Efficacy of Plaque Removal by Two Types of Toothpick

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Purpose: To compare the efficacy of two types of interdental device, namely triangular woodstick and round toothpick, in the removal of interproximal dental plaque.

Materials and Methods: This study had a split-mouth design and was conducted on 15 individuals. After 72 h of dental plaque accumulation, the dental plaque was quantified by the Quigley–Hein Plaque Index (QHPI). Two quadrants were then randomly assigned for the use of triangular woodstick and the other two for the use of round toothpick. After the use of toothpicks, the QHPI was re-evaluated by a calibrated examiner, blinded to the types of toothpick used. The mean values of QHPI were calculated for both types of toothpick, before and after use. Comparison within and between groups was performed by the paired *t* test, at a significance level of 0.05.

Results: Both the toothpicks provided significant reduction of QHPI, without any statistically significant difference between the types of toothpick (from 3.31 ± 0.61 to 2.42 ± 0.60 using triangular woodsticks and from 3.19 ± 0.71 to 2.24 ± 0.54 using round toothpicks, in the initial and the final periods, respectively). Individual comparison of proximal aspects by observation from buccal proximal and palatal/lingual proximal aspects revealed that round toothpicks removed a greater amount of plaque than triangular woodsticks in areas that were analysed by observation from the palatal/lingual proximal aspect.

Conclusions: No statistically significant differences were found between round toothpicks and triangular woodsticks in the removal of supragingival plaque.

Key words: dental plaque, dental plaque index, oral hygiene, oral and dental hygiene products

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The processes of caries and periodontal disease may be balanced by the correct use of mechanical and/or chemical measures to prevent the accumulation and the organisation of dental plaque on the tooth surface. However, failures in such measures may lead to the formation of pathogenic bacterial plaque and may cause an imbalance in the health and disease process of soft and hard tissues (Cury, 1999; Oppermann and Rösing, 1999).

Mechanical removal of plaque by the patient is usually achieved by toothbrushing and interdental cleaning (Lövdal et al, 1961; Axelsson and Lindhe, 1981; Halla and Oppermann, 2000; Cachapuz, 2001; Piccinin, 2005). However, maintenance of periodontal health is closely related to the ability of the individuals to perform oral hygiene procedures (Axelsson and Lindhe, 1981), which invariably depends on factors related to each individual, including interest, motivation, dexterity and ability (Rodrigues and Serpa, 2001).

Several studies demonstrate that interdental regions present more plaque and gingivitis, even in motivated patients who receive professional care (Axelsson and Lindhe, 1978; Ramberg et al, 1995).

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It should be mentioned that the proximal aspects are most affected by periodontal attachment loss (Albandar and Rams, 2002). This may be explained by the limited access to these regions, thus requiring additional resources besides conventional toothbrushing (Barton and Abelson, 1987). Mechanical removal of interproximal plaque may be performed with the aid of different devices, for example dental floss, interdental brushes and toothpicks. Comparative studies on these methods have been conducted in the past few years and have revealed that dental floss is the most effective device for controlling dental plaque and gingivitis in regions with small embrasure spaces; in the presence of large embrasure spaces, the interdental brush is the best choice (Gjermo and Flötra, 1970; Schmid et al, 1976; Kiger et al, 1991; Festugatto et al, 1997; Rösing et al, 2006).

Even though dental floss provides a good outcome for plaque and gingivitis control, its use is limited in the population (Hamilton and Coulby, 1991; Payne and Locker, 1996; Macgregor et al, 1998). This observation is justified as its use requires ability, manual dexterity, time and individual motivation, besides the high cost that limits its use to high socioeconomic levels (Finkelstein and Grossman, 1979; Mauriello et al, 1987; Maruniak et al, 1992; Cancro and Fischman, 1995).

Toothpicks are one of the resources available for mechanical plaque removal. They are used by nearly 50% of the population, due to the low cost, easy access and use (Bergenholtz et al, 1980; Chiapinotto et al, 2001). However, there are some limitations in the use of toothpicks. Studies that tested the efficacy of toothpicks compared with dental floss for removal of plaque from interproximal spaces demonstrated that the isolated use of toothpicks was ineffective; rather, it may be effective in combination with single-tufted toothbrushes (Gjermo and Flötra, 1970; Brasil and Oppermann, 1987). Other studies reported that toothpicks are as effective as dental floss in promoting good hygiene of proximal spaces from the buccal aspect, especially the triangular woodstick, whose shape allows it to fit into the embrasure space (Anaise, 1976; Bergenholtz and Brithon, 1980). Therefore, most studies investigating the efficacy of toothpicks adopt the use of triangular woodsticks (Warren and Chater, 1996).

