

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

## II. Examinations using first year dental hygiene students as subjects

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### Summary

In a continuation of the first report, the authors hoped to clarify the relationship between toothbrush specifications and various brushing methods. For this purpose, we compared the effectiveness of plaque removal for 4 different types of brushes with 4 different brushing methods. The first year students of Matsumoto Dental College, School of Dental Hygiene, were selected as subjects.

The results were as follows :

#### 1. Brushing methods :

No significant difference was observed with the roll, Bass, or modified Stillman methods when all surfaces were grouped together. Also, no significant difference was observed on the facial surfaces with the different methods. However, the Bass and roll methods tended to be slightly better.

The results of this study did not correlate with the previous study or with the reports from Arai and Watanabe. The subjects' skill and control at the time of evaluation were taken into consideration.

#### 2. Test brushed :

Test brush S was the most effective when all surfaces were grouped together and test brush M was the least effective. This tendency was observed on both the facial and the

proximofacial surfaces.

### 3. Interaction between test brushes and the amount of plaque prior to testing :

It was observed that subjects who were divided into the "small" group prior to testing kept the amount of plaque at the same low level after testing. By comparing the results with the previous report, the authors concluded that there was more advancement in the skill of the second year students than the first year students.

## Introduction

It is well known that brushing the teeth is a very important factor in the prevention and treatment of periodontal disease. Also, the brushing methods and type of toothbrush affect oral cleanliness, especially plaque control. A number of reports have been made on basic brushing methods and toothbrushes<sup>1-10</sup>. However, there were no reports on the effectiveness of plaque removal for different brushing methods when the specifications of the toothbrush were changed.

In the first report<sup>11</sup>, the authors presented the clinical results for subjects who were selected from second year students of the Matsumoto Dental College, School of Dental Hygiene. In this study, the subjects were selected from first year students of the same school to compare the correlation between various brushing methods and 4 different types of brushes with respect to the effectiveness of plaque removal.

## Materials and Methods

Thirty-five first year students of the Matsumoto Dental College, School of Dental Hygiene, were requested to test 4 different types of brushes with the roll, Bass, modified Stillman and scrub methods over a 4 week period.

As shown on Table 1, test brushes S, M and H had the same hole diameters, pitches and arrangements. However, their length and bristle thickness were different. An open-tufted brush had different hole diameter, pitch and arrangement than that of brushes S, M and H.

The thickness and length of the bristles were the same with test brush M. The same tooth paste was used during the test period.

Six teeth  $\frac{6}{41} \frac{14}{6}$  were observed. Measurements were made in the mesial, mesiofacial line angle, central, distofacial line angle, and distal regions of the facial and lingual surfaces, 10 points in total. On the last day of the test, the plaque amounts at 0.5 mm intervals from the gingival margin were measured and registered as the "plaque score."

Table 1. Specification of tested tooth brushes

Brushes	Items	Stiffnes of filaments	Pitch of hole(mm)	Arrangement of hole	Diameter * of filaments(mil)	Height of filaments(mm)	Length of brush (mm)
S		Soft	3.2	2+3 6+2	6	10	24.2
M		Medium	3.2	2+3 6+2	8	11	24.2
H		Hard	3.2	2+3 6+3	10	12	24.2
Open-tufted		Medium	4.2	2 6	8	11	23.6

\* 1 mil = 1/1000 inch

The analysis of variances were made using 5 elements which included brushing method, type of brush, amount of plaque prior to testing, tooth, and tooth surface.

**Results**

1. Overall results

a. Brushing methods :

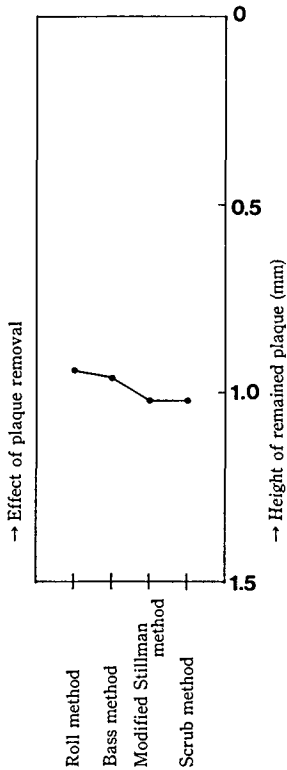
There was no significant difference between the brushing methods (Fig. 1).

