

A Comparison of Four Types of Toothbrushes and Different Tooth Brushing Methods on Plaque Removal

I. Examinations using second year dental hygiene students as subjects

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Summary

To clarify the relationship between the type of brush and brushing methods, 30 students in Matsumoto Dental College, School of Dental Hygiene were requested to use 4 different types of brushes with 4 brushing methods during 4 two week periods. The following results were obtained :

1. Brushing methods :

The scrub method had the best results in plaque control, followed by the Bass, modified Stillman and roll methods in that order. A significant difference was observed with these brushing methods ($p < 0.01$).

2. Toothbrushes :

Test brushes S and M got the best results, and H and the open-tufted brushes followed. Significant differences were observed with these brushes ($p < 0.01$).

3. Interaction between brushing methods and brushes :

Plaque control effectiveness tended to differ with brushing method between the facial and proximofacial surfaces.

a. Facial surfaces :

Test brush H showed a higher plaque control effectiveness with the scrub and Bass methods than that of test brushes M and S.

Test brush M was the most effective for plaque control using the roll and modified Stillman methods.

b. Proximofacial surfaces:

Test brush S was the most effective with the Bass method and M was more effective with the other methods.

Introduction

Tooth brushing is very important for avoiding periodontal disease and the need for periodontal treatment. Brushing methods and tooth brushes are related to oral cleanliness, especially plaque removal. There have been a number of reports on basic brushing methods and toothbrushes.¹⁻⁸⁾ However, there was no report on plaque removal of the various brushing methods when the specifications of the toothbrushes were changed.

In this study, the authors tried to clarify this relationship between the specification on the toothbrushes and various brushing methods. For this purpose, the authors compared the effectiveness of plaque removal of 4 different types of toothbrushes with 4 brushing methods.

Materials and Method

Thirty students in the second class at Matsumoto Dental College, School of Dental Hygiene, were selected as subjects. They tried test brushes with the roll, Bass, modified Stillman, and scrub methods for 2 week intervals.

The test brushes had 4 different hole diameters, numbers of holes, filament diameters, and filament lengths, as shown in Table I, Fig. 1.

The same tooth paste was used during the test period. Areas $\frac{6}{41} \frac{14}{6}$ were observed. Plaque measurement per tooth was made on the mesial, center and distal of the facial and lingual surfaces, and mesial and distal proximal surfaces. A total of 10 points were measured.

On the last day of the testing period, the height of plaque was measured at 0.5 mm intervals from the gingival margin and registered as the plaque score.

Analysis was made of the brushing method, toothbrushes, amount of plaque, tooth, and tooth surfaces, and then an analysis of variance was performed.

Table 1. Specification of tested tooth brushes

Items Tested tooth-brushes	Diameter of hole (mm)	Pitch of hole (mm)	Arrangement of hole	Diameter* of filaments (mil)	Height of filaments (mm)	Buchling Load of filaments (kg/cm ²)	Stiffnes of filaments	Length of brush (mm)
Tooth brush. S	1.8	3.2	2+3 6+2	6	10	4.1	Soft	24.2
Tooth brush. M	1.8	3.2	2+3 6+2	8	11	6.2	Medium	24.2
Tooth brush. H	1.8	3.2	2+3 6+2	10	12	9.5	Hard	24.2
Tooth brush Open-tufted	1.8	4.2	26	8	11	7.6	Medium	23.6