It is believed that the toothpick is widely used by the population for mechanical plaque removal. However, round toothpicks are used in many countries owing to the lack of triangular woodsticks on the market. Even though the toothpick seems to be frequently used in the population, evidence of the efficacy of round toothpicks is scarce.

Thus, the present clinical trial of efficacy aimed to compare the removal of proximal supragingival plaque by the use of triangular woodsticks and round toothpicks.

MATERIALS AND METHODS

Sample selection

This randomised clinical trial of efficacy had a split-mouth design. The study sample comprised 15 volunteers, all of whom were dental students at the Franciscan University Center (UNIFRA) who met the inclusion and exclusion criteria.

The inclusion criteria comprised a minimum age of 18 years; the presence of 20 or more natural teeth, except for the third molars; the presence of at least six contiguous teeth in each hemiarch ([a] at least two molars, one premolar, one canine, one lateral incisor and one central incisor or [b] two molars, two premolars, one canine and one lateral incisor); and sufficient psychomotor capacity to use the toothpicks under study. Volunteers should not be previous regular users of toothpicks.

Exclusion criteria comprised the presence of plaque retention factors, including caries lesions, residual tooth roots, ill-fitting prostheses and/or restorations, increased gingival volume and orthodontic appliances or retainers; the presence of destructive periodontal disease or ongoing periodontal treatment; and the need for chemoprophylaxis before the evaluation procedures.

The study was revised and approved by the Institutional Review Board of the Franciscan University Center (CEP/UNIFRA). All volunteers received oral and written information on the study objectives and design, and they signed an informed consent form.

Clinical evaluation

The presence of dental plaque was evaluated only on proximal aspects by the Quigley–Hein Plaque Index (QHPI) (1962) modified by Turesky et al (1970), according to the following criteria.

- Score 0: absence of dental plaque on the gingival region.
- Score 1: small, sparse areas of dental plaque on the cervical margin of teeth.
- Score 2: thin and continuous line of dental plaque on the cervical margin of teeth.

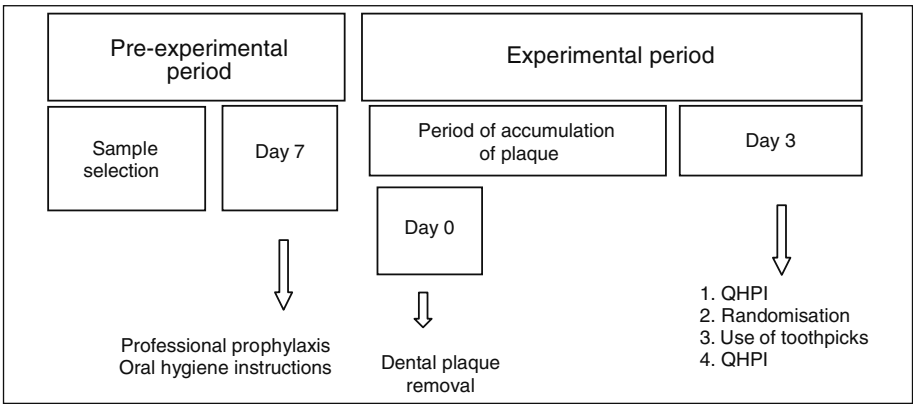

Fig 1 Summary of the experimental design.

- Score 3: dental plaque layer > 1 mm covering at least one-third of the tooth crown.
- Score 4: dental plaque covering one- to two-thirds of the tooth crown.
- Score 5: dental plaque covering two-thirds or more of the tooth crown.

Training on the Plaque Index was provided to the patients with the help of a gold-standard calibrated examiner. Each score of the index was extensively discussed until a similar criterion was established. After the training period, intraexaminer calibration was performed by examining four patients twice within a 1-h interval. Reproducibility was assessed by the kappa coefficient and this revealed a value of 0.78.

Experimental design

The experimental period was preceded by a pre-experimental period, in which all volunteers were subjected to removal of occasional deposits of supragingival calculus, treatment of gingivitis (if present), dental plaque removal and polishing of all the teeth, 7 days before study onset, so that all the subjects would have a similar baseline gingival status. As volunteers were not regular users of toothpicks, on this pre-experimental phase, they were trained on the use of both the interdental devices. Thus, at baseline (day 0), the removal of supragingival plaque was performed on all volunteers, and efficacy was checked by plaque disclosure. Following this, the subjects were asked to refrain from using their routine oral hygiene measures for a period of 72 h. After this period, the dental plaque was disclosed with a 0.75% sodium fluorescein solution, and the QHPI was evaluated on all proximal aspects from the buccal proximal and palatal/lingual proximal aspects.

Table 1 Mean values of the QHPI (±SD) in the initial and final examinations with the use of experimental toothpicks (n = 15)

	Initial examination	Final examination	*P*
Triangular woodstick	3.31 ± 0.61	2.42 ± 0.60	0.00
Round toothpick	3.19 ± 0.71	2.24 ± 0.54	0.00
P	0.10	0.06	

Paired *t* test.

