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# The long-term effect of an oscillating/rotating electric toothbrush on gingivitis

## An 8-month clinical study

**G. A. van der Weijden, M. F. Timmerman, E. Reijerse, M. M. Danser, M. S. Mantel, A. Nijboer and U. van der Velden**

Department of Periodontology, ACTA, Academic Centre for Dentistry Amsterdam, The Netherlands

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*Abstract.* The purpose of this study was to evaluate the safety and efficacy of the Braun Plak Control® for the removal of supragingival plaque and improving gingival health in a long-term clinical trial, and to compare it to a regular manual toothbrush. Assessed were plaque accumulation, amount of gingival inflammation, gingival bleeding on probing, and calculus. In total, 77 young individuals were selected on the basis of having 'moderate gingivitis'. They were monitored over 8 months and divided among 2 groups; a control group that used a manual toothbrush and a test group that used the Braun Plak Control. The clinical assessments were repeated after 1, 2, 5, and 8 months. At baseline, subjects were handed their assigned toothbrushes together with written oral hygiene instructions. They were instructed to brush for at least 2 min. 1 month after baseline examinations, all subjects received a professional prophylaxis and oral hygiene instruction from an experienced dental hygienist. Plaque removal was reinforced at the 2- and 5-month examination. In conclusion, results indicate that the Braun Plak Control is a safe and efficient home care device. At the end of this trial, this electric toothbrush proved to be more effective than a regular manual toothbrush.

Key words: electric toothbrush; plaque; bleeding, gingivitis.

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Since Löe's 1965 experimental gingivitis study, thorough plaque control has been considered essential to control and prevent gingival and periodontal disease. Undisturbed supragingival plaque accumulation may lead to the development of gingivitis. Some of these gingivitis lesions will eventually convert into destructive periodontal disease and therefore regular removal of supragingival plaque is important in maintaining periodontal health. (review, Kristoffersen & Meyer, 1983).

Toothbrushing is the most common method of controlling dental plaque. Other aids, such as interdental cleansers (dental floss, tape, toothpicks, interdental brushes) and oral irrigation devices are also used, but much less commonly. These mechanical cleansing procedures are efficient, provided the method used is sufficiently thorough and performed regularly. However, the maintenance of satisfactory standards of oral hygiene for a long period of time by mechanical tooth cleaning measures is laborious (Wennström 1988).

Recently, BRAUN developed a new type of electric toothbrush with a mode of action that resembles that of a rotary instrument used professionally in the cleaning of the teeth; the Braun Plak Control®. In 2 previous short-term clinical trials, we have found this electric toothbrush to be more effective for supragingival plaque removal than a regular manual toothbrush (Van der Weijden et al. 1993 a,b). Ainamo et al. (1991) showed in a 4-week, triple cross-over study, that the Braun Plak Control was more effective in reducing gingivitis than a conventional electric toothbrush and manual toothbrush. However, these short-term effects on plaque removal and gingivitis only provide an indication of the potential capacity of this electric toothbrush. The long-term effectiveness is not known. The purpose of this single (examiner) blind, randomized, 8-month study was to evaluate the safety and efficacy of the Braun Plak Control regarding removal of supragingival plaque and reducing gingivitis compared to a manual toothbrush (Butler® GUM 311) in a long-term clinical trial.

### Material and methods

*Subjects*

For this study, 87 volunteers (students

from the Free University and University of Amsterdam, with no connection to the Dental Faculty) were selected on the basis of having moderate gingival inflammation. Moderate gingivitis was defined as subjects having at least 35% of the test-sites showing bleeding on probing and an MGI (Lobene et al. 1986) of at least 1. No subjects were allowed with sites of either probing pocket depth $\geqslant 5$ mm or attachment loss of $\geqslant 2$ mm (apart from gingival recession). No previous experience with the use of an electric toothbrush was permitted in the group under examination. Furthermore, a minimum of 24 teeth had to be present.

Subjects were excluded if they had orthodontic bands on the maxillary and/or mandibullary teeth. They were also excluded if they had serious medical problems or if they were using medications that might interfere with the outcome of the study (e.g., antibiotics).

After selection, the purpose, procedures and duration of the study was explained to participants eligible for the study. They were asked to sign an informed consent and to fill out a medical questionnaire.

