

Efficacy of Plaque Control by Tooth Brushing with and without Different Dentifrices: A Clinical Trial

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Abstract

Objective: Microbial plaque is among the main etiologies of periodontal disease, and tooth brushing with toothpaste is the most commonly used method of plaque control. This study aimed to compare the efficacy of tooth brushing with and without three different dentifrices.

Methods: Thirty dental students were randomly selected to participate in this clinical trial and were asked to refrain from any plaque control measure for 24 hours. Candidates were then randomly assigned to one of the three groups of tooth brushing with Pooneh whitening toothpaste, Crest 3D White, Sensodyne Original and tooth brushing without toothpaste. Subjects were asked to brush their teeth for two minutes using the Bass technique. Plaque index was calculated before and after the intervention. This process was repeated until all subjects experienced all the understudy interventional protocols (tooth brushing with three different toothpastes and without toothpaste). Data were analyzed by repeated measures ANOVA and paired t-test.

Results: No statistically significant difference was noted in the efficacy of plaque control by tooth brushing with Crest 3D White and Sensodyne Original and tooth brushing without toothpaste; however, significant differences were noted in this respect between Pooneh toothpaste and the remaining three tooth brushing protocols ($p \leq 0.001$).

Conclusion: Tooth brushing without toothpaste may have a plaque control efficacy equal or even higher than that of tooth brushing with toothpaste.

Key words: Dental plaque, Detergent, Lubricant, Sorbitol, Toothpaste, Triclosan.

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Introduction:

Microbial plaque is widely known as the main etiology of periodontal disease (1). Dental plaque control refers to its regular elimination, and prevention of its re-accumulation on the teeth and adjacent gingival surfaces (2). Tooth brushing with toothpaste is a highly emphasized oral hygiene measure and is the most commonly

used method of plaque control (3, 4). American Dental Association has specified four types of toothpastes for use:

1. Anti-caries toothpastes: Fluoride toothpastes, first introduced in late 1950, are generally believed to decrease the rate of caries (5).
2. Anti-caries, anti-plaque and anti-gingivitis toothpastes: Triclosan is among the most important compounds incorporated into

toothpastes as an anti-plaque and anti-gingivitis agent and is effective against many types of bacteria (6). Evidence shows that its incorporation in toothpastes and mouth rinses is safe (7, 8).

3. Anti-caries and anti-sensitivity toothpastes: The mechanism of action of most anti-sensitivity agents is obstruction of dentinal tubules (9).

4. Anti-caries and anti-calculus toothpastes (10) Many studies have investigated the anti-plaque efficacy of toothpastes and the role of different toothpaste ingredients in this respect. White in 2007 evaluated the efficacy of toothpastes for decreasing microbial plaque and reported that 0.45% stannous fluoride toothpaste had a significantly higher efficacy than 0.24% sodium fluoride in this respect (11). Barnes, *et al*, in 2008 evaluated the efficacy of toothpaste containing zinc citrate for dental plaque reduction and reported that it was significantly more efficient than conventional fluoride toothpaste (12). Ebadifar, *et al*. compared the efficacy of Iranian toothpastes in 2008 and it was revealed that the Three-Color Pooneh and conventional Pooneh toothpastes had similar efficacy in prevention of dental plaque formation (13).

Some previous studies have compared the efficacy of tooth brushing with and without toothpastes. Eid and Talik in 1991 stated that tooth brushing with toothpaste was more effective than tooth brushing with water for microbial plaque removal (14). However, some other studies have questioned this statement. Parizotto, *et al*. in 2003 found no significant difference in plaque removal efficacy of tooth brushing with and without toothpaste (15). Many others have also stated that dentifrices do not contribute to the efficacy of tooth brushing for plaque removal (1, 16, 17).

Controversy exists about the efficacy of toothpastes for microbial plaque removal when

used in conjunction with tooth brushing. Considering the important role of plaque control for prevention of periodontal disease, this study aimed to assess the efficacy of tooth brushing with and without three popular toothpastes in the Iranian market (Crest 3D White, Sensodyne Original and Pooneh) for plaque control.

