REVIEW ARTICLE

NL Hoenderdos DE Slot S Paraskevas GA Van der Weijden

The efficacy of woodsticks on plaque and gingival inflammation: a systematic review

Authors' affiliations:

N. L. Hoenderdos, D. E. Slot, S. Paraskevas, G. A. Van der Weijden, Department of Periodontology, Academic Centre of Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands

Correspondence to:

N. L. Hoenderdos Academic Center of Dentistry (ACTA) Department of Periodontology Louwesweg 1 1066 EA Amsterdam The Netherlands Tel.: 0031 5188 307/548 Fax: 0031 5188 512 E-mail: N.Hoenderdos@acta.nl

Dates:

Accepted 21 April 2008

To cite this article:

Int J Dent Hygiene 6, 2008; 280–289 Hoenderdos NL, Slot DE, Paraskevas S, Van der Weijden GA. The efficacy of woodsticks on plaque and gingival inflammation: a systematic review.

© 2008 The Authors. Journal compilation © 2008 Blackwell Munksgaard Abstract: Objective: To review the literature on whether a hand-held triangular woodstick, as compared with no adjunct or other interdental cleaning device in addition to daily toothbrushing, can improve clinical parameters of gingival inflammation. Material and Methods: MEDLINE and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched through February 2008 to identify appropriate studies. Plaque and gingivitis were selected as outcome variables. Results: Independent screening of the titles and abstracts of 181 MEDLINE and 65 CENTRAL papers yielded seven publications with eight clinical experiments that met the eligibility criteria. The improvement in gingival health, as observed in seven studies, represents a significant incremental benefit realized by the use of triangular woodsticks. None of the studies that scored plaque demonstrated any significant advantage to the use of woodsticks, as opposed to alternative methods, in gingivitis patients. Conclusion: Evidence from controlled trials, most of which were also randomized, shows that woodsticks do not have an additional effect on visible interdental plaque or gingival index, but do, however, provide an improvement in interdental gingival inflammation by reducing the bleeding tendency.

Key words: bleeding; gingivitis; plaque; systematic review; toothpicks; woodsticks

Introduction

Plaque control through daily oral hygiene is the key to the prevention of gingivitis and periodontitis (1) as it is causally related to the important aetiological factor in these diseases (2–5). Toothbrushing is probably the most important and common oral hygiene practice; however, it does not provide adequate interdental hygiene. This is especialy true in dentitions where proper contact relationships exist between adjacent teeth. In other words, only part of the total circumference of each individual tooth is cleaned by brushing alone. Epidemiology and general clinical experience show that in almost all patients, the interdental areas, especially those in the posterior region, contain accumulations of soft and/or hard deposits (6). Therefore, the aim of modern oral hygiene programmes must be to place a major emphasis on the interdental and aproximal areas of the dentition (7). The most appropriate interdental hygiene aids must be selected for each individual patient, with the choice depending for the most part on the size and shape of the interdental spaces as well as on the morphology of the interdental surfaces of the teeth (8).

Picking at teeth may well be one of humanity's oldest habits, and the woodstick one of the earliest tools. In primitive man, woodsticks were used simply for the removal of an unpleasant subjective sensation. However, the evolution of the primitive woodstick took an alternative pathway in the more acquisitive societies where it became part of a personal care kit along with a depilatory tweezer and an ear wax scoop (9). Originally, dental woodsticks were advocated by the dental profession as 'gum massagers' to be used to massage inflamed gingival tissue in the interdental areas to reduce inflammation and encourage keratinization of the gingival tissue (9).

Woodsticks are designed to allow the mechanical removal of plaque from interdental surfaces. They are fabricated from soft wood to improve adaptation to the interdental space and to prevent injury to the gingiva. Some are hand-held, while others are designed to be mounted on a handle. Woodsticks can only be used effectively where sufficient interdental space is available. They should not be confused with toothpicks, which are meant simply for removing food debris after a meal (8). The round toothpick is too thick and too blunt to reach the lingual half of the tooth when trying to angle it, while the curved surface of the toothpick provides only point contact with the tooth surface. For these reasons, no cleaning is performed lingually when using the round toothpick. The rectangular woodstick is also designed inappropriate for interdental cleaning as the device is too pliable to be able to clean lingually (10). However, a triangular woodstick seems to have the correct shape to fit the interdental space, according to Waerhaug (11).