*Study design* (Fig. 1)
At baseline, the participants were scored using a 'half-mouth' design. Either the 1st and 3rd or 2nd and 4th quadrant were scored in a randomized order. The subjects were randomly divided among 2 experimental groups.

Each group of subjects received either a Butler GUM 311 ($N=43$) or Braun Plak Control ($N=44$). Braun users were advised to read and follow the manufacturer's instructions carefully. Manual brushers were supplied with an oral hygiene instruction brochure (as promoted by the Dutch Society of Periodontology). All the participants were asked to brush for at least 2 min and to refrain from using any other toothbrushes during the test period. In order to keep track of the brushing time, manual brushers were supplied with a 2-min hourglass. Braun users were told to pay attention to the timing device which was incorporated in the handpiece. No further instructions regarding mechanical plaque control measures or information regarding etiology and pathogenesis of periodontal disease were given to the patients throughout this 1st month of the study.

At the end of this 1-month period, the same clinical indices as at baseline were recorded. All participants were then instructed thoroughly by a dental hygienist in oral hygiene using the assigned toothbrushes. In addition, they all received a professional oral prophylaxis.

2, 5 and 8 months after baseline, the recording of all clinical indices was repeated. Oral hygiene was reinforced at 2 and 5 months. At each assessment, the participant was supplied with sufficient brushes/brushheads and a standard toothpaste – Zendium® (RDA $60 \pm 10$).

Participants were carefully instructed to brush their teeth approximately 3 h before, but not within 1 h prior to each examination appointment.

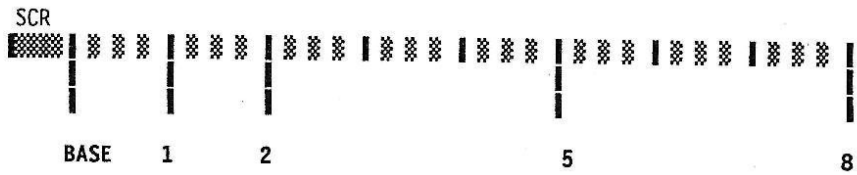
*Clinical examination*
At each assessment, hard and soft oral tissues (e.g., gingival abrasion) were examined for changes due to brushing with either toothbrush. The following indices were assessed in the order as listed, on the vestibular, mesio-vestibular, disto-vestibular and lingual surfaces:
calculus
Volpe et al. (1965)
plaque
Silness & Löe, (1964)
visual inflammation
modified gingival index (Lobene et al. 1986)
bleeding
plaque
modified Quigley & Hein plaque index, vestibular surface only (Turesky et al. 1970)

*Assessment of bleeding*
The gingivae was lightly dried with compressed air. The probe was inserted into the gingival crevice to a depth of approximately 2 mm or until slight resistance was felt. The probe was held at an angle of approximaely 60° to the longitudinal axis of the tooth after which the probe was drawn gently along the marginal gingiva in contact with the soft tissue wall. Minimal axial force was used to avoid undue penetration in the tissues. The probe was moved with a continuous motion along the entrance of the sulcus into the next interproximal area.

The number of gingival units which bled upon probing were recorded (scores 0, 1 and 2) giving non-bleeding sites a (0) and bleeding sites a (1) 'pin prick' and (2) 'excess'. Bleeding was scored within 30 s after probing. For each subject, the number of bleeding points elicited was totalled and divied by the units probed.

*Examination procedure*
All examination procedures were performed under the same conditions by one and the same clinical investigator (ER), whereas 4 other persons were responsible for the professional tooth cleaning and instructions. At each clinical examination, all subjects were reminded by the dental assistant, who recorded the clinical indices, not to reveal their group identity to the clinical examiner. Therefore, in the course of the experiment, the examiner was unaware of the brush type used by the subject. Records of previous examinations were not available to the examiner at the time of re-examination.