b. Tooth brushes :

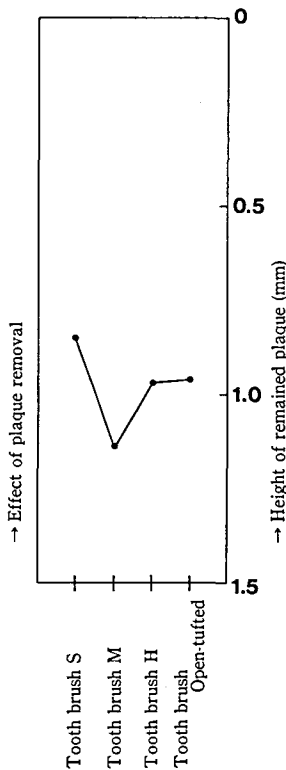
Significant difference was observed ( $p < 0.01$ ). Test brush M was most effective and H and M followed in that order (Fig. 2).

c. Plaque :

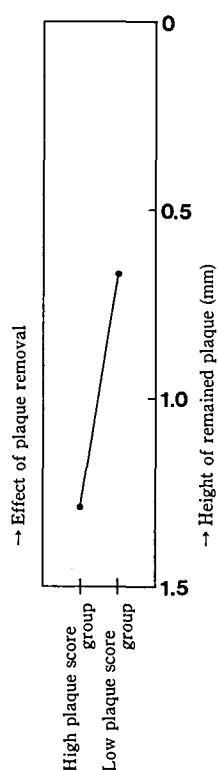
The amount of plaque prior to testing (a total of 10 points) was used in dividing the groups. The subjects that had a plaque amount of 56 mm and more were classified as the "large" group and the subjects that had less than 56 mm as the "small" group. Significant difference between these two groups were observed ( $p < 0.01$ ). It was also observed that the plaque amount of the "small" group



**Fig. 1.** Effectiveness of the plaque removal of brushing methods



**Fig. 2.** Effectiveness of the plaque removal of tooth brushes ( $P < 0.01$ )



**Fig. 3.** Effectiveness of the plaque removal between 2 groups that divided by an amount of plaque before clinical test ( $P < 0.01$ )

remained at a low level even following testing (Fig 3).

d. Teeth :

A significant difference was observed ( $p < 0.01$ ). The most effective plaque removal was observed on the first premolar. The central incisor and first molar followed in that order. They were at the same level (Fig. 4).

e. Tooth surface :

Measurements of 10 areas were combined into 4 surfaces for analysis. They were the facial surface (mesial, central, and distal regions), lingual surface, proximofacial surface (mesial and distal interproximal regions) and the proximolingual surface. Significant differences were observed for these surfaces ( $p < 0.01$ ). The best results were observed on the facial surface, with the lingual, proximolingual and proximofacial surfaces following in that order (Fig. 5).

2. Results for the facial and proximofacial surfaces

Analysis was done for the facial and proximofacial surfaces. The reason these two surfaces were selected was that the brushing on the lingual was not done according to instructions and was different for each student.

a. Results for the facial surface :

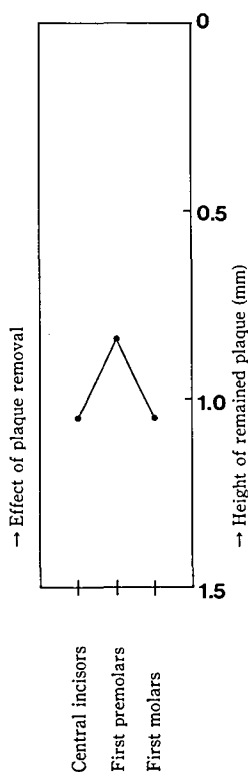


Fig. 4. Effectiveness of the plaque removal among tooth ( $P < 0.01$ )