The tapered form of a triangular woodstick makes it possible for the patient to angle the device interdentally and even clean the lingually localized interdental surfaces (12). From the results of Bergenholtz *et al.* (10), it may be concluded that triangular woodsticks with low surface hardness and high strength values are preferred for interdental cleansing. From studies performed *in vivo* and from autopsy material, it was shown that a triangular pointed woodstick inserted interdentally can maintain a plaque-free region 2–3 mm subgingivally (12). The resilience of the gingival papilla allows cleaning apical to the subgingival margins of fillings (i.e. risk surfaces for recurrent caries). For open interdental spaces, common among adults, woodsticks seem most appropriate (13). In periodontitis patients, the woodstick will depress the papilla which may help in recontouring the interdental tissues and consequently preclude the need for periodontal surgery (14).

Woodsticks have the ability to clean the middle part of the interdental surfaces of teeth in contact; areas that are inaccessible to the toothbrush. They are somewhat difficult to use in the far posterior regions of the jaws because of the lack of accessibility, and as the triangular cross-section must pass into the embrasure at a specific angle (15). Woodsticks can only be used effectively where sufficient interdental space is available. Woodsticks have the advantage of being easy to use and can be used throughout the day without the need for special facilities such as a bathroom or a mirror (9).

So far, no systematic reviews (SRs) are available to confirm the hypothesis that woodsticks are effective interdental devices in reducing the clinical parameters of plaque and gingival inflammation. SRs are considered the gold standard for evidence because their strict protocol reduces bias. These reviews provide a summary of studies that are relevant to a specific research question (16). The goal of this review was to evaluate and summarize the available evidence on the effectiveness of the use of triangular woodsticks, in combination with toothbrushing, in reducing both plaque and the clinical inflammatory symptoms of gingival inflammation.

Materials and Methods

Focused question

For a patient using a toothbrush, can a hand-held triangular woodstick, as compared with no adjunct or another interdental cleaning device, improve the clinical parameters of gingival inflammation?

Search strategy

Two internet sources were selected in the search for papers satisfying the study purpose: The National Library of Medicine, Washington DC (MEDLINE) and the Cochrane Central Register of Controlled Trials (CENTRAL). The searches were performed to be inclusive for any study that evaluated the effect of using woodsticks as an interdental plaque-removing aid.

The databases were searched up to and including February 2008. The following terms were used for both search strategies: <u>Intervention</u>: (Toothpick* OR woodstick* OR wooden interdental cleaner OR wedge stimulator* OR wooden stimulator* OR interdental cleaning devices OR interproximal cleaning devices.)

AND

<u>Outcome</u>: ('Periodontal Diseases' [MeSH] OR gingivitis OR periodontitis OR gingival pocket OR periodontal pocket OR gingival inflammation OR gingival diseases* OR periodontal diseases* OR bleeding on probing OR papillary bleeding index OR gingival bleeding OR bleeding index OR plaque removal OR plaque index OR dental plaque OR plaque OR removal OR interdental plaque OR interproximal plaque OR dental deposit*.)

Eligibility criteria

The eligibility criteria were as follows:

- Randomized controlled clinical trials (RCTs)
- Controlled clinical trials (CCTs)
- Subjects ≥18 years of age
- Subjects in good general health (no systemic disorders)
- Intervention with hand-held triangular woodsticks
- Control group: (no) other interdental cleaning device
- Evaluation parameters: plaque/bleeding/gingivitis
- Conducted in humans

Only papers written in the English language were accepted. Case reports, letters and narrative or historical reviews were excluded from the results of the search. Papers without abstracts but with titles that related to the objectives of this review were included so that the full text could be screened for eligibility.

Screening and selection

The titles and abstracts were screened independently by two reviewers (NLH and GAW). As a second step, full-text papers were identified that fulfilled the eligibility criteria for inclusion according to the study aim. All reference lists of the selected papers were screened for additional papers that might meet the eligibility criteria for this review. Any disagreements between the two reviewers were resolved by discussion.

Assessment of heterogeneity

The heterogeneity of the primary outcome across studies was detailed according to the following factors:

- Study design and evaluation period
- Number, age, range and oral hygiene level of subjects
- Type of intervention
- Oral prophylaxis, oral hygiene instruction/reinforcement during the study
- Smoking status
- Parameters (baseline and end plaque and gingivitis levels)
- Study population characteristics.

Quality assessment

The methodological study quality was evaluated for the following aspects:

- Method of randomization
- Blindness of examiners
- Completeness of follow up

Data extraction

From the selected papers, data were extracted with regard to the effectiveness of self-performed interdental plaque removal using woodsticks in comparison to a control treatment. Mean values and standard deviations (SD) were extracted by authors NLH, DES and GAW.