*1 mil=1/1000 inch

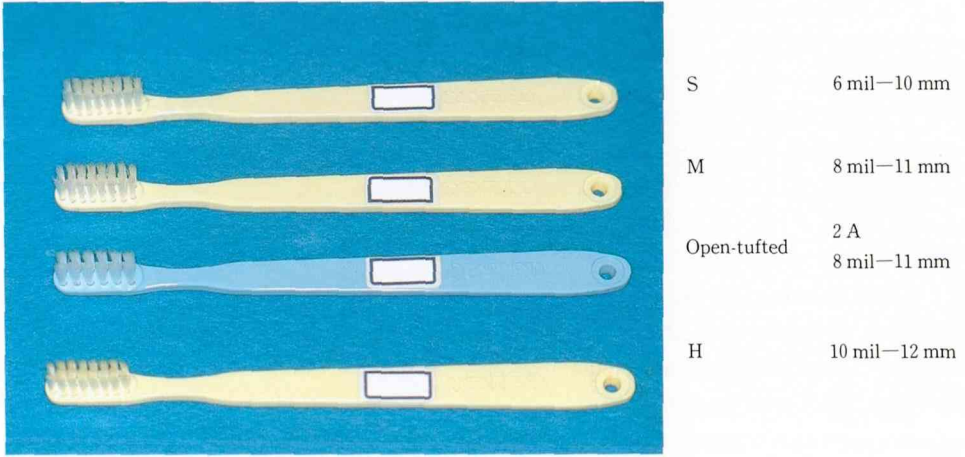


Fig. 1. Four kinds of trial tooth brushes used in the experiment

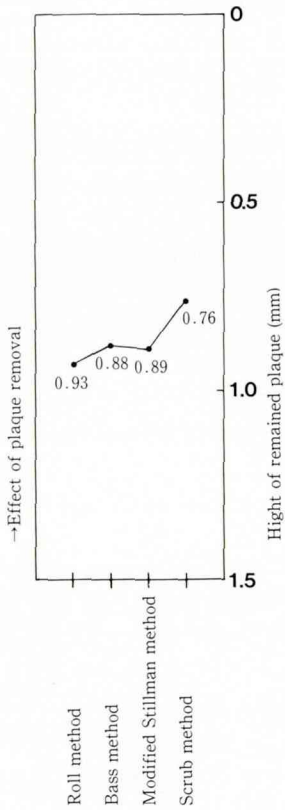


Fig. 2. Effectiveness of the plaque removal of brushing methods. ($P < 0.01$)

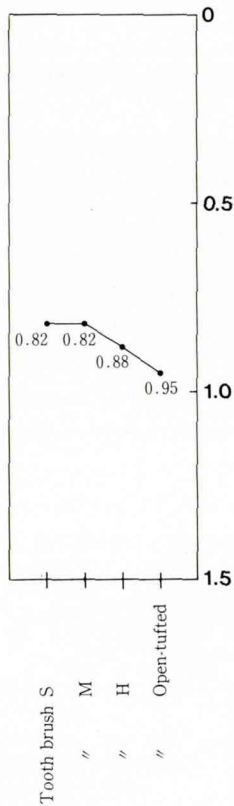


Fig. 3. Effectiveness of the plaque removal of tooth brushes. ($P < 0.01$)

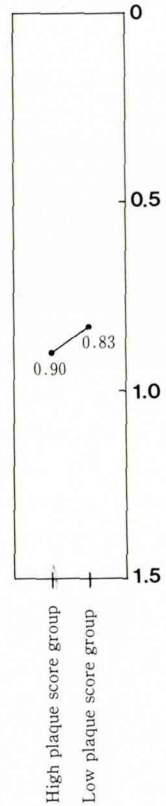


Fig. 4. Effectiveness of the plaque removal between 2 groups that divided by an amount of plaque before clinical test. ($P < 0.01$)

Results

1. The results of the overall analysis

a. Brushing methods:

A significant difference was observed for each brushing method ($p < 0.01$). The scrub method was most effective for plaque removal, followed by the Bass, modified Stillman and roll methods in that order (Fig. 2).

b. Toothbrushes:

Test brushes S and M achieved the best results for plaque removal, followed by H and the open-tufted brush. Significant differences ($p < 0.01$) were observed for each brush (Fig. 3).

c. The amount of plaque before testing:

Before testing, the amount of plaque (sum of 10 points) was determined. The students were divided into two groups. The first group had a total of 56 mm or more plaque and the second had less. There was a significant difference between the groups ($p < 0.01$). It was observed that the amount of plaque in the second group remained low after testing (Fig. 4).

d. The teeth:

There were significant differences for each tooth examined ($p < 0.01$). The best plaque removal

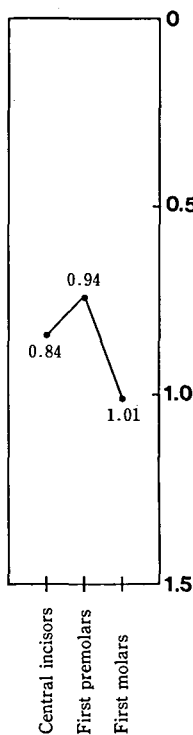


Fig. 5. Effectiveness of the plaque removal among teeth. ($P < 0.01$)

