A influência da disposição das cerdas de escovas dentais manuais na remoção de placa dental

The influence of manual toothbrush bristle arrangement on dental plaque removal

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ABSTRACT

This crossover study aimed to compare plaque removal efficiency of two manual toothbrushes with identical design, the exception being the pattern of bristle arrangement. Twenty-six subjects were selected following inclusion and exclusion criteria. Dental plaque was scored before and after seven days of use of each toothbrush (Sanifill Smooth® – T1 and Sanifill Active Smooth® – T2) employing the Turesky Plaque Index. Plaque Index values were handled with parametrical statistics employing Analysis of Variance (p<0.05) and, later, the Tukey Test. At the end of the trial, each subject was asked which toothbrush they preferred. Results: plaque scores for toothbrush T1 were not statistically different from those for toothbrush T2. Subjects showed a distinct preference for toothbrush T1. Conclusion: there was no difference in terms of plaque removal when toothbrushes T1 and T2 were compared, although patients showed a higher preference for toothbrush T1. Thus the different toothbrushes bristles arrangements did not influence the dental plaque removal.

UNITERMS

Toothbrushes; bristle; dental plaque; mechanical control.

INTRODUCTION

According to the available literature, the importance of plaque control has been widely proved to prevent oral disorders, such as periodontal diseases and caries. Moreover, toothbrush associated with dentifrice is the most commonly used instrument for the mechanical control of plaque all over the world. This is due to its effectiveness, convenience and cost [10].

Although toothbrushes may all look essentially the same, specific details, such as the specific bristle material; length, diameter and total number of fibers; length and design of the brush head; number and arrangement of bristle tufts; handle-head angle and handle design may affect the quality of oral hygiene [2].

Various designs of toothbrushes are available in the market, and manufactures have been implementing new changes as to achieve a design capable to optimize plaque removal, hence improving oral health.

It is essential that patients know the characteristics of a toothbrush in order to achieve safe and efficient oral hygiene. The desirable features of a toothbrush include a relatively small head for easy access, a wide and long handle to ensure a firm grasp, soft nylon bristle tips to minimize gingival damage, and a multi-tufted head, uniformly arranged to optimize cleanliness[14].

Clinical trials have investigated the efficacy of toothbrushes, manual and electric, regarding efficiency in plaque removal, amount of dental abrasion, and acceptance by patients[11,12,5].Most of these studies showed that the efficacy of the toothbrushes was evaluated considering the toothbrush as a whole, made up by its handle, head, and bristles. Investigations about the characteristics of each component of a toothbrush are not so common[3,20].

Farrel et al.[6] compared the plaque removal efficacy of a power toothbrush and a manual toothbrush emphasizing the gingival margin and interproximal areas. Use of the power toothbrush resulted in a significant plaque reduction in whole mouth and both toothbrushes were well tolerated by the subjects. Sharma et al.[21], in a clinical study, evaluated the plaque removal efficacy of three power toothbrushes and a manual toothbrush. All four toothbrushes showed statistically significant change from pre-brush to post-brush scores; all groups demonstrated a significant reduction in plaque although there were greater differences in the amount of plaque removed by the power toothbrushes as one of them showed the best performance and the manual toothbrush showed the worst performance.

As dental plaque accumulates gingivally to orthodontic wire a triple – headed toothbrush (TH-TB) was designed to reach the gingival tooth margin and Rafe et al.[15] evaluated the efficacy of this new toothbrush in improving oral health as compared with conventional and orthodontic toothbrushes. The TH-TB was more effective than conventional and orthodontic toothbrushes in tooth – plaque removal, bracket – plaque removal and in improving gingival health. The patients showed preferences for the TH-TB.

Harpenau et al.[8] evaluated the plaque removal efficacy of two manual toothbrushes no differences were observed in the amount of plaque removed by the toothbrushes and also there was no evidence of soft tissue abrasion from either brush.

Toothbrushes with different designs can offer different degrees of oral cleanliness and the role of specific parts of the toothbrush in oral hygiene offers different levels of plaque removal[9]. Taking these facts into consideration, this study aimed to compare plaque removal efficacy of two manual toothbrushes with different bristle arrangements. Furthermore, this study aimed to observe the preferences of the subjects between the toothbrushes used.