Methods:

This prospective clinical trial was conducted on 30 dental students aged 18-24 years including 17 females and 13 males who were randomly selected among dental students of Isfahan University of Medical Sciences, School of Dentistry. From the alphabetical list of students, numbers that were multiples of 10 were chosen (45 subjects); of which, 8 did not qualify and 7 were not willing to participate in the study. The inclusion criteria were:

- Absence of orthodontic appliances
- Having a minimum of five teeth in each quadrant
- Absence of removable partial dentures
- Not having heavy calculus or long-span fixed partial denture
- No pregnancy
- No tobacco consumption
- No periodontitis
- No systemic disease affecting oral and dental health status
- No allergy to toothpaste ingredients

The objectives and the course of study were thoroughly explained to subjects and written informed consent was obtained from them. Before the intervention, all patients received oral prophylaxis and scaling if required. Tooth brushing using the Bass technique was instructed to subjects. GUM-411 toothbrush was given to all subjects in order to eliminate the effect of any possible confounder related to the type of toothbrush on plaque control such as the type of movement, force, frequency, stiffness of bristles and round end of bristles. Subjects were the

randomly divided into four groups; out of which, three received Crest 3D White, Sensodyne Original or Pooneh whitening toothpaste, respectively. The fourth group received no toothpaste. In the next sessions, the plaque control measure (type of intervention) was changed for each group in such way that by the end of the experiment, all four groups had experienced all the understudy interventions. In order to eliminate the carry-over effect, two strategies were used: In order to prevent the effect of the previous plaque control measure on the next one, a one-week wash out period was allowed in between the interventions. During this time period, the subjects used none of the understudy toothpastes. Moreover, in order to eliminate the effect of increased expertise and skills of the candidates (as a confounding factor) during the study, we tried our best for the candidates to reach maximum level of expertise in using the Bass tooth brushing technique. Additionally, order of interventions was different in the four groups. Random allocation of subjects to groups was done as follows: Each subject was given a number from 1 to 30 and all numbers were placed in a box. An individual blinded to the groups did the drawing and each subject was assigned to a group. The four types

of interventions were written on sheets of paper and placed in a box. Accordingly, the order of using each type of intervention by each individual was randomly determined. Subjects were then asked to brush their teeth with the given toothbrush and toothpaste using the Bass technique for one week to become acquainted with the protocol. Also, subjects were requested to refrain from tooth brushing for 24 hours prior to their next visit. In the next session, after ensuring complete patient compliance with the protocols, the plaque index was measured using the Quigley and Hein Plaque Index (1962) (18) modified by Turesky, *et al.* (1970) (19) and Lobene, *et al.* (1982) (20). Examiners were blinded to the group allocations and distribution of data. Data were analyzed using SPSS version 16, repeated measures ANOVA and paired t-test (for pair wise comparison of groups).

Results:

The mean percentage of plaque reduction based on the plaque control protocol is shown in Table 1. The mean baseline and post-intervention plaque index values and their difference (plaque reduction) in different groups are shown in Diagram 1.

Table 1- The mean percentage of plaque reduction based on the type of plaque control measure

Plaque control measure	mean (SD) plaque reduction
Tooth brushing without toothpaste	56.47 (21.50)
Tooth brushing with Pooneh whitening toothpaste	34.59 (17.96)
Tooth brushing with Crest 3D White	56.29 (21.91)
Tooth brushing with Sensodyne Original	62.38 (17.29)

Diagram 2 shows the percentage of plaque reduction based on the plaque control measure applied.

Considering the dependent nature of variables, repeated measures ANOVA was applied to compare plaque reduction in different groups and revealed significant differences in this

respect among groups ($p \leq 0.001$).

Significant differences existed in the mean plaque reduction by Pooneh toothpaste and the remaining three protocols. The remaining three protocols were not significantly different in terms of the efficacy of plaque control.