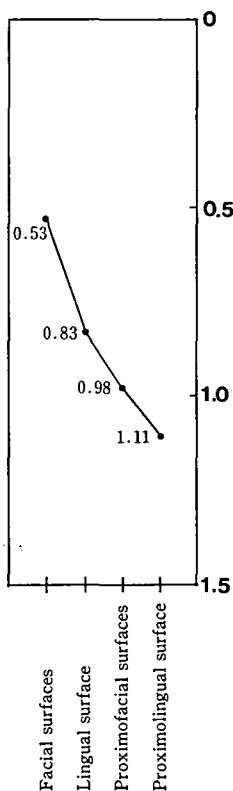


Fig. 6. Effectiveness of the plaque removal among tooth surfaces. ($P < 0.01$)

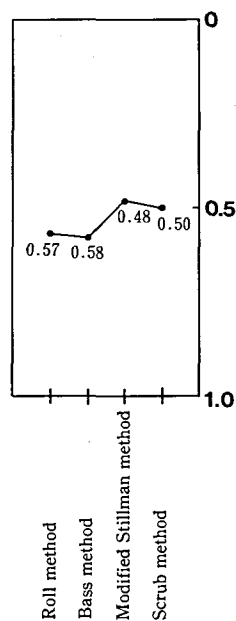


Fig. 7. Effectiveness of the plaque removal of brushing methods. N. S. (This result was analysed using the facial surfaces data.)

was observed on the first premolar, followed by the central incisor and first molar in that order.
 e. The tooth surfaces:

The ten areas measured were grouped into 4 surfaces for analysis. They were the facial, lingual, proximofacial and proximolingual surfaces. A significant difference was observed for each tooth surface ($p < 0.01$). The facial surfaces had the least amount of plaque followed by the lingual, proximofacial and proximolingual surfaces in that order (Fig. 5).

2. Analysis of the facial surfaces

This comparison was made between the facial and proximofacial surfaces. The reason why we selected these two surfaces was that the brushing instructions for the lingual were not complete (Fig. 6). Brushing in this area varied with each student.

a. The results for the facial surfaces:

The effectiveness of plaque removal using the modified Stillman and scrub methods was slightly better than that for the roll and Bass methods. No significant difference was observed (Fig. 7). However, a significant difference was observed between the brushes ($p < 0.05$), Test brush H had the best results (Fig. 8).

b. The result for the proximofacial surfaces:

A significant difference was observed for each brushing method ($p < 0.01$). The scrub method produced the best results, with the modified Stillman, Bass and roll methods following in that order (Fig. 9). Test brush M got the best results of all brushes (Fig. 10).

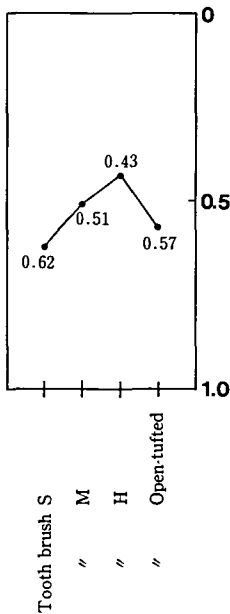


Fig. 8. Effectiveness of the plaque removal of tooth brushes. ($P < 0.05$) (This result was analysed using the facial surfaces data.)

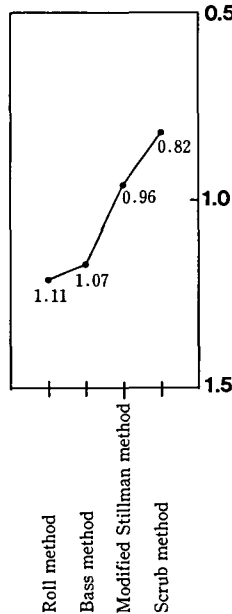


Fig. 9. Effectiveness of the plaque removal of brushing methods. ($P < 0.01$) (This result was analysed using the proximofacial surfaces.)

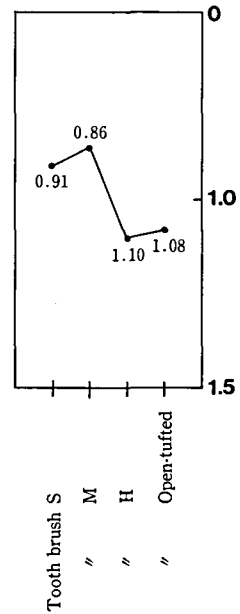


Fig. 10. Effectiveness of the plaque removal of tooth brushes. ($P < 0.01$) (This result was analysed using proximofacial surfaces data.)

c. Interaction between methods and test brushes :

The effectiveness of plaque removal of each test brush, with its different specifications, is shown in Fig. 11. They are divided as to brushing method. The brushing methods, except for the roll method, produced different results for different brushes on the facial and proximofacial surfaces.