MATERIAL AND METHODS

The study received approval from the Research Ethics Committee (2004.1.20.58.9). The subjects were selected from the Faculty of Dentistry of Ribeirão Preto – University of São Paulo based on exclusion criteria. The exclusion criteria were that the subjects had to have ages from 18 to 60 years, could not be prosthetic or orthodontic users, should have at least twenty-four natural teeth and a plaque index different from zero. Therefore, a total of twenty-six subjects were selected to take part in the study.

On the first visit, a clinical examination (CE) was done to observe the integrity of the soft tissues and to assess the Plaque Index (PI) based on Turesky et al.[23]. Values were attributed to the quantity of plaque accumulated in the buccal surfaces of teeth 11, 26, 16 and 31 and in the lingual surfaces of teeth 46 and 36 (Box 1). All clinical measurements were performed by a previously calibrated examiner. For the examiner's calibration a training and calibration exercise was done. The examiner evaluated 10% of the subjects twice without knowing who the subject was and the measurements were compared. This was done until the values were equal.

Box 1 – Values attributed to dental surfaces

Values	Plaque distribution
0	Absence of plaque
1	Plaque in 1/3 of dental surface
2	Plaque in 2/3 of dental surface
3	Plaque in more than 2/3 of dental surface

The study was a crossover study and was planned in such a way that all patients could use both toothbrushes (Figure 1) with the same toothpaste
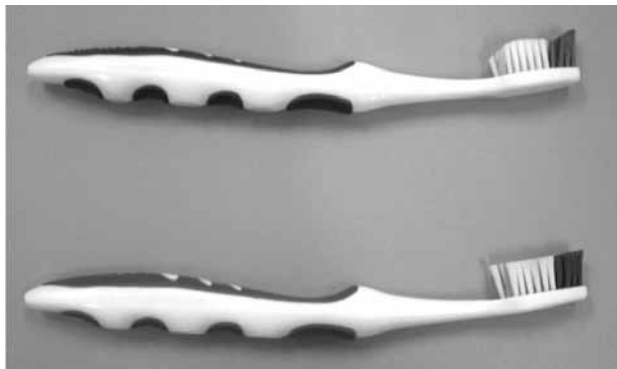
Figure 1 – Lateral view of the two toothbrushes. Sanifill Smooth Active – T2 (top) and Sanifill Smooth – T1 (bottom).

(Sorriso Dentes Brancos – Kolynos® – São Paulo, São Paulo, Brazil). None of the patients received oral hygiene instructions at any moment during the study. This meant to ensure that any modification on the amount of plaque was due to the toothbrush alone.

The patients randomly received an experimental toothbrush and all the instructions about its use. This toothbrush was used for a week and after that an one-week interval was established, allowing the subjects to return to their habitual toothbrush in order to return the plaque values to the initial levels. Finally, they received the second experimental toothbrush and again it was used for a week.

During the period of the study, PI and CE were assessed before and after the use of each experimental toothbrush. At the end of each week, the toothbrush used during that week was retained by the examiner as to ensure that the subject would use the toothbrush selected for the following period. At the end of the trial period, the volunteers answered a preference questionnaire that was used to survey for their preferences between both toothbrushes used.

Plaque Index values were handled with parametrical statistics using the Analysis of Variance ($p<0.05$) followed by Tukey Test, for the differentiation of the average values.

RESULTS

Study results are shown in Tables 1 and 2, and Figure 2.

Table 1 – Plaque index values at the buccal and lingual surfaces, before and after the use of the toothbrushes evaluated.

Toothbrush	Lingual		Buccal	
	before	after	before	After
T1	1.29±0,92	1.38±0,92	1.88±0,82	0.90±0,61
T2	1.37±0,90	1.29±0,90	0.91±0,67	0.95±0,73

Table 2 – Patients' answers to the preference questionnaire administered at the end of the clinical trial.