After the evaluation of the QHPI, the participants were taken to another room, where randomisation was performed by coin toss to assign the quadrants for the use of triangular woodsticks (Sanodent®, Oslo, Norway) and round toothpicks (Gaboardi®, São Cristovão do Sul, SC, Brazil). Later, the volunteers were informed and were supervised during the use of the toothpick as established by randomisation, for 45 s on each quadrant. The toothpick was inserted in the proximal buccal region of the distal aspects of central incisors up to the distal aspects of second molars.

After the use of the toothpicks, the participants were taken to the first room for re-evaluation by the examiner, who was blinded to the toothpicks used; the Plaque Index was re-evaluated as described for the first examination (Fig 1).

Analysis of results

The individuals were taken as units of analysis. The mean values of QHPI were calculated for all proximal

Table 2 Mean values of the QHPI (±SD) for the buccal proximal aspects in the initial and final examinations with the use of experimental toothpicks (n = 15)

	Initial examination	Final examination	*P*
Triangular woodstick	3.16 ± 0.84	2.35 ± 0.67	0.00
Round toothpick	3.10 ± 0.88	2.25 ± 0.49	0.00
P	0.61	0.39	

Paired *t* test.

Table 3 Mean values of the QHPI (±SD) for the palatal/lingual proximal aspects in the initial and final examinations with the use of experimental toothpicks (n = 15)

	Initial examination	Final examination	*P*
Triangular woodstick	3.46 ± 0.56	2.48 ± 0.61	0.00
Round toothpick	3.37 ± 0.74	2.22 ± 0.66	0.00
P	0.09	0.03	

Paired *t* test.

aspects, as well as individually on the buccal proximal and palatal/lingual proximal aspects in both the study periods (initial and final examination). Differences within and between groups were investigated by the paired *t* test, at a significance level of 0.05.

RESULTS

Data in Table 1 present the results obtained by the calculation of the mean values of the Plaque Index for all surfaces subjected to the use of triangular woodstick and round toothpick, in the initial and final examinations. Even though analysis within groups revealed significant differences between the initial and final periods, no significant differences were observed in the QHPI in the initial and the final periods between the two types of toothpick.

Data in Tables 2 and 3 present the results obtained by individual analysis of the QHPI for the buccal proximal and palatal/lingual proximal aspects. Analysis within groups revealed significant differences for both the aspects between the initial and final periods, thus demonstrating plaque reduction. No significant differences were observed on buccal proximal aspects between the two types of toothpick in the initial and the final periods. With regard to palatal/lingual proximal aspects, the QHPI did not reveal significant differences in the initial examination. However, in the final period, surfaces cleaned with round toothpicks exhibited a smaller amount of dental plaque compared with surfaces cleaned with triangular woodsticks. However, if a Bonferroni correction is applied to the data, the significance is lost ($P > 0.05$).

Figure 2 presents the descriptive analysis of frequency of QHPI scores for both the surfaces cleaned with triangular woodsticks and round toothpicks in the initial and the final periods. It may be observed that, for both the toothpicks, scores 4 and 5 were significantly reduced, whereas scores 1 and 2 presented a significant increase between the initial and the final periods.

DISCUSSION

The present study aimed to compare the efficacy of two types of toothpick, with different transverse sections (round and triangular), on bacterial plaque removal. The results revealed that both the toothpicks remove significant and similar amounts of dental plaque from the buccal proximal aspect. However, on the lingual aspect, the round toothpick was more effective. One hypothesis for this finding is the thinner active tip of the round toothpicks, allowing deeper penetration into the proximal lingual embrasure and thus removing a greater amount of dental plaque.

The experimental design was an important aspect of the present study. The split-mouth design allows comparisons between the two groups that are less biased, as all individuals are compared with another situation in their own mouth. Also, randomisation of the quadrants between the types of toothpick allows equal distribution of the variables between groups, for example larger or smaller interproximal spaces and manual ability for the use of the toothpick: this further highlights the influence of toothpick design *per se* for the removal of bacterial plaque. It should be mentioned that, as this was a clinical trial of efficacy, the sample was composed of dental students, who usually present well-developed manual dexterity that allows better evaluation of the possible performance of the toothpicks. On the other hand, our results cannot be extrapolated as if an effective study was performed, as assessment of gingival inflammation would be necessary, and therefore further studies need to be conducted.