Especially with the Bass method, test brushes S, M, and H showed different results for different tooth surfaces. Test brush H (hard) was better on the facial surfaces than M (medium) or S (soft) with the scrub methods which require the use of the edge of the filament. Test brush M was best with the roll method.

And open-tufted brush got good results using the modified Stillman method. Test brush S was good on the lingual surfaces for the Bass methods, and brush M was good for the other three Methods. The open-tufted brush was worse than the other brushes with the roll and Bass methods.

d. Interaction between the test brushes and the amount of plaque before testing :

As shown in Fig. 12, no definite tendency was observed. Also an average total of plaque showed similarity between the two groups, i. e., the plaque scores remained high for those subjects who started the test with high scores, and remained low for the others.

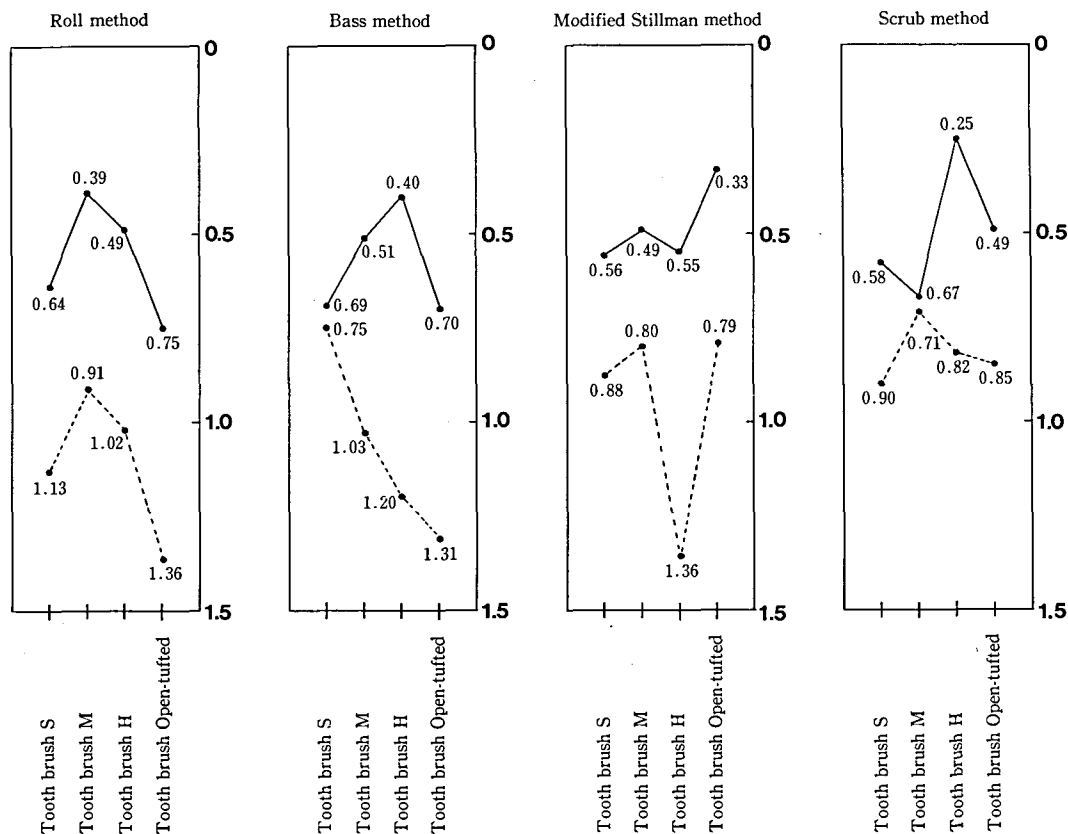


Fig. 11. Interaction of brushing method and tooth brush to plaque removal from the facial surfaces and the proximofacial surfaces. Real lines show the result of analysis using the facial surfaces data. Dotted lines show the result of analysis using the proximofacial surfaces data.

Discussion

There are a number of reports comparing the effectiveness of plaque removal and brushing methods on adult patients^{5,6,7}. Most of them mix the effects of brushing methods and toothbrushes. For example, Arai⁵) reported that the Fones technique using the Perio H brush got better plaque control results than the Charter and Bass methods using the Dent PD-M. However, it was not clear whether the difference resulted from the method or the brush.