Data analysis

After a preliminary evaluation of the selected papers, it was found that considerable heterogeneity was present in the study designs, characteristics, outcome variables and results. It was therefore not possible to perform a valid quantitative analysis of the data and subsequent meta-analysis. Instead, a descriptive manner of data presentation was used.

Results

Search results

The MEDLINE search resulted in 181 abstracts and the CEN-TRAL search resulted in 65 abstracts of clinical trials. After screening by title and abstract, 15 papers were selected for full text reading after which 10 papers had to be excluded. A schematic overview of the search and the reasons for rejection are presented in Table 1a and b. Screening of the reference lists of

Table 1. (a) Search results. (b) Reasons for rejection after full reading or for insufficient data presentation (a)

Selection	MEDLINE	Cochrane	Identical
Search	181	65	47
Excluded: titles and abstracts	166	53	35
Selected papers for full reading	15	12	12
Excluded from selection after full reading (Table 1b)	1	0	
Included from reference lists		3	
Subfinal selection	8	3	
Excluded for insufficient data presentation (Table 1b)		1	
Final selection of papers for data extraction	-	7	
Total number of experiments for data extraction	ł	3	

(b) Author(s) (year) Reason for rejection Bergenholtz et al. No control group (1980)(18)Glavind et al. (1981) (19) Woodsticks as part of intervention of three oral hygiene regimen in periodontitis patients Glavind et al. (1983) (20) No specific results on woodsticks Kallio et al. (1997) (21) Only self-assessments Lewis et al. (2004) (22) Woodstick inserted in a holder Loos et al. (1988) (23) No specific results of the use of woodsticks on periodontal disease Schmid et al. (1976) (24) Woodstick inserted in a holder Walsh and Heckman No triangular woodstick used (1985) (25) Walsh et al. (1985) (26) No triangular woodstick used Gjermo and Flötra No quantitative data presentation (1969) (15)

the five selected studies resulted in an additional three papers. The eight selected papers were read in detail by two reviewers. One paper (15) had to be excluded because of insufficient data presentation. Finally, seven papers with eight experiments were processed, as Gjermo and Flötra (32) presented two useful clinical trials in one publication.

Assessment of heterogeneity

An overview of the papers and study characteristics are presented in Table 2.

Study design and evaluation period

Six experiments were RCTs (#II, III, V, VIa, VIb, VII) and two were CCTs (#I, IV). Of these, four had a cross-over design (#II, III, Via,VII), while the other four had a parallel design (#I, IV, V, VIb). The evaluation period of the selected studies varied from 3 weeks to 3½ months.

Number, age, range and oral hygiene level of subjects

The total number of participants varied between studies (10–174). The age of study participants varied from 18 to 81 years. One study (#II) included partially edentulous subjects. Three studies (#III, VIb, VII) used dental students and patients treated for periodontitis. Studies II, III, IV and VII selected subjects who either used no adjunct or only occasionally used interdental cleaning devices (such as dental floss or woodsticks) before the start of the study.

Type of intervention

In all studies, the interventions were performed in conjunction with unsupervised manual toothbrushing. Five studies compared woodsticks with dental floss. Two studies evaluated the effectiveness of the use of woodsticks in comparison to interdental brushes. In the identified papers, different brands of woodsticks were used as test products (Stim-U-Dent[®]; Johnson & Johnson: New Jersey, USA, Jordan[®]: Oslo, Norway and Inter-Dens[®]: Sydney, Australia).

Oral prophylaxis and oral hygiene instruction/reinforcement

In study VII, individual instructions were given according to the manufacturer's instructions or through an audio-visual programme (study #II). The products were used by the participants at home without supervision. In studies with a tooth-brushing group as a control, no instructions were given concerning toothbrushing. Before or after the initial scoring, oral prophylaxis was given in five out of eight experiments. Oral prophylaxis included supra- and subgingival scaling (#II, III, IV, VIb, VII) and for study II polishing (with polishing paste) until the over-hanging margins of restorations were removed. In study II oral prophylaxis was given before each leg of the cross-over design.

Parameters (baseline and end plaque and gingivitis levels)

Assessment of the presence of plaque and bleeding is reported in Plaque Indexes and Bleeding Indexes. Three different indices were used for scoring plaque, the Plaque Index of Silness and Loe (34) and Löe (35) (II, III, Via, VIb), the Global Plaque Index (31) (#V) and the Wolffe (33) Index (#VII). Two indices for scoring gingival inflammation were used, the Eastman Interdental Bleeding Index (36) (EIBI) (#I, IV, V) and the Visual Gingival Index (VGI) (37) (#V).