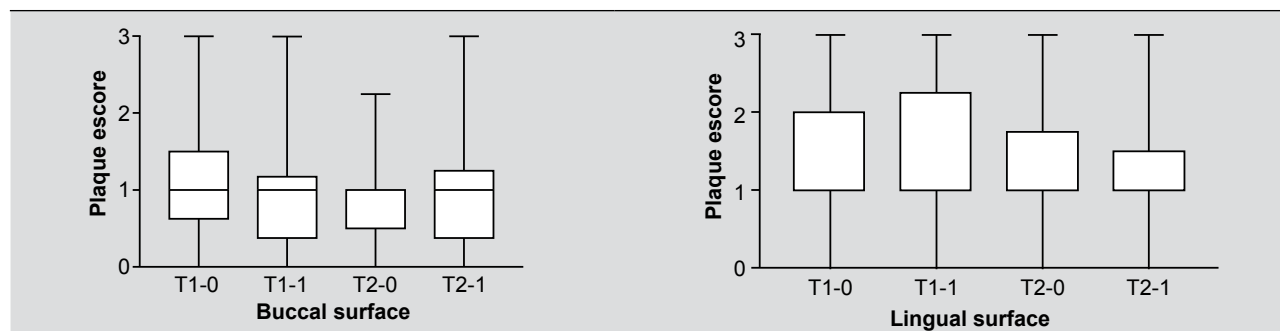| QUESTIONS	T1	T2	All the toothbrushes	None of the toothbrushes
Which toothbrush did you consider the most effective?	66.6%	25.9%	3.7%	3.7%
Which had the most comfortable grip?	51.8%	51.8%	0%	3.7%
Which toothbrush better cleaned your posterior teeth?	48.1%	14.8%	29.6%	0%
Did any of the toothbrushes hurt your mouth?	7.4%	22.2%	0%	70.3%

Figure 2 – Graphic illustration of the plaque index distribution (median and quartiles) in the buccal and lingual surfaces before (0) and after (1) the use of toothbrushes T1 and T2.

The analysis consisted of a comparison of the plaque index distribution values at the beginning and at the end of the testing period, for each toothbrush. The comparisons were done separately per surface (buccal and lingual).

Table 1 shows the average plaque index values before and after the use of each toothbrush. For toothbrush T1, the PI showed an increase in the lingual surface and a decrease in the buccal surface. For toothbrush T2, a decrease of PI occurred in the lingual surface and an increase in the buccal surface. However, none of these alterations could be considered statistically significant. The initial and final values were closely similar, showing the same pattern of plaque removal for both toothbrushes evaluated. The analysis of Figure 2, where the distribution of PI is shown graphically for lingual and buccal surfaces, allows for the observation of these facts.

Table 2 summarizes patients' answers to the survey (regarding their preference) administered at the end of the clinical trial. The responses showed that most subjects chose toothbrush T1 as the most effective and the best to clean posterior teeth; the grip of T1 and T2 were reported as being similarly adequate. Six subjects reported that toothbrush T2 had hurt their mouths, although no signs of soft tissue trauma were observed during CE.

DISCUSSION

The toothbrush, since its elementary forms, is the most commonly employed instrument for the mechanical removal of dental plaque. It is essential that patients know the characteristics of a toothbrush in order to achieve safe and efficient oral hygiene. This means that there should be no soft tissue trauma and patients should feel motivated to improve their oral health.

Toothbrushes T1 – Sanifill Smooth® (Curitiba, Paraná, Brazil) and T2 – Sanifill Smooth Active® (Curitiba, Paraná, Brazil) had as their main characteristics: ergonomic rubber-lined handle, middle-sized head, and soft nylon bristles disposed in tufts. The evaluated toothbrushes were identical in shape and material for the handle, shape and material for the head, and material for the bristles. The only difference between them was bristle arrangement. Toothbrush T1 had all bristle tufts of the same length and perpendicular to the head, whereas toothbrush T2 had bristle tufts with different lengths, and a longer, angled anterior tuft.

According to the manufacturer, Sanifill Smooth Active (T2) would make it easier to clean posterior teeth and lingual surfaces than Sanifill Smooth (T1), since Sanifill Smooth Active (T2) has a longer, angled anterior tuft of bristles. However, this could not be proved, since the analysis of the results indicated that, considering the initial and final plaque index values of each toothbrush, there were no differences in the reduction of the amount of plaque in the lingual and buccal surfaces.

The present study corroborates with the results obtained by Claydon et al.[4] and Sharma et al.[20]. In their study, they evaluated, through clinical trials, the efficacy and safety of two toothbrushes, from different manufacturers, that had angled bristles or perpendicular bristles to the head. They concluded that the toothbrushes were equally efficient on plaque removal. Furthermore, neither toothbrush caused any damage to soft tissues.

