Evaluation of plaque removal efficacy of two manual toothbrushes with different textures: a comparative analysis
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Abstract

Aim: To compare the effect of two manual tooth brushes with varying textures in relation to plaque removing efficacy. Methods: The present trial was examiner blind, randomized and three visit study with 20 volunteers using either of the two types of manual tooth brushes with varying textures. Subjects were assessed for dental plaque according to the criteria of Simplified oral hygiene index (OHI-S) and Turesky’s Gilmore modification of Quigley-Hein plaque index using two tone disclosing agent at baseline, first visit (7 days) and second visit (14 days). All the subjects were demonstrated modified Bass method of brushing at each visit. Results: OHI-S score and Quigley Hein plaque scores of subjects using Thermoseal ultra-soft tooth brush was significantly higher than those using Plakoff smart soft tooth brush at both first and second visits. There was a definite trend with plaque scores at 1st visit and 2nd visits being significantly higher than the baseline among ultra-soft tooth brush users in contrast to soft tooth brush users who demonstrated significantly lower scores at 1st and 2nd visit when compared to the baseline score. Conclusions: Plakoff smart soft tooth brush (0.25 mm tuft filament diameter) was effective in reducing plaque compared to Thermo seal ultra-soft tooth brush (0.18 mm tuft filament diameter).

Key words: Dental plaque; Manual toothbrush; Texture.

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Introduction

Plaque control has become the cornerstone of periodontal therapy. Plaque control is the regular removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival surfaces. It is well documented, that mechanical plaque control can prevent gingivitis, periodontitis and caries (1). Habit of regular tooth cleaning is essential to maintain gingival health (2).

Tooth brushing is the most widespread mechanical means of personal plaque control technique in the world due to its effectiveness, convenience and cost and is considered to be an important factor in the long term maintenance of periodontal health (3). 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 (4).

Patients who have not received any professional advice regarding the type of brush to be used for cleaning, usually choose brushes based on cost, availability, advertising claims, family tradition or habit. Unfortunately to date, there has been insufficient evidence to conclude that any one design of manual toothbrush is superior to others; the conclusion of reviews being that the user is the major variable (5-7). The various designs of toothbrushes available in the market often put the common man in dilemma about the best design and they often seek professional advice on this matter.

Particularly in the last decade, there have been numerous new designs of tooth brush. Manufacturers, in their designs are clearly attempting to improve the efficacy and safety of their products (8). For some products, comparative plaque removal properties have been published (9-12). Therefore the dental professional must maintain a high level of knowledge of these products and advice the patients appropriately.

However although some electric tooth brushes appear more effective than manual ones, several workshops and reviews have consistently concluded that there is no superior design of manual toothbrush. At present, there are no clearly established or more particularly, universally agreed methods to evaluate toothbrush efficacy or safety although many methods have been or could be employed (8).

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 (13). An in vitro study used 5 proprietary medium toothbrushes and a prototype brush with medium texture in long axis and soft texture at right angle to long axis and revealed that stain removal was progressive over time with each brush and therefore relate to the physical action of the brushes (14). It could be construed therefore that differences in plaque removal may be expected in clinical use by difference in the texture of the toothbrushes. Taking these facts into consideration, this present clinical trial aimed to compare plaque removal efficacy of two manual toothbrushes with varying textures.

Material and methods

Subjects

All the post graduate students of Yenepoya Dental College were invited to participate in the study, of which 20 students were considered for the study who met the inclusion criteria. In present clinical trial, there were no dropouts. From all volunteers, written informed consent was obtained and screened with the following study criteria;

Inclusion criteria:

- Able to attend for the period of the trial (3 Weeks)
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- At least minimum of 20 healthy natural teeth without caries and restorations.
- Systematically healthy individuals.

Exclusion criteria:
- Currently participating in any other trial or study involving the oral cavity.
- Antibiotics therapy in previous three months.
- Known sensitivity/allergy/oral mucosal tissue reaction to dental products/ingredients.
- Wearing any oral prosthesis.
- Patient under orthodontic treatment.

Study design
The present study is a randomized examiner blind trial with the random allocation of subjects into any one of the two experimental tooth brush groups, a Plakoff smart tooth brush (ICPA health products ltd., Mumbai, India) and Thermoseal ultra soft tooth brush (ICPA health products ltd., Mumbai, India). Approval for the study was provided by Yenepoya University Ethics Committee.