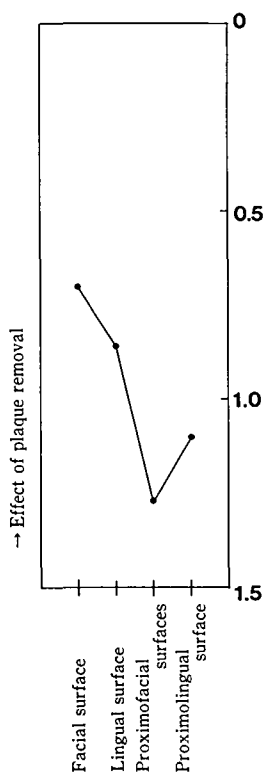


Fig. 5. Effectiveness of the plaque removal among tooth surfaces ( $P < 0.01$ )

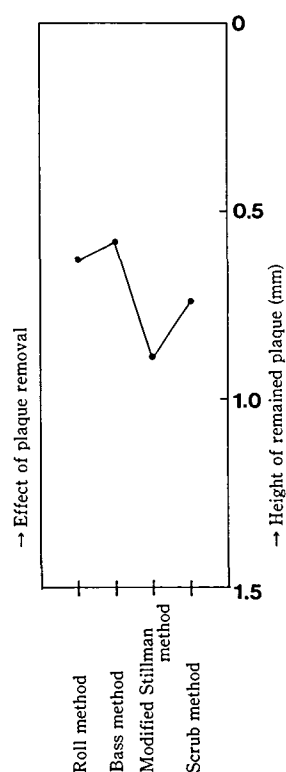


Fig. 6. Effectiveness of the plaque removal of brushing methods: This results is analysed using the facial surfaces data.

Among the brushing methods, the roll method showed the most effective plaque removal, while the scrub and modified Stillman methods followed in that order. However, no significant difference was observed between them (Fig. 6).

A significant difference was observed between each of the test brushes ( $p < 0.01$ ). Test brush S had the best results, with H and the open-tufted brush following. Test brush M had the worst results (Fig. 7).

b. Results for the proximofacial surface :

No significant difference was observed. The effectiveness of plaque removal for the 4 methods were similar (Fig. 8). However, a significant difference was observed for each of the test brushes ( $p < 0.01$ ). Test brush S showed the best results, while H, the open-tufted brush, and S followed in that order (Fig. 9).

c. Interaction between brushing methods and test brushes :

Fig. 10 shows the difference in plaque removal with each of the specified brushes and respective brushing methods.

As far as test brushes S, M, and H were concerned, the effectiveness of plaque removal was

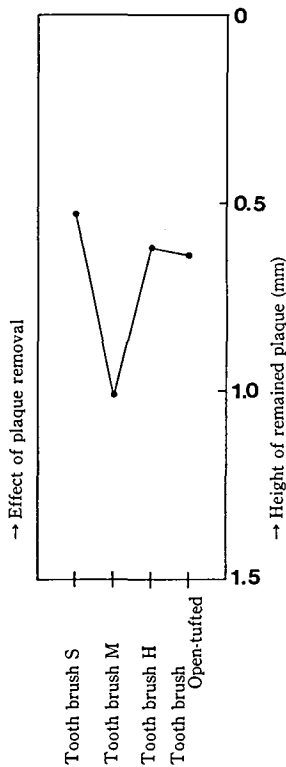


Fig. 7. Effectiveness of the plaque removal of tooth brushes ( $P < 0.01$ ): This result was analysed using the facial surfaces data.

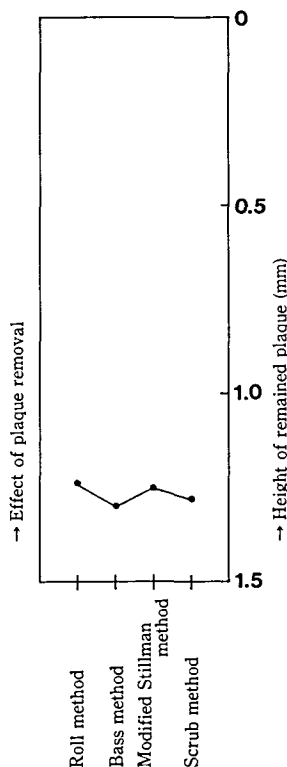


Fig. 8. Effectiveness of the plaque removal of brushing methods: (N. S.) This result was analysed using the proximo facial surface.