In this study, the authors used 4 different types of brushes and 4 brushing methods to determine the effectiveness of the brushing methods and brushes separately.

1. Evaluation Methods :

In this study, the authors measured the amount of plaque in the gingival margin area and recorded the values as the plaque score. This was because the authors felt that since the subjects were selected from students in dental hygiene school, little difference in O. H. I. would be expected. The authors referred to the reports by Arai and Kinoshita⁵) for the evaluation method.

2. Assessment of the plaque control with different brushing methods :

On the facial and proximofacial surfaces, where the brushing was done according to instructions, the scrub and modified Stillman methods achieved better results than the rolling and Bass methods. In particular, the scrub method showed the best results on the proximofacial surfaces. The

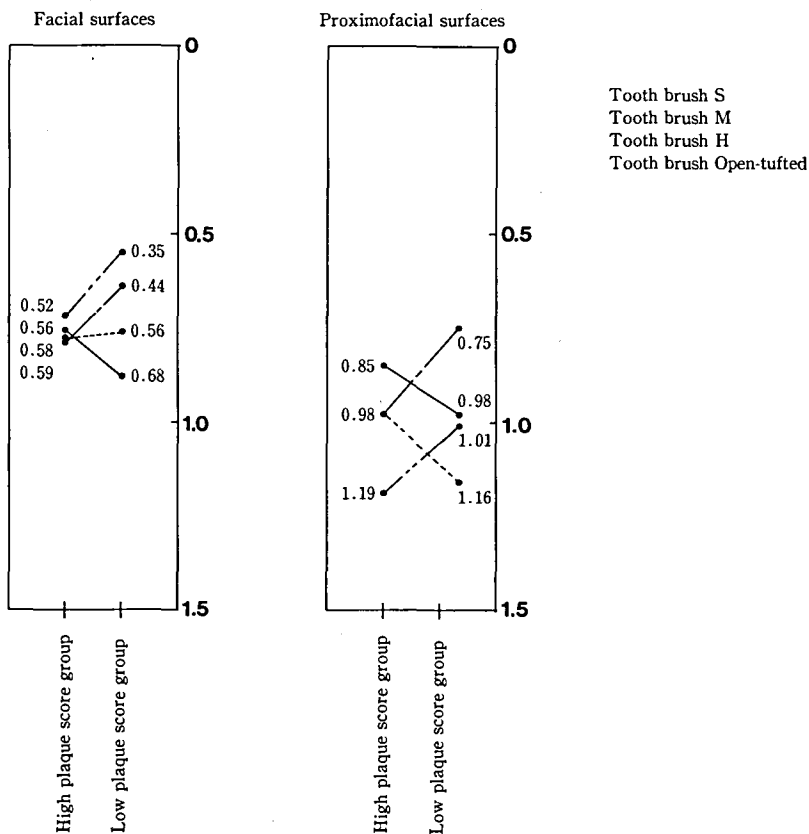


Fig. 12. Interaction of tooth brush and an amount of plaque before clinical test

result was the same as in the reports by Watanabe⁹⁾ and Arai⁵⁾. Watanabe⁹⁾ used only one kind of brush and Arai⁵⁾ used different brushes for the rolling and scrub methods and compared the results.

The fact that the results in this study agreed with the above two reports meant that the scrub technique, for which a filament-head brush was used on the surface at a right angle, was considered a better method than the rolling and modified Stillman methods, for which the bristle was applied parallel to the surface, and better than the Bass technique, for which the bristle was applied to the tooth surface at a 45 degree angle. Also, Saito et al⁸⁾ and Sangnes et al⁹⁾ reported similar results.

3. The effectiveness of plaque control with three different test brushes :

Test brushes S, M, and H had the filament hardnesses indicated as "hard," "medium," and "soft." The open-tufted brush had a larger hole to hole width than the above three brushes and had "medium" filaments.

Test brush H had comparatively good plaque control on the facial surfaces. On the proximo-facial surfaces, test brush S was more effective with the Bass method, and test brush M was good with the other methods.

Arai⁶⁾ reported that generally a "hard" brush was good for plaque control. In this study, a similar tendency was observed on the facial surfaces but not on the proximofacial surfaces.

It is thought that filaments should have a well-balanced contact for brushing the facial surface. On the proximofacial surface, however, several elements such as brushing pressure, length of stroke, and width of the brushing area affect plaque control.

Barnes¹⁰⁾ reported that a dense-tufted brush showed better results than an open-tufted brush. The Bass method showed similar results in this study.

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