*Oral hygiene instruction*
This was given by an experienced dental hygienist, consisting of verbal explanation, followed by demonstration and practice in the mouth with the aid of a mirror. The disclosed plaque was shown to the subjects and individual instructions were given in removal of this remaining plaque with either the manual brush or the Braun Plak Control. Use




SCR: screening of the participants
Base: baseline measurements; distribution of the assigned brushes, written instructions only
1: 1-month evaluation; professional prophylaxis and oral hygiene instruction with the assigned toothbrushes
2: 2-month evaluation; oral hygiene reinforcement
5: 5-month evaluation; oral hygiene reinforcement
8: end-trial (8-month) evaluation

*Fig. 1.* Outline of this study.

of the Braun Plak Control was demonstrated according to the manufacturer's instructions. Patients in the control group were instructed according to the modified 'Bass' technique. It was stressed that a brushing time of at least 2 min should be used. No instructions regarding interdental cleaning were given.

*Questionnaire*

At the end of the study, all subjects were asked to fill out a questionnaire. This included questions concerning interdental cleaning and subjects being either left- or right-handed.

### Statistical Analysis

The mean plaque, gingivitis and bleeding indices were calculated for each individual by computer, using the VU-STAT package. For statistical analysis, the SPSS/PC+ statistical package for IBM PC was used. First the baseline data for the 2 groups were compared using a Mann Whitney *U*-test. Scores were calculated for the overall plaque index (6 surfaces per tooth) and for 4 assessment-site surfaces: vestibular, lingual, interproximal-vestibular, interproximal-lingual, and 3 regions of the mouth: front, premolars and molars. The front section consisted of the central and lateral incisor and the canine, the premolar section of the 2 bicuspids and the molar section of the 1st and 2nd molar. Comparison of the 2 brushes at each assessment was carried out using the Mann Whitney *U*-test. The efficacy of both brushes in the course of the experiment was compared and tested using the 'Multivariate analysis of variance' (Manova). Effects of the factors 'left- or right-handed', gender, and half-mouth design were evaluated within this procedure.

Values of $p < 0.05$ were accepted as statistically significant.

## Results

At the 8-month examination, 77 subjects remained. Out of the initial 87 subjects at baseline, 8 control subjects, and 2 subjects using the Braun Plak Control left the study because of scheduling conflicts with clinical examinations. Data on these subjects was not used in the analysis. The distribution of age, gender and 'left- or right-handed' for each group (manual, electric brushers) in this study is presented in Table 1. The mean age for both groups was approximately 22 years. The right-handed subjects were in the majority, approximately 5× in the manual toothbrush group and 3× in the electric toothbrush group. There was an equal number of females in both groups. The number of males in the manual brushers group was 15, and in the electric toothbrush group, 22.

*Table 1.* Distribution of age, gender and dexterity

| | Age (years) | Gender | | Dexterity | |
|---|---|---|---|---|---|
| | mean age | male | female | left-handed | right-handed |
| Manual toothbrush | 22.3 | 15 | 20 | 6 | 29 |
| Braun Plak Control | 22.2 | 22 | 20 | 10 | 32 |

*Table 2.* Summary of the means; % difference between the electric toothbrush and the regular manual toothbrush. Standard deviation in parenthesis.

| | Manual | Braun Plak Control | *P*-value | %difference |
|---|---|---|---|---|
| $N=(77)$ | 35 | 42 | | |
| plaque | | | | |
| base | 1.51 (0.30) | 1.52 (0.27) | 0.91 | |
| 1-month | 1.32 (0.33) | 1.22 (0.30) | 0.19 | |
| 2-month | 1.01 (0.33) | 0.87 (0.35) | 0.06 | |
| 5-month | 0.89 (0.33) | 0.65 (0.26) | <0.01 | |
| 8-month | 0.73 (0.24) | 0.55 (0.25) | <0.01 | 25% |
| gingival index | | | | |
| base | 1.72 (0.18) | 1.73 (0.15) | 0.89 | |
| 1-month | 1.55 (0.28) | 1.54 (0.25) | 0.78 | |
| 2-month | 1.12 (0.24) | 1.15 (0.26) | 0.60 | |
| 5-month | 0.98 (0.33) | 0.88 (0.26) | 0.10 | |
| 8-month | 0.94 (0.26) | 0.80 (0.24) | <0.01 | 15% |
| bleeding | | | | |
| base | 1.56 (0.25) | 1.63 (0.21) | 0.33 | |
| 1-month | 1.49 (0.25) | 1.50 (0.23) | 0.88 | |
| 2-month | 1.25 (0.26) | 1.19 (0.24) | 0.32 | |
| 5-month | 0.92 (0.33) | 0.76 (0.27) | 0.03 | |
| 8-month | 0.89 (0.27) | 0.69 (0.31) | <0.01 | 22% |
| Quigley & Hein | | | | |
| base | 1.67 (0.37) | 1.67 (0.48) | 0.65 | |
| 1-month | 1.36 (0.42) | 1.34 (0.34) | 0.73 | |
| 2-month | 1.16 (0.42) | 1.07 (0.38) | 0.40 | |
| 5-month | 1.22 (0.53) | 0.93 (0.32) | 0.01 | |
| 8-month | 1.25 (0.53) | 0.97 (0.39) | 0.01 | 21% |
| Calculus | | | | |
| base | 0.62 (0.35) | 0.60 (0.26) | 1.00 | |
| 1-month | 0.65 (0.37) | 0.64 (0.33) | 0.95 | |
| 2-month | 0.19 (0.19) | 0.19 (0.18) | 0.69 | |
| 5-month | 0.21 (0.19) | 0.20 (0.16) | 0.99 | |
| 8-month | 0.25 (0.20) | 0.20 (0.21) | 0.17 | 20% |