No	Author(s) and year	Title	Design and evaluation period	Number of subjects, gender, age	Comparison	Conclusion
_	Barton and Abelson (1987) (27)	The clinical efficacy of wooden interdental cleaners in gingivitis reduction	CCT, parallel, 3 months	81 subjects, aged 21+ years	Toothbrush only	Woodsticks in addition to toothbrushing results in a highly significant improvement in reducing gingival inflammation
=	Bassiouny and Grant (1981) (28)	Oral hygiene for the partially edentulous	RCT, cross-over, 2 months	19 subjects, 11 <i>d</i> ; mean age, 26 years; range, 21–42 years; 8♀; mean age, 23 years; range, 18–28 years	Toothbrush only Interdental brush [*]	The woodsticks were more effective than the aproximal brush on the aproximal surfaces of teeth in contact
≡	Bergenholtz and Brithon (1980) (29)	Plaque removal by dental floss or toothpicks. An intra- individual comparative study	RCT, Cross-over, 3½ months	10 subjects, 4♂, 6♀; mean age, 49 years; range, 21–69 years	Dental floss Waxed⁺, Unwaxed⁺, Superfloss⁺	In general, dental floss removes significant more plaque than triangular toothpicks, especially on lingual axial surfaces
≥	Caton <i>et al.</i> (1993) (30)	Comparison between mechanical cleaning and an antimicrobial rinse for the treatment and prevention of interdental gingivitis	CCT, Parallel, 3 months	92 subjects, 92 <i>3</i> ; mean age, 23.3 years; range, 18–28 years	Toothbrush only	An antimicrobial mouthrinse used in conjunction with toothbrushing is not effective when compared with mechanical interdental cleaning at preventing or treating interdental gingival inflammation
>	Finkelstein and Grossman (1980) (31)	Mechanical devices versus antimicrobial rinses in plaque and gingivitis reduction	RCT, Parallel, 3 months	161 subjects	Toothbrush only Dental floss [†]	The woodsticks and dental floss groups showed no significant incremental plaque reductions. The improvement in gingival bleeding scores as evaluated by the EIBI was the best for those subjects who included the woodsticks in addition to toothbrushing
Vla*	Gjermo and Flötra (1970) <i>Part 1</i> (32)	The effect of different methods of interdental cleaning	RCT, Cross-over, 2 months	24 subjects, 15♂ 9♀; mean age, 23 years	Toothbrush only Dental floss [†]	The use of a woodstick did not reduce the amount of plaque as compared with the control group
VIb*	Gjermo and Flötra (1970) <i>Part 3</i> (32)	The effect of different methods of interdental cleaning	RCT, Parallel, 4 weeks	16 subjects; mean age, 53 years; range, 27–81 years	Dental floss⁺, Interdental brush [†]	Wide interdental spaces are most efficiently cleaned with the interdental brush
=	Wolffe (1976) (33)	An evaluation of proximal surface cleansing agents	RCT, Cross-over, 3 weeks	35 subjects, 16♂ 19♀, range 19–54	Dental floss [†]	There was no difference in the effectiveness
RCT, *This †Usec	randomized controlled paper contains two ext t as an adjunct to tootr	clinical trial; CCT, controlled clinical t oeriments. hbrushing.	trial; EIBI, Eastman In	iterdental Bleeding Index.		

Table 2. Overview of the studies processed for data extraction

Study population characteristics and smoking status

One study (#II) did not mention anything about the gingival health. Subjects in studies #III and VII had previously received periodontal treatment. In studies #I, III and VIa, subjects were not allowed to have clinical signs of advanced periodontal disease. As an inclusion criterion in studies #I, IV and V, subjects had to have a minimum of 8–10 bleeding sites as judged by the EIBI scoring system. Study #VII mentioned that there had to be sufficient space available between teeth for woodsticks to be passed easily from the facial to the lingual aspects. In study #VIb they only included subjects with wideopen interdental spaces. None of the studies provided information on the smoking habits of the participants.

Quality assessment

Method of randomization

All studies were randomized except #I and IV. Subjects in study #IV were stratified according to the number of gingival bleeding sites (EIBI). The procedures for allocation concealment were not described.

Blindness of examiners

The examiners in five studies were blinded to the intervention assignment during examination. Studies #I, IV and V did not mention blinding of the examiner.

Completeness of follow-up

All subjects in studies #VII completed the trial. Studies #I and #V mentioned that three subjects did not complete the total experiment. Data from these withdrawn subjects were not used for the calculations presented in the tables. The data presented in study #VIa concerning the number of subjects did not correspond with the number of subjects in the tables. Four studies did not mention completeness of follow-up at all (#II, III, IV, VIb).