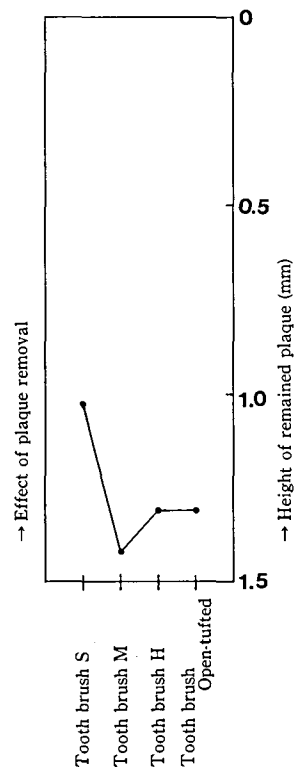


Fig. 9. Effectiveness of the plaque removal of tooth brushes ( $P < 0.01$ ): This results was analysed using the proximofacial surfaces data.

identical for different bristle hardnesses with the roll, Bass and scrub methods. Among these three methods, test brushes S and H showed better results than test brush M. Test brush M showed better results for the facial surface with all brushing methods than S or H. No significant difference was observed with the open-tufted brush. It showed 0.54 mm-0.69 mm with each of the brushing methods. When the proximofacial surfaces were observed, test brush M tended to show poorer results than S or H with the roll and scrub methods.

Test brush S had better results with the Bass method, and M with the modified Stillman method. The Open-tufted brush showed comparatively better results with the roll and modified Stillman methods, which require the use of the side of the bristles. However, it was worse with the Bass and scrub methods since they require the use of the head of the bristles.

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

As shown on Fig. 11, it was observed that the subjects who were classified as the "small" group prior to testing kept the amount of plaque at the same low level following testing.

Discussion

There are a number of reports comparing the effectiveness of plaque removal and brushing

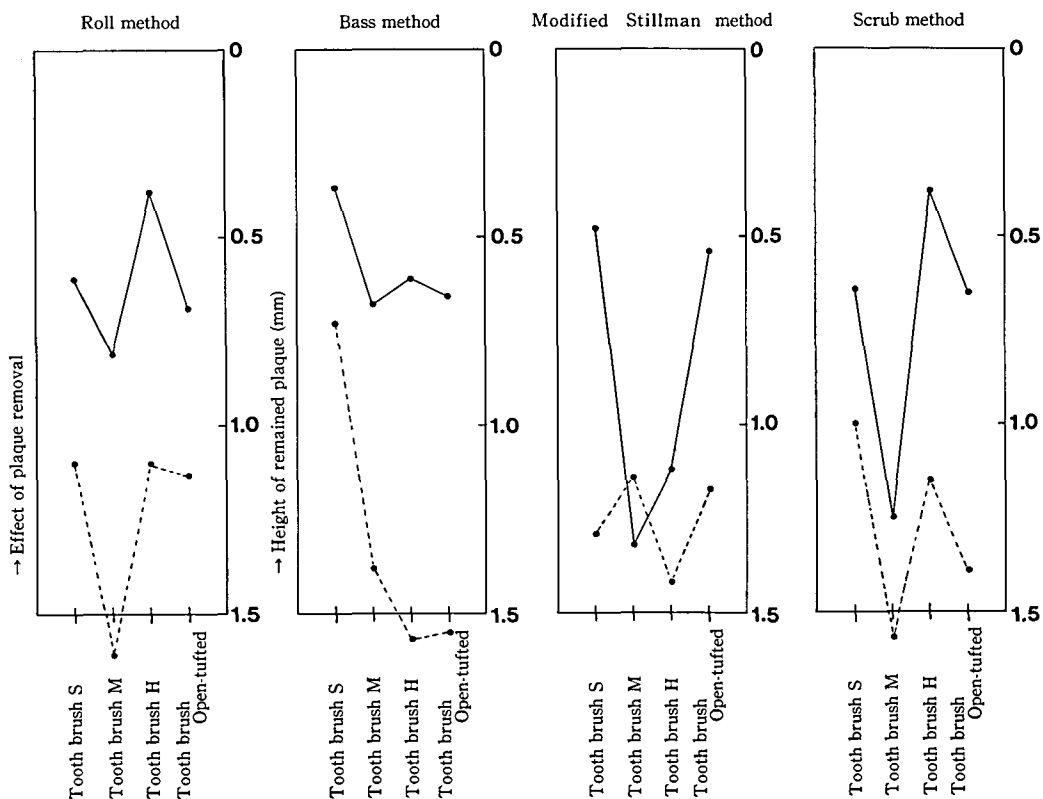


Fig. 10. Interaction of brushing method and tooth brush to plaque removal from the facial surfaces and the proximofacial surfaces: Real lines show the results of analysis using the facial surfaces data. Dotted lines show the result of analysis using the proximofacial surface data.