The number of individuals in this study might be questioned. However, power analysis of the study, taking the standard deviation of alterations in the

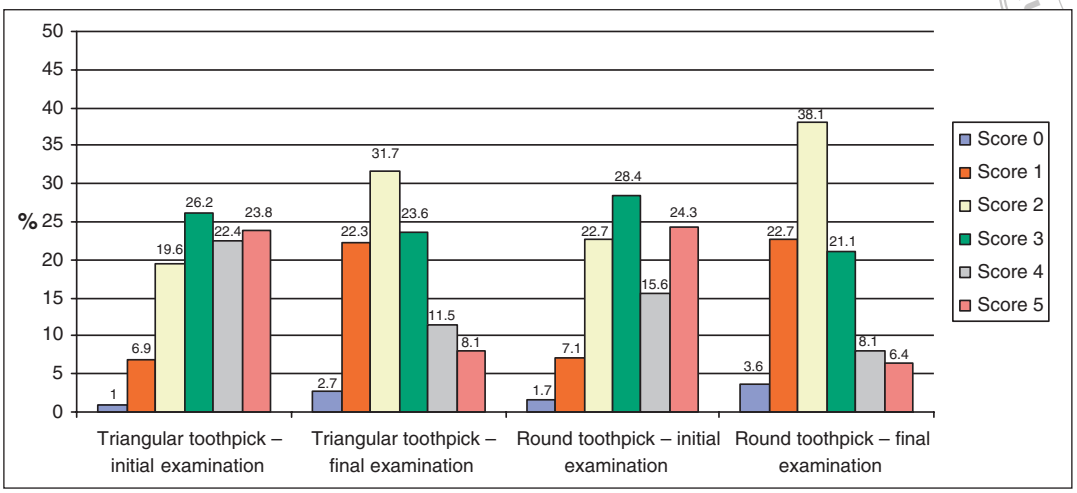

Fig 2 Frequencies of scores of QHPI for round toothpicks and triangular woodsticks in the initial and final examinations.

Plaque Index into account and considering a difference of 0.5 in the mean QHPI and an alpha error of 0.05 as clinically relevant, revealed that the power of the present study was 0.83, which is considered adequate (Altman, 1992).

The Plaque Index of Quigley and Hein (1962) modified by Turesky et al (1970) was used for quantification of dental plaque due to the number of scores of the index. This allowed the evaluation of slight changes in the amount of dental plaque. Use of 0.75% sodium fluorescein for plaque disclosure was also important in this methodology. The dental plaque stained by this solution might be observed only with the aid of a blue light, thus preventing the observation of disclosed plaque by volunteers during use of toothpicks, which might divert their attention from the toothpick technique.

The results of the present study are interesting, as evidence of the efficacy of round toothpicks is scarce. Bergenholtz et al (1980) demonstrated greater efficacy for the triangular woodstick after comparison with other toothpick designs. However, the authors did not use round toothpicks in the comparison groups.

From a clinical standpoint, the present study demonstrated that both the toothpicks provided effective dental plaque removal. However, evaluation of the remaining dental plaque after use of the toothpicks revealed a considerable amount, as demonstrated by the frequency of plaque scores (Fig 2), which revealed more than 30% and 20% of proximal aspects presenting scores 2 and 3 in the final period, respectively. These reductions were statistically significant. However, the frequency of score 0 for both the interdental devices was very low. These results suggest that the remaining dental plaque might be enough to cause an imbalance in the health and disease process of dental caries and periodontal disease, and thus might lead to the occurrence of the disease. Unfortunately, the present study design does not provide conclusions on the implications for the prevention of caries and periodontal disease on proximal regions, due to the lack of longer longitudinal follow-up. Bergenholtz et al (1974) found smaller amounts of remaining dental plaque with use of dental floss compared with that of triangular woodstick.

However, Lewis et al (2004) conducted a study on individuals with gingivitis and did not find any significant differences between the use of dental floss and triangular woodstick for the reduction of proximal gingivitis. Cercek et al (1983) used a similar methodology and observed similar outcomes. These results might not be due to the remaining visible plaque, but might be due to the mechanical action of the interdental devices interfering in the pathogenicity. However, it should be highlighted that all subjects in these studies had periodontitis and thus probably exhibited larger interproximal spaces, in which the toothpick may provide better results (Gjermo and Flötra, 1970). In the present study, the use of toothpicks in individuals without periodontal attachment loss and thus with intact proximal aspects may partly explain the amount of remaining dental plaque for both groups of toothpicks. However, further studies on the samples of diseased individuals with a longer follow-up should be conducted.

In summary, analysis of the present results allows the following conclusions.

- Both the interdental devices improved the Plaque Index. Intragroup analysis (over time) of buccal proximal and palatal/lingual proximal aspects did not reveal differences in the efficacy of dental plaque removal between triangular woodsticks and round toothpicks.
- Both triangular woodsticks and round toothpicks provide similar outcomes on buccal proximal and palatal/lingual proximal aspects.
- Both types of toothpick were not effective for complete removal of dental plaque from the embrasure spaces. The clinical relevance of this remaining dental plaque is unknown.

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