Study outcomes

Comparison baseline to end (within groups)

Table 3a and b show the results of the data extraction. One study (#II) showed statistically significant differences among all three regimens for plaque scores, including woodsticks.

Gjermo and Flötra (32) (#VIb) only found this for the interdental brush. For the bleeding index measured by EIBI (36), one study (#I) showed that both the woodstick group and the brushing only control significantly reduced bleeding as compared with baseline. Caton *et al.* (30) (IV) observed a significant reduction exclusively with woodsticks. No data were offered for changes of the gingival index from baseline to end (#V).

Comparison between groups

Table 4 summarizes differences between woodsticks and the different comparisons. Six studies (#II, III, V, VIa, VIb, VII) provided data with respect to plaque scores. Three out of these six papers (#II, V, VIa) compared the use of woodsticks in combination with toothbrushing to toothbrushing only. No statistically significant difference was observed (Table 3a). In five studies, the additional use of woodsticks was compared with dental floss (#III, V, VIa, VIb, VII). Only one study (#III) showed a significant difference between these two interdental oral hygiene products, although this was in favour of the dental floss. Two studies (#II, VIb) compared the additional use of woodsticks to interdental brushes. Study #VIb showed that interdental brushes were significantly more effective in the removal of plaque (Table 3a). The other study (#II) showed a discrepancy between the text and data. Data presented in the table were assumed to be correct, although no statistical information could be extracted.

Three studies (#I, IV, V) provided data on gingival inflammation using bleeding scores as the assessment parameter (Table 3b). In comparison to brushing alone, all studies showed that woodsticks provided a significant additional effect on the reduction of bleeding scores. Only one study (#V) compared floss and woodsticks with respect to bleeding scores, but it was unclear if there was a difference. Study #V also provided data on the visual signs of inflammation (37) (VGI). When woodsticks were compared with brushing only and to dental floss, there were no significant differences.

Discussion

Epidemiological surveys have indicated that bacterial plaque is the primary aetiological factor in gingival inflammation, which over time may progress to periodontal disease (9). The role of bacterial plaque has been further corroborated by CCTs that have shown that the prevalence and severity of gingivitis can be reduced considerably by improving oral

Table 3. (a) Study results plaque index. (b) Study results mean bleeding scores

(a)

No.	Intervention/groups	Index	Baseline	End	Increment
	Woodstick Toothbrush only Interdental brush	Silness and Löe (34) mean (SD)	Θ x 1.88 (0.25)	1.42 (0.27)* 1.48 (0.32)* 1.38 (0.29)*	$0.46^{\diamond} \ 0.4^{\diamond} \ 0.5^{\diamond}$
	Woodstick Waxed nylon floss Unwaxed nylon floss Superfloss	Löe (35) sum	Θ	152 171 120° 133°	
V	Woodstick Toothbrush only Dental floss	Finkelstein and Grossman (31) mean	12.6% 12.3% 12.2%	5.8% 5.9% 5.5%	54% 52% 55%
Vla	Woodstick Toothbrush only Dental floss	Löe (35) mean	<u>∓</u> 0.88	0.83 0.86 0.53	$0.05^{\diamond} \\ 0.02^{\diamond} \\ 0.35^{\diamond}$
VIb	Woodstick Dental floss Interdental brush	Silness and Löe (34)	Θ	0.92 0.95 0.64*□	$0.92^{\diamond} \ 0.95^{\diamond} \ 0.64^{\diamond}$
VII	Woodstick Dental floss	Wolffe (33)	Θ	2.11 (53% [◇]) 2.04 (51% [◇])	2.11 [◇] 2.04 [◇]
(b)					
No.	Intervention/groups	Index	Baseline	End	Increment
l	Woodstick Toothbrush only	EIBI (37)	0.739 0.695	0.353* 0.634* [‡]	-52.2% -8.8%
IV	Woodstick Toothbrush only	EIBI (37)	56.09% 47.50% [⊕]	5.70%* 40.46% [‡]	50.39% [◇] 7.04% [◇]
V	Woodstick Toothbrush only Dental floss	EIBI (37)	0.62 0.58 0.62	0.21 0.41 [‡] 0.36	66% 29% 42%

EIBI, Eastman Interdental Bleeding Index.

⁹Baseline oral prophylaxis.

[◊]Calculated by the authors.

*Significant change from baseline, P < 0.05.

Significantly more effective than triangular woodsticks, P < 0.05.