methods on adults<sup>5-7)</sup>. Most of these mixed the effects of the brushing methods and toothbrushes. For example Arai<sup>6)</sup> reported that the Fones technique using the Perio H brush had better plaque control results than the Charter's method using the Dent PD-M brush or the Bass method using the Dent PD-M. Consequently, it was not clear that the difference was due to the method or the brush.

In this study, the authors attempted to determine the effect of the method and the type of brush separately by using 4 types of brushes and 4 brushing methods.

The authors also attempted to compare the results between the first<sup>11)</sup> and second reports by changing the subjects. In this report, first year students were selected as subjects instead of second year students since they are considered to be less skilled in oral health.

1. Evaluation method :

The authors also used the measurement of the height of plaque in the area of the gingival margin, which was the same procedure as in the first report, and recorded it as the plaque score.

The authors used the measurement of plaque amount instead of the O. H. I. since differences in

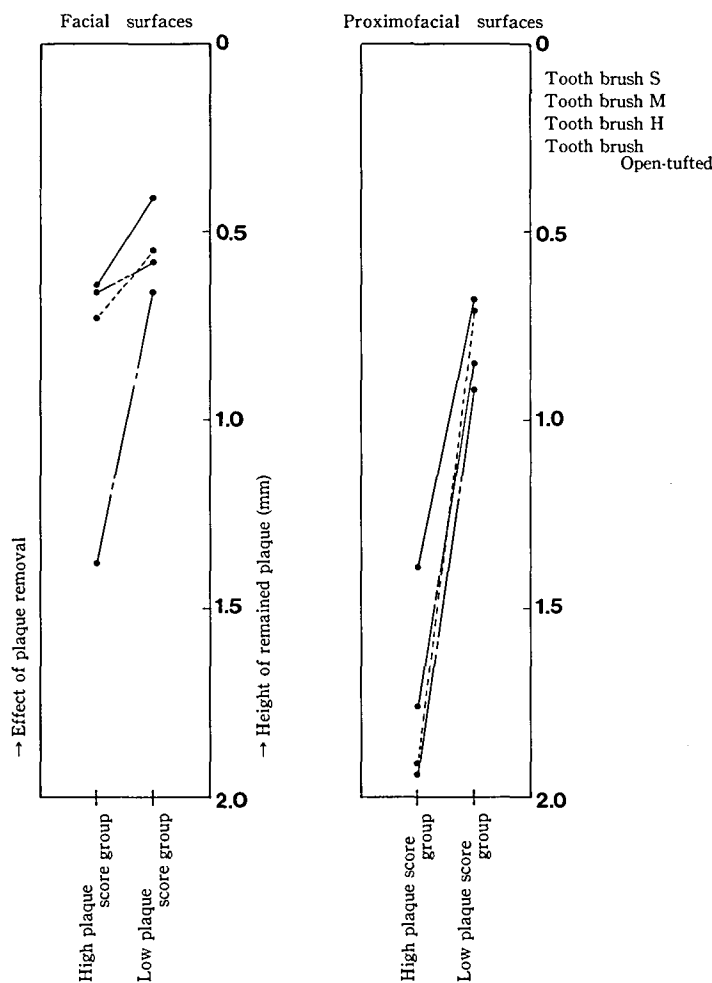


Fig. 11. Interaction of toothbrush and an amount of plaque before clinical test

O. H. I. could not be expected for well-trained subjects such as dental hygienists. Thus, the authors used the same examination method as in the reports by Arai and Kinoshita<sup>5)</sup>.

## 2. Plaque removal with the different brushing methods :

The Bass and roll methods tended to be better on facial surfaces, while no difference was observed on the proximofacial surfaces. Also, this result did not coincide with the first report<sup>11)</sup>. The authors considered this due to differences in the subjects. The subjects in the first report were well-trained, while those in this study were freshmen at the school. They had spent only 2 months at the school and had only one instruction period prior to testing.