Volunteers who fulfilled the inclusion criteria were subjected for scaling. On their next visit after the pre-experimental phase of 7 days after scaling, they were randomly assigned to any one of the following experimental groups.

Group A: 10 subjects were provided with Thermoseal ultra soft tooth brush (0.1875 mm tuft filament diameter and 4 rows of bristles) and Colgate tooth paste.

Group B: 10 subjects were provided with Plakoff smart soft tooth brush (0.25 mm tuft filament diameter and 2-3 rows of bristles) and Colgate tooth paste.

A non-participating dentist was requested to carry out the randomization procedure. Each tooth brush was given code and the codes were decoded only at the end of the study.

Following the randomization, modified Bass method of brushing was demonstrated on cast models. Subjects were instructed to brush accordingly their teeth twice daily. All the subjects were assessed for dental plaque according to the criteria of Simplified oral hygiene index (OHI-S) of Greene and Vermillion and Turesky Gilmore modification of Quigley-Hein plaque index using two-tone disclosing agent at baseline, first visit (7 days) and second visit (14 days). At each visit after scoring for the above mentioned indices, modified Bass method was reinforced by a demonstration on cast model.

Clinical evaluation
A single examiner evaluated all the subjects for plaque assessment using OHI-S (15) and Turesky-modified Quigley–Hein index (16) in a dental chair under artificial light illumination. OHI-S was assessed from six index teeth which has two components—Debris Index (DI) and Calculus Index (CI). The average individual debris score and calculus score were determined and were added together to obtain the OHI-S for each subject while the whole set of dentition except the third molars were assessed for plaque on buccal and lingual surfaces after staining with the disclosing agent using Turesky-modified Quigley–Hein index for plaque.

Statistical analysis
Data was entered on to Microsoft Excel and statistically analyzed using statistical package for social sciences (SPSS), 17.0. Unpaired and paired t test were used to assess the significant of difference between the unrelated and related samples respectively. A p value of <0.05 was considered to be statistically significant.
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Results

Table 1 demonstrates that OHI-S score of subjects using Thermoseal ultra-soft tooth brush was significantly higher than those using Plakoff smart soft tooth brush at both first (p= 0.03) and second visits (p= 0.019). In addition, subjects using toothbrushes with 0.018 mm diameter tuft filaments showed significant increase in OHI-S scores at 2nd visit while the OHI-S scores among users of 0.25mm filament tooth brush were significantly lesser than the baseline scores both at first and second visits.

Table 1: OHI-S scores of Group A and B subjects at baselines and subsequent visits

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean± Standard deviation</th>
<th>P</th>
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<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A†</td>
<td>1.30±0.27</td>
<td>0.717</td>
</tr>
<tr>
<td>Group B‡</td>
<td>1.26±0.20</td>
<td></td>
</tr>
<tr>
<td>I visit*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>1.36±0.29</td>
<td>0.030*</td>
</tr>
<tr>
<td>Group B‡</td>
<td>1.11±0.15</td>
<td></td>
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<tr>
<td>II visit*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A‡</td>
<td>1.37±0.27</td>
<td>0.019*</td>
</tr>
<tr>
<td>Group B§</td>
<td>1.11±0.15</td>
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</tbody>
</table>

*Unpaired ‘t’ test, significant difference between mean scores of Group A and Group B.
‡Paired ‘t’ test, significant difference between mean OHI-S at baseline and 1st visit.
†Paired ‘t’ test, significant difference between mean OHI-S at baseline and 2nd visit.

Similarly, plaque scores assessed using Turesky-modified Quigley-Hein plaque index were significantly different between the groups at both the visits with subjects using Ultra soft tooth brush (Group A) presenting higher plaque accumulation as depicted in table 2. There was a definite trend with plaque scores at 1st visit and 2nd visits being significantly higher than the baseline among group A (tooth brush with 0.18mm tuft filament diameter) subjects in contrast to group B (tooth brush with 0.25mm tuft filament diameter) subjects who demonstrated significantly lower scores at 1st visit and 2nd visit when compared to the baseline score.