*Mean data*

Table 2 shows a summary of the data for plaque, visual signs of inflammation, bleeding upon probing and calculus at each examination. Statistical analysis of the baseline data showed that both groups were 'well-matched' and no significant difference was observed with regard to the clinical indices.

1 month later, during which the subjects had brushed according to written instructions, a decrease in all indices was observed (Table 3), with the exception of bleeding in the manual group. No significant difference between groups was observed (Table 2).

Subjects then received a professional prophylaxis and oral hygiene instruction and returned 1 month later showing a further decrease in all indices (Tables 2, 3). The plaque, as assessed according to the Silness & Löe plaque index, showed a difference with a trend toward significance between both groups (Table 2). At the 5-month appointment, a further improvement on the indices was observed with the exception of the plaque as scored ac-

*Table 3.* Statistical comparison between assessments; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS = non-significant

| | | Base-1 M | 1 M–2 M | 2 M–5 M | 5 M–8 M |
|---|---|---|---|---|---|
| PI | manual | *** | *** | * | ** |
| | Braun | *** | *** | *** | * |
| GI | manual | ** | *** | * | NS |
| | Braun | *** | *** | *** | NS |
| BI | manual | NS | *** | *** | NS |
| | Braun | * | *** | *** | NS |
| Q/H | manual | *** | * | NS | NS |
| | Braun | *** | *** | * | * |

*Table 4.* Results of the repeated measures analysis with the factors group (manual or electric), dexterity, gender, and design; ▼ over base, 1, 2, 5 and 8 month results; ▼▼ over 2, 5 and 8 month results. * $p<0.05$; ** $p<0.01$; NS: non significant, ND: not done

| Factors | Multivariate analysis of variance | | | | |
|---|---|---|---|---|---|
| | PI▼ | MGI▼ | BI▼ | Q/H▼ | CALC▼▼ |
| group | * | NS | ** | ** | NS |
| left- or right-handed | NS | * | * | NS | NS |
| gender | NS | NS | NS | NS | NS |
| design | NS | NS | NS | NS | NS |

cording to the Quigley & Hein index in the manual group (Table 3). A difference was observed between the 2 groups for both plaque indices, whereby the electric toothbrush removed more plaque than the manual. In addition, a difference was observed for bleeding in favor of the electric toothbrush, although no difference was observed for visual signs of inflammation (Table 2). Compared to the 5-month results, no significant decrease was observed for bleeding and gingival inflammation at the 8-month assessment. However a further decrease in both groups was observed for the plaque as scored according to Silness & Löe index. Plaque as scored with the Quigley & Hein index only showed a further reduction for the Braun Plak Control (Table 3). In general, comparison between the groups shows that the effect as observed at 5-months continued and a significant difference between groups was observed for all but the calculus indices (Table 2). The Braun Plak Control appeared to be more effective in the treatment of gingivitis than the manual toothbrush.

In Table 4, the results of the repeated measures analysis of the factors group (manual and electric), 'left- or right-handed', gender and (half-mouth) design are presented. Plaque indices (both Silness & Löe and Quigley & Hein) and bleeding upon probing were significantly different among groups. This confirms the data of the above where the data were analyzed separately at each assessment (Tables 2, 3).