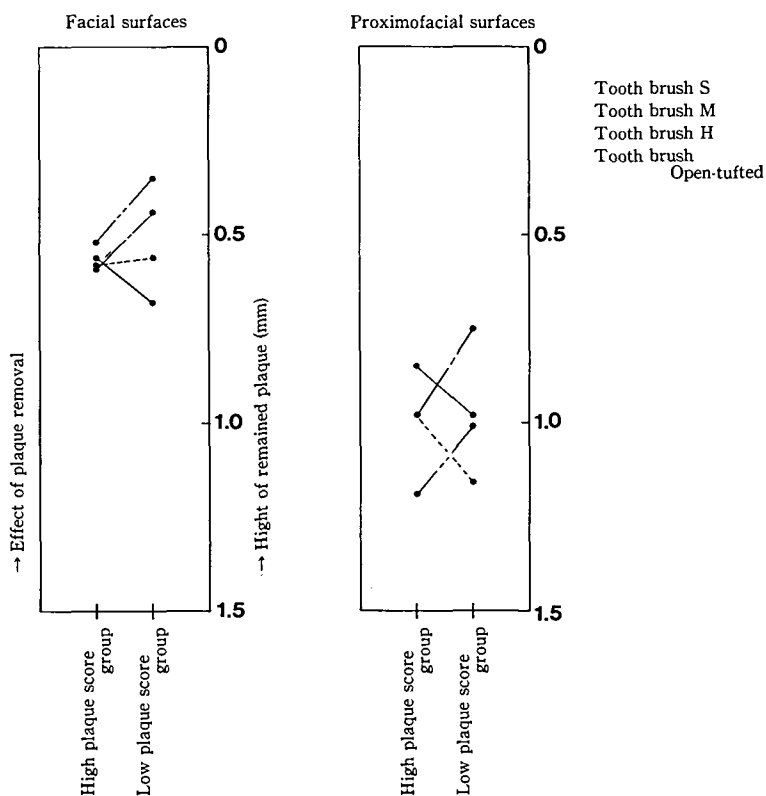
The subjects in the reports from Arai<sup>5)</sup> and Watanabe<sup>9)</sup> were selected from student and staff at the university. As a result, they were well-trained subjects. In addition, the subjects were made to brush their teeth in front of the instructors to see if they were doing it properly.

Therefore, the authors think the reasons for the poor results with the scrub and modified Stillman methods in this study were due to the skill of the subjects and the difference in their manual dexterity on the evaluation day.

## 3. The effectiveness of plaque removal for each test brush :

Test brushes S, M, and H had soft, medium, and hard bristles respectively. The open-tufted brush had a larger hole-to-hole width and medium bristles.

The test brush S was the most effective on both the facial and the proximofacial surfaces, while



**Fig. 12.** Interaction of toothbrush and an amount of plaque before clinical test (second years): Facial surfaces and proximofacial surfaces



H and M were the worst. More specific results are shown on Fig. 10. When the Bass and modified Stillman methods were used, test brush M showed the worst results at all measured points except on the facial surfaces.

Arai<sup>6)</sup> and Saito<sup>8)</sup> et al reported that hard brushes were generally considered more effective. The authors hope to further investigate this point.

#### 4. Interaction between the test brushes and the amount of plaque prior to testing :

As shown on Fig. 11, both "small" and "large" groups showed the same tendency before and following testing. The "small" group remained at a low level and the "large" group continued to show a large amount of plaque. The difference in the amount of plaque between these two groups was 0.62 mm in the first year and 0.07 mm in the second year students<sup>11)</sup> (Fig. 3).

The factors affecting the amount of plaque were divided into two groups. Misaligned teeth, the condition of the food, and the retention capacity of plaque for each subject were in the first group. Skill, and length and frequency of brushing were in the second group.

Though it was difficult to find differences in the "first group" factors, a large difference in the plaque amount between the "large" and "small" groups in first year students was observed, even during the test period.

In the first report,<sup>11)</sup> however, the differences between the "large" and "small" groups of second year students were smaller than that of first year students. No well defined tendency was observed for the various brushes during the test period (Fig. 12).

From the above, it is thought that skill, as well as the length and frequency of brushing, varied in both first and second year students.

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