Nathoo et al.[12] and Singh et al.[18] compared the capacity of plaque removal and gingivitis reduction of two manual toothbrushes with different designs. Their results showed that one of the two toothbrushes achieved better performance. Biesbrock et al.[3] compared the safety and the efficacy of two different

manual toothbrushes in removing plaque. The results showed that one of the toothbrushes removed significantly more whole mouth, proximal, and gingival margin plaque than the other experimental toothbrush Within this context of clinical studies concerning toothbrushes, it is consensual that a large number of variables may be relevant, such as brushing techniques, presence or absence of supervision, differences in population, frequency and duration of brushing time, motor skills, and users' motivation. Thus, it is essential to establish inclusion and exclusion criteria and to try to control all the variable factors as much as possible[3,4,7,13,16].

It is important to understand the mechanism and dynamics of bristle movements, regarding how they travel on teeth surfaces, and not only how the bristles and tufts are organized within a brush. As stated by Sasahara and Kawamura[16], when teeth surfaces are flat, any angle and any shape of the bristles is equally effective in plaque removal. However, for curved surfaces and for dental grooves, an alteration in any of these characteristics may affect the quality of oral hygiene. Thus, the bristles angle and shape may affect predominantly the cleanliness of proximal surfaces and gingival areas, having little influence in buccal and lingual surfaces.

In the present study, no specific brushing technique was given to the patients so they maintained their habitual technique. This may be a limitation of this study as the brushing technique influences the efficacy of the oral hygiene. Another point is the fact that the Turesky Plaque Index evaluated buccal and lingual surfaces and, regarding the bristle arrangement of the Sanifill Smooth Active (T2) that has a longer, angled anterior tuft of bristles, the evaluation of proximal and occlusal surfaces may be an important point in the assessment of toothbrushes efficacy.

Although there were no statistically significant differences in relation to plaque index, 66.6% of the subjects showed preferences towards toothbrush T1, considering it as the most effective for cleanliness. Some of them reported discomfort when using toothbrush T2, although no trauma in the soft tissues was observed during clinical exams. This fact shows that many patients correlated efficacy with comfort.

The different bristle arrangement was the only factor responsible for patients' opinions, since the toothbrushes were identical in all other aspects.

Therefore, there was no correlation between the patients' opinions and the real effect of the toothbrushes in oral cleanliness. The discrepancy on the opinion of the patient about a particular toothbrush and its possible effectiveness makes the participation of the dentist essential on the choice of a good toothbrush. Oral hygiene instructions and an adequate brushing technique have to be given by the professional in order to help the patient make an effective use of the toothbrush, improving cleanliness and avoiding tissue damage[7,9,17,19,21].

This research evaluated the importance of a specific part of toothbrushes in oral hygiene: bristle arrangement. Other studies referring specifically to the shape, material and angle of the handle; shape and material of the head, and the material of the bristles may prove essential to establish parameters for toothbrush efficacy. Therefore, many commercially available designs that, according to the marketing strategies and buying appeal of the manufacturers, supposedly aim to improve oral hygiene, may not actually achieve this goal.

Future researches referring specifically to the shape, material and angle of the handle; shape and material of the head, and the material of the bristles as well as referring to the use of different brushing techniques and different plaque indices may prove essential in the assessment of toothbrushes efficacy.

CONCLUSION

The analysis of the results obtained from the comparison of two manual toothbrushes with different bristle arrangement showed no significant differences in the amount of plaque on the dental surfaces evaluated, so bristle arrangement did not interfere in the effectiveness of oral hygiene.

The patients showed a preference for toothbrush T1, demonstrating differences between public perception and the clinical index used to assess the amount of dental plaque.

RESUMO

Este estudo cruzado se propôs a comparar a eficiência de remoção de placa dental de duas escovas manuais com modelos idênticos, exceto para o padrão da disposição das cerdas. Vinte e seis sujeitos foram selecionados de acordo com critérios de inclusão e exclusão. Placa dental foi mensurada antes e após sete dias de uso com cada uma das escovas (Sanifill Smooth® – T1 and Sanifill Active Smooth® – T2) utilizando-se o Índice de Placa de Turesky. No final do estudo, cada paciente foi questionado sobre qual a escova preferida. Os valores do Índice de Placa para T1 não foram estatisticamente diferentes para os da escova T2. Não houve diferença em termos de remoção de placa quando as escovas T1 e T2 foram comparadas, embora os pacientes tenham demonstrado grande preferência pela escova T1. Assim, as diferenças nas disposições das cerdas das escovas dentais manuais não influenciaram na remoção de placa dental.

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Placa dental; higiene bucal; escovação dentária.

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