Furthermore, the factor 'left- or right-handed' showed a significant effect on the MGI and bleeding on probing. Analysis of the means as calculated at each assessment for left- and right-handedness show a trend for less bleeding in case a subject is left-handed. This is not as obvious with regard to the visual signs of inflammation.

No effect was found for gender and half-mouth design for any of the indices (Table 4). Furthermore, no interactions were observed between 'left- or right-handed' by design and 'left- or right-handed' by group.

*Data by site*

Table 5a-c show the data for plaque (Silness & Löe), bleeding and gingival inflammation (MGI) divided by assessment-site for each brush at baseline and 8-months. These data reveal that the overall difference between the manual and electric group is largely due to improved efficacy on the vestibular and interproximal-vestibular surfaces. Analysis of the 3 defined regions of the mouth (front, premolars and molars) shows that, compared to the manual brush, the greatest improvement for plaque, gingival inflammation and gingival bleeding was observed for the molars in the Braun group.

*Interdental cleaners*

Table 6 shows the interdental cleaning habits of the 77 subjects within this experiment. These figures reveal that interproximal cleaning was not a common practice in this group of subjects. Only 8 subjects from the manual group and 7 from the Braun Plak Control group cleaned interdentally a few times per week. 37 out of the 77 subjects reported never to practice any form of interproximal oral hygiene at all.

*Adverse reactions*

No serious adverse reactions were observed affecting either the hard or soft tissues throughout the 8 months of this study period. Occasionally, gingival abrasion was observed but this was equally divided amongst both groups (Table 7).

## Discussion

Long-term studies are generally accepted as necessary for the evaluation of any treatment of plaque and gingivitis. This 8-month study uses a model in which a group of gingivitis patients is enroled in an oral hygiene program.

At baseline, the subjects were handed written oral hygiene instruction only. After 1 month, they received a scrupulous scaling and root-planing together with professional oral hygiene instruction. The results observed after 4 weeks confirm those reported in an earlier study (Van der Weijden et al. 1993a), which demonstrated that written oral hygiene instruction are insufficient for obtaining the maximum improvement in efficacy with the manual toothbrush, conventional electric toothbrush, and Braun Plak Control. This is in agreement with the results of Elliot et al. (1972), who showed that instruction and motivation had a significant effect on the efficacy of the electric toothbrush. As was discussed in the earlier study (Van der Weijden et al. 1993a), other investigations have shown conflicting results with regard to the influence of oral hygiene instruction on the efficacy of toothbrushes (Glavind et al. 1981, Shifter et al. 1983). These reports as well as the results of other studies (McKendrick et al. 1968, McAllan et al. 1976), which have taken toothbrushing instruction into consideration as a parameter, demonstrated that oral hygiene instruction did not result in an improved efficacy for one toothbrush being more effective than the other.

*Table 5a.* Plaque index at baseline and 8-months, divided by 4 assessment sites and 3 regions of the mouth; standard deviation in parenthesis; * $p<0.05$, ** $P<0.01$

| | Plaque Index | | | | | |
|---|---|---|---|---|---|---|
| | base | | | 8-month | | |
| | manual | Braun | sign | manual | Braun | sign |
| 6-sites | 1.51 (0.30) | 1.52 (0.27) | ns | 0.73 (0.24) | 0.55 (0.25) | ** |
| inter-vest. | 1.68 (0.34) | 1.63 (0.32) | ns | 0.79 (0.31) | 0.51 (0.25) | ** |
| inter ling | 1.70 (0.28) | 1.78 (0.23) | ns | 0.98 (0.27) | 0.87 (0.31) | ns |
| vestibular | 1.33 (0.37) | 1.30 (0.38) | ns | 0.59 (0.31) | 0.33 (0.23) | ** |
| lingual | 1.42 (0.37) | 1.50 (0.31) | ns | 0.72 (0.30) | 0.67 (0.34) | ns |
| front | 1.37 (0.36) | 1.36 (0.39) | ns | 0.62 (0.24) | 0.47 (0.26) | ** |
| premolars | 1.49 (0.35) | 1.53 (0.26) | ns | 0.70 (0.31) | 0.57 (0.25) | ns |
| molars | 1.86 (0.23) | 1.91 (0.18) | ns | 1.05 (0.27) | 0.83 (0.31) | ** |