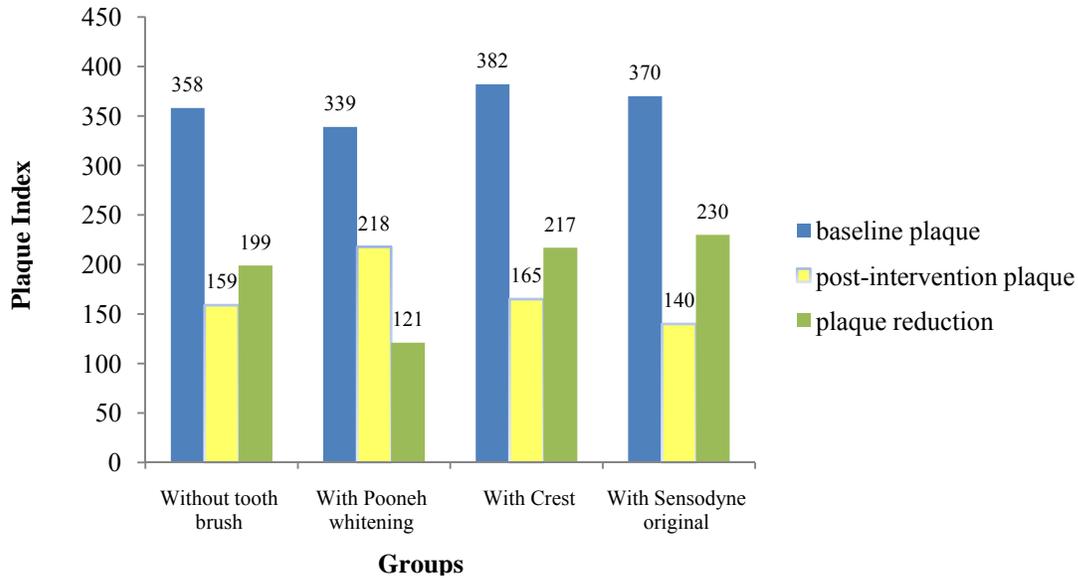


Diagram 1- The mean baseline and post-intervention plaque index values and their difference (plaque reduction) in the four groups

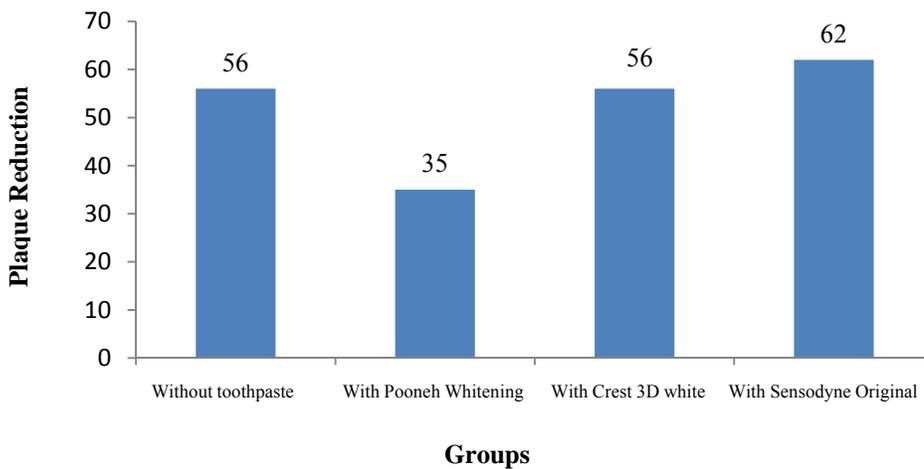


Diagram 2- Percentage of plaque reduction using each intervention

Table 2- p-values calculated by pair wise comparison of different plaque control measures using paired t-test

Plaque control measure	Pooneh whitening toothpaste	No toothpaste	Sensodyne Original
Crest 3D white toothpaste	*p≤0.001	p=0.438	p=0.661
Sensodyne original toothpaste	*p≤0.001	p=0.159	-
Without toothpaste	*p≤0.001	-	-

*Significant

Discussion:

In this study, three popular toothpastes in Iran

namely Crest 3D White (whitening), Sensodyne Original (anti-sensitivity) and Pooneh (whitening) were compared. Abrasive agents and

detergents are present in the composition of toothpastes. Abrasive materials have long been incorporated into toothpastes to eliminate plaque collagen matrix and decrease microbial plaque (3, 21). It has been claimed that detergents can also penetrate into the dental plaque structure and dissolve it and consequently whiten the tooth surface. Moreover, the bubbling effect of detergent can also help plaque elimination by compromising its bond to tooth structure (22).

Considering the constant and inevitable daily formation of microbial plaque, evaluation of the effect of time on decreasing or increasing plaque formation within 24 hours does not seem to be appropriate and it is different from the pattern of disease because dental plaque starts to accumulate again slightly after its removal.