[‡]Significantly less effective than triangular woodsticks, P < 0.05.

hygiene (17). The removal of microbial deposits from the tooth surface has consequently become the primary objective for the control and prevention of gingivitis. Furthermore, it has been convincingly demonstrated that gingivitis is the most frequent and severest of pathological conditions in the interdental areas (30). Therefore, the removal of plaque from interdental surfaces remains a continuing and valid objective for patients (8). A common problem with all interdental cleaning aids is patient dexterity and motivation (8). A Swedish national dental survey showed that approximately 46% of adults use woodsticks sporadically and only 12% use woodsticks daily. On the other hand, dental floss is used occasionally by 12% of adults and daily by

only 2%. In other words, adults use woodsticks as an oral hygiene aid four to six times more frequently than dental floss (39).

How effective is the woodstick in maintaining oral health? Does it offer any particular advantage over flossing or other forms of interdental cleaning? It is not difficult to find literature to support either positive or negative positions on the value of interdental cleaning *per se* in maintaining periodontal health (38). The present SR was therefore initiated to systemically evaluate the existing literature with respect to the efficacy of woodsticks. A summary of the results in Table 3 shows that the effect on plaque is negligible. This means that removal of visible plaque from the interdental Table 4. Overview of the results for woodsticks in comparison with the other intervention

No.	Author(s)	Plaque Score	Bleeding Score	Gingival Index	Comparison
l IV V Vla	Barton and Abelson (27) Bassiouny and Grant (28) Caton <i>et al.</i> (30) Finkelstein and Grossman (31) Gjermo and Flötra (32, Part 1)	0 0 0 0	+ + 	□ □ 0	Toothbrush only Toothbrush only Toothbrush only Toothbrush only Toothbrush only
III V Vla Vlb VII	Bergenholtz and Brithon (29) Finkelstein and Grossman (31) Gjermo and Flötra (32, Part 1) Gjermo and Flötra (32, Part 3) Wolffe (33)	- 0 0 0	□ ? □ □	0 0 0	Dental floss Dental floss Dental floss Dental floss Dental floss
ll Vlb	Bassiouny and Grant (28) Gjermo and Flötra (32, Part 3)	?			Interdental brush Interdental brush

+ A significant difference in favour of the woodsticks.

- A significant difference in favour of the comparison method.

0 No significant difference.

□ No data evaluated.

? Not possible to extract these data based on the available text and tables.

surface after the use of a toothbrush is not improved by a woodstick nor is a woodstick as effective as dental floss. Utilizing woodsticks in the interdental region was, however, correlated with a significant reduction of interdental gingival bleeding (40). This in itself was surprising, as a positive correlation between dental plaque and gingivitis is well-documented and the correlation of the bleeding index with plaque in natural gingivitis is strong (41). Lie *et al.* (42) observed a correlation of 0.66 of bleeding with plaque in patients with relatively healthy gingiva. Therapy aimed at the control of bacterial plaque reduces or eliminates gingival bleeding (2). One would therefore assume that an effect on the bleeding scores would be preceded by a reduction in the plaque index.

The absence of this correlation has been described before. Barendregt et al. (41) point out that the absence of a correlation between plaque and bleeding indicates that care should be taken when testing therapeutic products. This underlines the importance of looking not only at plaque but also at the bleeding score, when one wants to evaluate the anti-gingivitis potential of a therapeutic product. One may speculate about the reason behind this absence of correlation. A series of histological investigations in periodontitis patients has shown that the papillary area having the greatest inflammation corresponds to the middle of the interdental tissue. It is difficult to clinically assess the mid-interdental area as it is usually not available for direct visualization (25). Also, when they are used in a healthy dentition, woodsticks depress the gingivae by up to 2 mm and therefore clean part of the subgingival area. Therefore woodsticks may specifically remove subgingivally located interdental plaque that is not visible, and therefore, not evaluated by the plaque index. This physical action of the woodsticks in the interdental area may produce a clear beneficial effect on interdental gingival inflammation (43).

The available studies from the present review show that changes in gingival inflammation as assessed by the Gingival Index are not as apparent as bleeding as an indicator of disease. Numerous studies have shown that sulcular bleeding is a very sensitive indicator of early gingival inflammation. Muhlemann and Son (44) demonstrated that bleeding upon probing of the sulcus represents the first clinical sign of gingivitis, preceding any visible colour change or edematous swelling (29). Studies #II, V, VI and VII used the EIBI to evaluate the effect of oral hygiene interventions by measuring bleeding of the interdental papilla upon insertion of a woodstick. In three of these studies, this resulted in an improvement of the incidence of gingival bleeding. The provocations 'bleeding upon probing of the gingival margin' and 'bleeding following insertion of a woodstick' are carried out in an entirely different manner. However, the ability of both of these methods to assess the level of gingival inflammation appears to be comparable (41).