*Table 5b.* Modified gingival index at baseline and 8-months, divided by 4 assessment sites and 3 regions of the mouth; standard deviation in parenthesis; * $p<0.05$; ** $P<0.01$

| | Modified gingival index | | | | | |
|---|---|---|---|---|---|---|
| | base | | | 8-month | | |
| | manual | Braun | sign | manual | Braun | sign |
| 6-sites | 1.72 (0.18) | 1.73 (0.15) | ns | 0.94 (0.26) | 0.80 (0.24) | ** |
| inter vest | 1.89 (0.17) | 1.89 (0.13) | ns | 1.14 (0.38) | 0.95 (0.31) | * |
| inter ling | 1.84 (0.19) | 1.86 (0.13) | ns | 1.24 (0.24) | 1.12 (0.28) | ns |
| vestibular | 1.56 (0.30) | 1.53 (0.31) | ns | 0.71 (0.31) | 0.51 (0.29) | ** |
| lingual | 1.65 (0.27) | 1.67 (0.23) | ns | 0.83 (0.22) | 0.72 (0.32) | ns |
| front | 1.67 (0.23) | 1.68 (0.20) | ns | 0.82 (0.31) | 0.70 (0.28) | ns |
| premolars | 1.69 (0.23) | 1.71 (0.18) | ns | 0.87 (0.30) | 0.70 (0.31) | * |
| molars | 1.87 (0.15) | 1.90 (0.10) | ns | 1.37 (0.25) | 1.20 (0.26) | ** |

*Table 5c.* Bleeding index at baseline and 8-months, divided by 4 assessment sites and 3 regions of the mouth; standard deviation in parenthesis; * $p<0.05$; ** $P<0.01$

| | Bleeding index | | | | | |
|---|---|---|---|---|---|---|
| | base | | | 8-month | | |
| | manual | Braun | sign | manual | Braun | sign |
| 6-sites | 1.56 (0.25) | 1.63 (0.21) | ns | 0.89 (0.27) | 0.69 (0.31) | ** |
| inter vest | 1.58 (0.31) | 1.66 (0.26) | ns | 0.94 (0.37) | 0.71 (0.35) | ** |
| inter ling | 1.68 (0.27) | 1.74 (0.22) | ns | 1.16 (0.30) | 0.98 (0.40) | * |
| vestibular | 1.49 (0.31) | 1.50 (0.31) | ns | 0.67 (0.32) | 0.40 (0.28) | ** |
| lingual | 1.57 (0.28) | 1.66 (0.27) | ns | 0.89 (0.31) | 0.75 (0.39) | ns |
| front | 1.53 (0.27) | 1.58 (0.28) | ns | 0.85 (0.34) | 0.69 (0.33) | * |
| premolars | 1.53 (0.28) | 1.60 (0.23) | ns | 0.82 (0.27) | 0.63 (0.38) | * |
| molars | 1.73 (0.26) | 1.80 (0.18) | ns | 1.15 (0.28) | 0.89 (0.43) | ** |

The results of the present study, however, showed that merely giving a subject a toothbrush, either manual or electric, and telling him/her to read the written instructions carefully will not result in the greatest possible improvement of gingival health or oral hygiene. Therefore, professional oral hygiene instruction is needed to ensure that a subject knows how to brush the teeth efficiently.

After a single professional prophylaxis and professional oral hygiene instructions, the gingival condition improved in the test group during the 8-month period and was significantly better than the control group. A supragingival and subgingival debridement was carried out only 1 × in the course of this study since other studies have revealed that cleaning the root surface at 3-monthly intervals for patients in maintenance is likely to mask any benefits of additional treatment (Boyd et al. 1989). The improvement of gingival health which is observed in both the test and control groups is in agreement with the results reported by Boyd et al. (1989). They used a similar protocol comparing a rotary electric toothbrush with a combination of conventional toothbrushing, flossing and toothpicks. They also observed a significant decrease in plaque, bleeding and visual inflammation from baseline throughout the 12-months for both groups. Glavind et al. (1981) suggested that the participation of a group in a preventive program may in itself improve the level of oral hygiene. This was ascribed to psychological and feedback mechanisms. Therefore, the most likely explanation for patients in both groups having improved gingival status at the end of this study is the increased efficiency of plaque removal which has been shown in previous studies (Van der Weijden et al. 1993 a,b).