To eliminate the carry-over effect, two measures were taken. First, in order to prevent the effect of previous plaque control measure on the next one, one week washout period was allowed for each patient in-between different methods. During the washout period, the patients did not use any of the understudy toothpastes. Second, to prevent the effect of increased expertise of candidates during the study period, as a confounder, we tried our best for candidates to reach their ideal level of expertise in conduction of Bass technique. Moreover, the order of conduction of methods in the 4 groups was planned differently (It should be noted that time effect and carryover effect analyses were performed but the results were not significant).

In the current study, Pooneh toothpaste had a statistically significant difference with the remaining three protocols in terms of plaque control. In other words, it had lower efficacy for plaque control than the other three methods. The inefficacy of toothpaste in combination with tooth brushing has been contradicted by many investigations including a study by Eid and Talic in 1991 (14). In their study, after two days of no plaque control measure, tooth brushing with toothpaste was more effective than tooth

brushing alone in dental plaque removal. Aside from the type of toothpaste (not mentioned), this finding may be due to the different methodology of their study. In their study, duration of tooth brushing was shorter and the index used for plaque measurement was different from the plaque index used in our study.

Similar recent studies have reported that tooth brushing without toothpaste is more effective than tooth brushing with toothpaste (1, 16, 17). However, type of toothpaste has not been mentioned in these studies. Type and composition of toothpastes play an important role in plaque control. In our study, significant differences were noted between Pooneh and the other two toothpastes. Moreover, the above-mentioned studies reported that the abrasive agents present in the composition of toothpastes had no effect on plaque control. In the current study, all three toothpastes were similar in terms of the abrasive agent in their composition (silica). In another study conducted by the authors of the current one in 2010, the abrasive effect of several toothpastes was compared by profilometry and the abrasiveness of Pooneh, Crest 3D White and Sensodyne Original was found to be significantly different (23).

The detergent used in Crest 3D White and Pooneh toothpastes is sodium lauryl sulfate. Due to the unfavorable cross-reaction of sodium lauryl sulfate with the anti-sensitivity agents in Sensodyne, another detergent is used in its formulation. Thus, type of detergent does not seem to be a determining factor in this regard. Since the detergent in Crest and Pooneh toothpastes is the same, the significant difference between Pooneh and the other two toothpastes may be attributed to the interaction of detergent with other ingredients in Pooneh toothpaste formulation. As mentioned earlier, detergents may lose their anti-plaque property in presence of other ingredients (22). The lubricant is another component that may also play a role in this regard (5). Sorbitol or glycerol may be

used as lubricants in the composition of toothpastes. Ranjitkar, *et al.* in 2009 discussed that glycerol or other lubricants in toothpastes (depending on their concentration) may lubricate the surface and decrease friction between the tooth surface and toothbrush bristles and consequently, decrease the efficacy of tooth brushing for mechanical plaque removal (24). Paraskevas, *et al.* in 2006 confirmed this finding and attributed it to the sliding effect of toothpastes (17).

As stated earlier, type and concentration of the lubricant present in the composition of toothpastes may play a role in this regard. The lubricant in Crest 3D White and Sensodyne Original is sorbitol but Pooneh toothpaste has both sorbitol and glycerol. Thus, it may be concluded that aside from its formulation and possibly lower efficacy of its detergent, the lower efficacy of Pooneh toothpaste for plaque removal may be due to the higher amount of lubricants in its formulation and greater sliding effect (25). Overall, it may be concluded that tooth brushing with water without any toothpaste is as effective as tooth brushing with toothpaste for microbial plaque removal. However, it greatly depends on the type of

toothpaste and its composition i.e. abrasive agents, detergents, lubricants and their sliding effect and the overall interaction effect of these components. This is probably responsible for the controversial results obtained by different studies on the effect of toothpaste on the quality of plaque control. It must be noted that although according to some studies, use of toothpastes does not improve the quality of plaque control, it does not justify not using them because toothpastes serve other purposes as well such as providing a rich source of fluoride or anti-calculus agents and refreshing the mouth. Thus, toothpastes are clinically beneficial.

Conclusion:

The results of the current study revealed significant differences in efficacy of plaque removal by tooth brushing with Pooneh toothpaste and Crest 3D White, Sensodyne Original and tooth brushing without toothpaste. These findings emphasize the low efficacy of Pooneh toothpaste for microbial plaque removal.

Conflict of Interest: “none Declared”

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