Bleeding can also be used to increase patient motivation and awareness of their gingival health. Several studies have shown the clinical effectiveness of gingival self-assessment (45–47). The presence of bleeding represents immediate feedback in relation to the level of gingival health. The dentist or dental hygienist can also easily demonstrate the gingival condition to the patient by using the Interdental Bleeding Index for this obvious clinical manifestation. This monitoring device may encourage patients to include woodsticks as part of their own oral hygiene regimen (29). In conclusion, this review examined the effect of triangular woodsticks as an adjunct to toothbrushing. The evidence from CCTs shows that woodsticks do not have an additional effect on visible interdental plaque, but do, however, provide an improvement in interdental gingival inflammation.

Acknowledgements

Thanks to Kim Geerlings for help in initiating this project. Special thanks to my colleagues, Paula Versteeg and Martijn Rosema, for there support in continuing this important work.

References

- 1 Axelsson P. Preventive Materials, Methods, and Programs. Carol Stream, IL, USA, Quintessence Publishing Co, Inc, 2004.
- 2 Löe H, Theilade E, Jensen SB. Experimental gingivitis in man. *J Periodontol* 1965; **36:** 177–187.
- 3 Mandel ID. Dental plaque: nature, formation and effects. J Periodontol 1966; 37: 357–367.
- 4 Socransky SS. Relationship of bacteria to the etiology of periodontal disease. J Dent Res 1970; 49: 203–222.
- 5 Timmerman MF, van der Weijden GA. Risk factors for periodontitis. Review. Int J Dent Hyg 2006; 4: 2–7.
- 6 Cumming BR, Löe H. Consistency of plaque distribution in individuals without special home care instruction. J Periodontol Res 1973; 8: 94–100.
- 7 Löe H. *Half a Century of Plaque Removal, What's Next?* Millennium Lecture. EuroPerio 2000 London, The Parthenon Publishing Group, 2002.
- 8 Warren PR, Chater BV. An overview of established interdental cleaning methods. *J Clin Dent* 1996; **7:** 65–69.
- 9 Galgut PN. The need for interdental cleaning. *Dent Health* 1991; **30:** 8–11.
- 10 Bergenholtz A, Björne A, Vikström B. The plaque-removing ability of some common interdental aids. An intra-individual study. *J Clin Periodontol* 1974; 1: 160–165.
- 11 Waerhaug J. (1959) Periodontittprofylakse. Nordisk Klinisk Odontologi, 14/II, 1-22.
- 12 Morch T, Waerhaug J. Quantitative evaluation of the effect of toothbrushing and toothpicking. J Periodontol 1956; 27(3): 183–190.
- 13 Lang NP, Karring T. Proceedings of the 1st European Workshop on Periodontology, Thurgau Switzerland. Quintessence, 1994. Axelsson P. Mechanical Plaque Control. p225.
- 14 Bear PN, Morris ML. *Textbook of Periodontics*. Philadelphia, USA, JB Lippincott Company, 1977; p. 159.
- 15 Gjermo P, Flötra L. The plaque removing effect of dental floss and toothpick. A group-comparison study. J Periodontol Res 1969; 4: 170.
- 16 Newman MG, Takei H, Klokkevold R, Carranza FA. *Carranza's Clinical Periodontology*, 10th edn. St. Louis Missouri, USA, Saunders, 2006.
- 17 Axelsson P, Nyström B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease

- Bergenholtz A, Björne A, Glantz PO, Vikström B. Plaque removal by various triangular toothpicks. *J Clin Periodontol* 1980; 7: 121–128.
- 19 Glavind L, Zeuner E, Attström R. Oral hygiene instruction of adults by means of self-instructional manual. J Clin Periodontol 1981; 8: 165–176.
- 20 Glavind L, Zeuner E, Attström R. Evaluation of various feedback mechanisms in relation to compliance by adult patients with oral home care instructions. *J Clin Periodontol* 1983; **10**: 57–68.
- 21 Kallio P, Uutela A, Nordblad A, Alvesalo I, Murtomaa H, Croucher R. Self-assessed bleeding and plaque as methods for improving gingival health in adolescents. *Int Dent J* 1997; **47**: 205–212.
- 22 Lewis MW, Holder-Ballard C, Selders RJ Jr, Scarbecz M, Johnson HG, Turner EW. Comparison of the use of a toothpick holder to dental floss in improvement of gingival health in humans. *J Periodontol* 2004; **75**: 551–556.
- 23 Loos B, Claffey N, Crigger M. Effects of oral hygiene measures on clinical and microbiological parameters of periodontal disease. *J Clin Periodontol* 1988; 15: 211–216.
- 24 Schmid MO, Balmelli OP, Saxer UP. Plaque removing effect of a toothbrush, dental floss and a toothpick. *J Clin Periodontol* 1976; 3: 157–165.
- 25 Walsh MM, Heckman BL. Interproximal subgingival cleaning by dental floss and the toothpick. *Dent Hyg (Chic)* 1985; **59:** 464– 467.
- 26 Walsh MM, Heckman BH, Moreau-Diettinger R. Use of gingival bleeding of reinforcement of oral home care behavior. *Community Dent Oral Epidemiol* 1985; **13**: 133–135.
- 27 Barton J, Abelson D. (1987) The clinical efficacy of wooden interdental cleaners in gingivitis reduction. *Clin Prev Dent* 1987; 9: 17– 20.
- 28 Bassiouny MA, Grant AA. Oral hygiene for the partially edentulous. J Periodontol 1981; 52: 214–218.
- 29 Bergenholtz A, Brithon J. Plaque removal by dental floss or toothpicks. An intra- individual comparative study. J Clin Periodontol 1980; 7: 516–524.
- 30 Caton JG, Blieden TM, Lowenguth RA *et al.* Comparison between mechanical cleaning and an antimicrobial rinse for the treatment and prevention of interdental gingivitis. *J Clin Periodontol* 1993; 20: 172–178.
- 31 Finkelstein P, Grossman E. The clinical quantitative assessment of the mechanical cleaning efficiency of toothbrushes. *Clin Prev Dent* 1984; 6: 7–12.
- 32 Gjermo P, Flötra L. The effect of different methods of interdental cleaning. *J Periodontol Res* 1970; **5:** 230–236.
- 33 Wolffe GN. An evaluation of proximal surface cleansing agents. J Clin Periodontol 1976; 3: 148–156.
- 34 Silness J, Löe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and and periodontal condition. Acta Odontol Scand 1964; 22: 121.
- 35 Löe H. The Gingival Index, the Plaque Index and the Retention Index System. J Periodontol 1967; 38: 610–616.
- 36 Caton J, Polson A. The interdental bleeding index: a simplified procedure for monitoring gingival health. *Compend Contin Educ Dent* 1985; 6: 88–92.
- 37 Löe H, Silness J. Periodontal disease in pregnancy I. Acta Odontol Scand 1963; 21: 533–551.
- 38 Mandel ID. Why pick on teeth? J Am Dent Assoc 1990; 121: 129-132.

- 39 Häkansson J. Dental Care Habits. Attitudes Towards Dental Health and Dental Status Among 20–60 years Old Individuals in Sweden. Thesis. Sweden, University of Lund, 1978.
- 40 Bouwsma O, Caton J, Polson A, Espeland M. Effect of personal oral hygiene on bleeding interdental gingiva. Histologic changes. *J Periodontol* 1988; **59**: 80–86.
- 41 Barendregt DS, Timmerman MF, van der Velden U, Van der Weijden GA. Comparison of the bleeding on marginal probing index and the Eastman interdental bleeding index as indicators of gingivitis. J Clin Periodontol 2002; 29: 195–200.
- 42 Lie MA, Timmerman MF, van der Velden U, van der Weijden GA. Evaluation of 2 methods to assess gingival bleeding in smokers and non-smokers in natural and experimental gingivitis. *J Clin Periodontol* 1998; **25**: 695–700.

- 43 Finkelstein P, Yost KG, Grossman E. Mechanical devices versus antimicrobial rinses in plaque and gingivitis reduction. *Clin Prev Dent* 1990; 12: 8–11.
- 44 Muhlemann HR, Son S. Gingival sulcus bleeding a leading symptom in initial gingivitis. *Helv Odontol Acta* 1971; **15:** 107–113.
- 45 Kallio P, Ainamo J, Dusadeepan A. Self-assessment of gingival bleeding. *Int Dent J* 1990; **40**: 231–236.
- 46 Kallio P, Uutela A, Nordblad A, Alvesalo I, Murtomaa H, Croucher R. Self-assessed bleeding and plaque as methods for improving gingival health in adolescents. *Int Dent J* 1997; 47: 205–212.
- 47 Walsh MM, Heckman BH, Moreau-Diettinger R. Use of gingival bleeding of reinforcement of oral home care behavior. *Community Dent Oral Epidemiol* 1985; **13**: 133–135.

Copyright of International Journal of Dental Hygiene is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.