Table 2: Plaque scores assessed using Modified Quigley-Hein plaque index of the study subjects

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean± Standard deviation</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A†‡</td>
<td>2.93±0.34</td>
<td>0.101</td>
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<tr>
<td>Group B§∞</td>
<td>3.17±0.28</td>
<td></td>
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<tr>
<td>I visit*</td>
<td></td>
<td></td>
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<tr>
<td>Group A†</td>
<td>3.13±0.30</td>
<td>0.010*</td>
</tr>
<tr>
<td>Group B§</td>
<td>2.79±0.21</td>
<td></td>
</tr>
<tr>
<td>II visit*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A‡</td>
<td>3.24±0.34</td>
<td>0.001*</td>
</tr>
<tr>
<td>Group B∞</td>
<td>2.59±0.29</td>
<td></td>
</tr>
</tbody>
</table>

*Unpaired ‘t’ test, significant difference between mean scores of Group A and Group B.
‡$Paired ‘t’ test, significant difference between mean plaque score of at baseline and 1st visit.
§∞Paired ‘t’ test, significant difference between mean plaque score at baseline and 2nd visit.

Discussion

Tooth brushing is the most commonly recommended and performed oral hygiene behaviour in developed nations. A good toothbrush is relatively inexpensive compared to most dental procedures. Choosing the best toothbrush begins with choosing the right bristles. Choosing the correct bristles is a valuable “insurance policy” against gum disease and tooth decay.

Designing the short term clinical study to test the efficacy of plaque removal is complicated since, many factors such as duration of tooth brushing; manual dexterity, motivation, the frequency of tooth brushing and the novelty effect influence the results (17). Although several workshops and reviews have consistently concluded that there is no superior design of manual tooth brush, yet different companies are coming out with different designs, each claiming superiority, backed by the results of their own clinical research team.
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Hard-, medium-, and soft-bristled toothbrushes all remove plaque; however, hard bristles can cause irreversible damage to the gums, they can also lead to periodontal disease and receding gum lines. A soft-bristled brush is more effective in removing plaque with less harm to soft and hard tissues than a brush with hard bristles because soft bristles are more flexible and thus can reach subgingival and proximal areas.

The soft-bristled brushes that are ADA approved are end-rounded. Round-ended bristles are recommended because they have been shown to cause 30% to 50% less soft tissue trauma than coarse-cut bristles and superior in plaque removal (18) whereas the tips of coarse-cut bristles have sharp corners that reduce their cleaning efficiency and increases damage to the oral tissue (19).

Soft filaments may hold toothpaste better than hard filaments both in terms of quantity and duration. Perhaps, the combined benefit of soft toothbrushes, low abrasive toothpastes, and better patient education about less aggressive brushing techniques has contributed to less concern about gingival lesions (20). A hard-bristled brush may cause 3-6 times more abrasion than soft brushes (19, 21).

The results of present study are in consistent with the study conducted by Gibson and Wade in 1977, where they compared a toothbrush with 0.2 mm diameter filaments and another with 0.18 mm diameter filaments and found that 0.2mm filaments cleaned marginal gingiva more effectively, but the difference was not statistically significant (22). Another study tested the difference between 0.13 and 0.28 mm bristle diameter bristle, found that plaque removal was significantly better (p<0.001) when 0.28mm bristles were used with the roll technique for brushing on facial and interproximal areas (23). In contrast, Beatty et al., in 1990 found no differences in plaque reduction between 0.18mm and 0.2mm bristle diameter (4).

In the present study, group B (Thermo seal ultra-soft tooth brush) though showed less effective plaque removal. In addition to the tuft filament diameter, the other reason for an effective plaque reduction with Plakoff smart soft tooth brush may be attributed to the design characteristics such as the bristle arrangement and a firmer grip on the handle providing an easy maneuverability to the patient.

Moreover, Bergenholtz et al., found no differences between space tufted and dense multitufted toothbrushes, between hard or soft bristles, or between short or long- headed brushes in clinical plaque removal efficacy using the roll technique (24). Scully and Wade in 1970 found that hard- textured (0.33mm) brushes were more effective than medium textured tooth brushes (0.22mm) brushes with long heads (25). Recently, Carvalho et al., in 2007 compared hard and soft filament tooth brushes and concluded that hard filament tooth brushes removed more plaque than soft filament tooth brush (26).

Conclusions
The plaque removal efficacy of Thermoseal ultra soft tooth brush with 0.18 mm tuft filament diameter was found to be significantly lower than Plakoff smart tooth brush with tuft filaments of 0.25 mm diameter. However, clinical trials on larger samples for longer periods could give a better picture on the effect of toothbrush texture on plaque removal efficacy.

References
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