The existence of a causal relationship between the presence of dental plaque and gingivitis has been well established (Löe et al. 1965). However, it is also recognized that not all gingival sites exhibiting plaque deposits develop inflammation, and as a corollary, that reduction in plaque accumulation is not always accompanied by reduction in existent gingivitis (e.g., Spindel et al. 1986, Khocht et al. 1992).

Results of the present study contribute to these observations on the variability of plaque-gingivitis relationships. They show that in sequence, the 1st observed difference between the 2 brushes is the plaque index. The next index to follow was bleeding upon probing, with the modified gingival index in its trial. There appears to be a 'lag period' between the improved plaque removal, bleeding and visual signs of inflammation. This confirms the observations of Saxton et al. (1991), who observed that from the clinical signs of inflammation (bleeding) seem to give a slightly greater discrimination compared to the MGI.

Bleeding upon probing has also in the

*Table 6.* Frequencies of interdental cleaning

| | Interdental cleaning | | | | | | |
|---|---|---|---|---|---|---|---|
| | no | every day | few times a week | 1 × a week | 1 × a month | dental floss | tooth pick |
| manual toothbrush | 13 | 1 | 7 | 6 | 8 | 11 | 11 |
| Braun Plak Control | 24 | 4 | 3 | 5 | 6 | 8 | 10 |

*Table 7.* Gingival abrasion

| | Gingival abrasion | | | | |
|---|---|---|---|---|---|
| | 1 month | 2 months | 5 months | 8 months | total |
| manual toothbrush | 5 | 3 | 2 | 2 | 12 |
| Braun Plak Control | – | 3 | 2 | 2 | 7 |

past been considered a more sensitive indicator of gingivitis (Mühlemann & Son 1971, Saxton & Van der Ouderaa 1989). Results from Meitner et al. (1979) indicate that when a change had taken place from gingival health to a detectable clinical sign, it was twice as frequent for that change to be bleeding upon probing compared with either visual inflammation, or a combination of the 2 clinical signs. Our results emphasize these observations, by indicating that bleeding is of great value as a diagnostic sign, showing earlier association with plaque scores than do visual signs of inflammation.

The previous study (Van der Weijden et al. 1993a) showed that even 'good' brushers, such as dental students, benefit from the Braun Plak Control, especially on the more inaccessible surfaces. The main effect was observed on the interproximal-vestibular surfaces. The present group consisted of an entirely different study population. The subjects in this study were non-dental students starting out with generalized gingivitis. The subjects either did not care, or were unaware of how to brush. In the present study, the main effect was also found on interproximal-vestibular surfaces; but in addition, on the vestibular surfaces, an improved efficacy was found. These results show that in a regular 'users' population, unconnected with dentistry or the Dental Faculty, the same potential benefit of the electric toothbrush is observed as in a dental student population.

Left-handed brushers appeared to have less gingival bleeding than right-handed subjects which is expected to be the result of more efficient plaque removal (Caton et al. 1989). Since right- and left-handed subjects were comparably divided among groups, the outcome of this study was not affected, as demonstrated by the repeated measures analysis, showing no interaction of 'left- or right-handed' with either group and half-mouth design. The observed effect of the factor 'left- or right-handed' is certainly of interest. This phenomenon however, is not so surprising if one considers that a relatively large number of, for example, top-tennis-players (20%) and top-fencers (30%) are left-handed. This is generally explained by the fact that the left extremities, such as hand and arm, are directed by the right hemisphere of the human brain. This hemisphere is responsible for the processing of visual demonstrations as opposed to the left hemisphere which translates verbal information. Furthermore, it is particularly important for visual and 3-dimensional coordination (for review, see Van Cranenburgh (1988). Therefore, considering that left- and right-handed brushers at baseline had comparable bleeding indices, the observed difference might be explained by the fact that left-handed subjects were able to benefit more from oral hygiene instruction.

In 2 previous short-term clinical trials, we have found that an oscillating/rotating electric toothbrush is more effective for supragingival plaque removal than conventional toothbrushing (Van der Weijden et al. 1993a, 1993b).

