unable to affect the severity of gingival inflammation.

CONCLUSION

These results suggest that while antimicrobial rinses can reduce plaque on visible tooth surfaces, they do not penetrate in adequate concentration

between the teeth in order to have an effect on interdental plaque and thus have no effect on interdental gingival inflammation. On the other hand, both floss and interdental cleaners, which mechanically disturb or remove interdental plaque but have little effect on visible tooth surface plaque, produce a significant improvement in interdental gingival inflammation.

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†From the Institutional Service Company, Northfield, New Jersey. The study was conducted at the Institutional Service Company under a grant from Johnson & Johnson Dental Care Company. It was presented at the American Association for Dental for Dental Research Meeting, March 1987.

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