According to the present study, the overall plaque-removing effect and as a consequence the gingivitis-reducing effect of the electric toothbrush, was greater than that of the manual, control brush. However, great individual variations were observed. The difference between the 2 tested brushes was mainly due to the fact that the electric brush was more effective on the vestibular interproximal and vestibular surfaces than the conventional brush.

*In conclusion,* this investigation demonstrated that the Braun Plak Control® is a safe and effective home-care device which markedly improved both the oral hygiene status and the gingival conditions. Individualized instructions for proper utilization, improve the efficacy of this oral hygiene device. At the end of this trial, this electric toothbrush proved to be more effective than a regular manual toothbrush.

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**Zusammenfassung**

*Der langfristige Einfluß einer oszillierenden/rotierenden elektrischen Zahnbürste auf die Gingivitis. Eine 8 Monate lange, klinische Studie*

Die Studie bezweckte, Sicherheit und Effizienz der Plaquekontrolle mit der elektrischen Zahnbürste nach Braun®, hinsichtlich der Entfernung supragingivaler Plaque und der Verbesserung der gingivalen Gesundheit mit einem langfristigen klinischen Versuch zu bewerten, sowie beide Parameter mit der Wirksamkeit einer konventionellen, manuell angewandten Zahnbürste zu vergleichen. Untersucht wurden: Plaqueanlagerung, Ausbreitung entzündlicher Gingiva, Zahnfleischblutung nach dem Sondieren und Vorkommen von Zahnstein. Alles in allem nahmen 77 junge Personen mit "mäßiger Gingivitis" an der Untersuchung teil. Sie wurden 8 Monate lang beobachtet und in 2 Gruppen eingeteilt; in eine Kontrollgruppe, die eine manuelle Zahnbürste anwendete und eine Testgruppe, die die Plaquekontrolle nach Braun durchführte. Die klinischen Beurteilungen wurden nach 1, 2, 5 und 8 Monaten widerholt. Bei der Erstuntersuchung wurden den Probanden die ihnen zugeteilten Zahnbürsten, sowie schriftliche Anleitungen für die Mundhygiene ausgehändigt. Sie wurden angewiesen, die Zähne mindestens 2 Minuten lang zu bürsten. Einen Monat nach der Erstuntersuchung wurde bei allen Probanden eine professionelle Prophylaxebehandlung vorgenommen, und eine erfahrene Dentalhygienistin (Fachschwester für Mundhygiene) erteilte Mundhygieneanweisungen. Bei den Nachuntersuchungen nach 2 und 5 Monaten wurde die Plaqueentfernung verstärkt. Es wird gefolgert, daß die Resultate die elektrische Zahnbürste zur Plaquekontrolle nach Braun als ein sicheres und effizientes häusliches Gerät erkennen lassen. Bei Abschluß des Versuchs zeigte sich, daß diese elektrische Zahnbürste effektiver ist als eine konventionelle, manuell anzuwendende Zahnbürste.

**Résumé**

*Effet à long terme d'une brosse à dents électrique rotative et oscillante sur la gingivite. Une étude clinique de huit mois*

La but de l'étude présente a été d'évaluer la sécurité et l'efficacité de la brosse dentaire Braun Plak Control® à enlever la plaque dentaire sus-gingivale et à améliorer la santé gingivale dans un essai clinique et de la comparer à une brosse à dents manuelle régulière. Les paramètres cliniques évalués aux mois 0, 1, 2, 5 et 8 ont été les suivants: plaque, gingivite, saignement et tartre. 77 jeunes individus avec gingivite modérée ont été sélectionnés et répartis en 2 groupes, test et contrôle. Lors de la visite initiale, les sujets ont reçu leur brosse avec les instructions écrites et ils devaient se brosser pendant au moins 2 min. 1 mois après (M1) les individus ont reçu un nettoyage professionnel et une instruction en hygiène buc-

cale par une hygiéniste dentaire. Un réinstruction a été faite aux mois 2 et 5. Les résultats ont indiqué que la Braun Plak Control® est sûre et même plus efficace qu'une brosse à dents manuelle régulière.

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Address:

*Fridus Van der Weijden*
*Department of Periodontology*
*Academic Centre for Dentistry, Amsterdam*
*Louwesweg 1*
*1066 EA Amsterdam*
*The Netherlands*