

[Original] Matsumoto Shigaku 13 : 35~40, 1987

key words : plaque removal — toothbrush — toothbrushing method — scanning electron microscopy —  
periodontal disease

# Scanning Electron Microscopic Investigations of the Shape of Toothbrush Filaments with Various Brushing Techniques

## II. The second and the worst cases of plaque removal

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### Summary

Using 30 second-year students of the Matsumoto Dental College. School of Dental Hygiene as subjects, we performed investigations on toothbrush filament shape changes using 4 test toothbrushes and 4 different brushing techniques over 2 weeks periods. Also, observation by scanning electron microscopy was done for the toothbrushes which yielded the second and the worst effectiveness of plaque removal. The results were as follows :

1. The round-cut filament was worn semispherically or triangularly when using the rolling and Stillman techniques. Also, the round-cut and moving areas of the toothbrush body were worn significantly with the rolling and Stillman techniques.

2. The ditches at the filament edge were not as deep after two weeks of using the Bass and scrub techniques. There were deep ditches and scratches on the edge and center area of the filament with the rolling and modified Stillman techniques.

### Introduction

Brushing is very important in the prevention and treatment of periodontitis. Toothbrushes are most frequently used for oral hygiene, and for the removal of dental plaque. It is important and

informative for effective plaque removal to know the change of the toothbrush filament shape after use.<sup>1-5)</sup>

As in the previous experiment 4 types of toothbrushes were studied with 4 different brushing techniques. In the previous experiment a change in toothbrush filament shape was examined and discussed microscopically only for the toothbrush which yielded the best effectiveness of dental plaque removal.<sup>6)</sup> However, in this investigation those which yielded the second best and the worst effect were also examined.

### Methods and Materials

Thirty students of the Matsumoto Dental College, School of Dental Hygiene were requested to use a new toothbrush<sup>6)</sup> with 4 different brushing techniques for 2 weeks each using the rolling, Bass, modified Stillman, and scrub techniques. After 2 weeks dental plaque scores were taken and the toothbrushes which yielded the best, the second best the worst dental plaque removal were selected and subjected to scanning electron microscopic observations.

One filament was taken at random from the front, center and base areas, cleaned, dried and gold coated. Scanning electron microscopic observations were made at a magnification of 200. In this experiment the filament bundle was also observed microscopically at a magnification of 80, but not for the toothbrushes which yielded the second best and the worst results.

This is the reason the edge of the filament bundle of the used toothbrush was rounded and the changes in shape were small.

### Results

1. Regardless of the cleaning effect, the edge of the toothbrush filaments were worn almost rectangularly to the longitudinal axis after two weeks of using the Bass and scrub techniques where the filament edge was in contact with the tooth surfaces (Fig. 1-4).

2. The round-cut filament was worn semi-spherically or triangularly using the rolling and modified Stillman techniques where the side of the toothbrush was in contact with the tooth surface. Especially the round-cut area and the moving area of the toothbrush body were worn significantly (Fig. 5-8).

3. Changes were observed in the body of the filament. Ditches were not particularly deep after two weeks of using the Bass and scrub techniques where the filament edge was mainly in contact with the tooth surface. There was a slight peeling and snapping of the filament edge and center areas. At the far end there were few ditches and some parts were intact and smooth. The filament was peeled off at the far end and snaps were observed with the rolling and modified Stillman techniques where the side of the toothbrush filament was in contact with the tooth surface. There were deep ditches in the edge and center areas of the filaments (Fig. 5-8).

### Discussion

Regardless of the cleaning effect, the edge of the toothbrush filament was worn almost rectangularly along the longitudinal axis of the filament using the Bass and scrub techniques. Suda *et al*<sup>3)</sup> had the same results.

In the preceding results<sup>6)</sup>, the filament edge tended to become sharp when using the rolling and modified Stillman techniques. This time the round-cut filament was worn semi-spherically or triangularly and also the round-cut area and the moving area of the toothbrush body were significantly worn. Suda et al.<sup>3)</sup> had the same results.

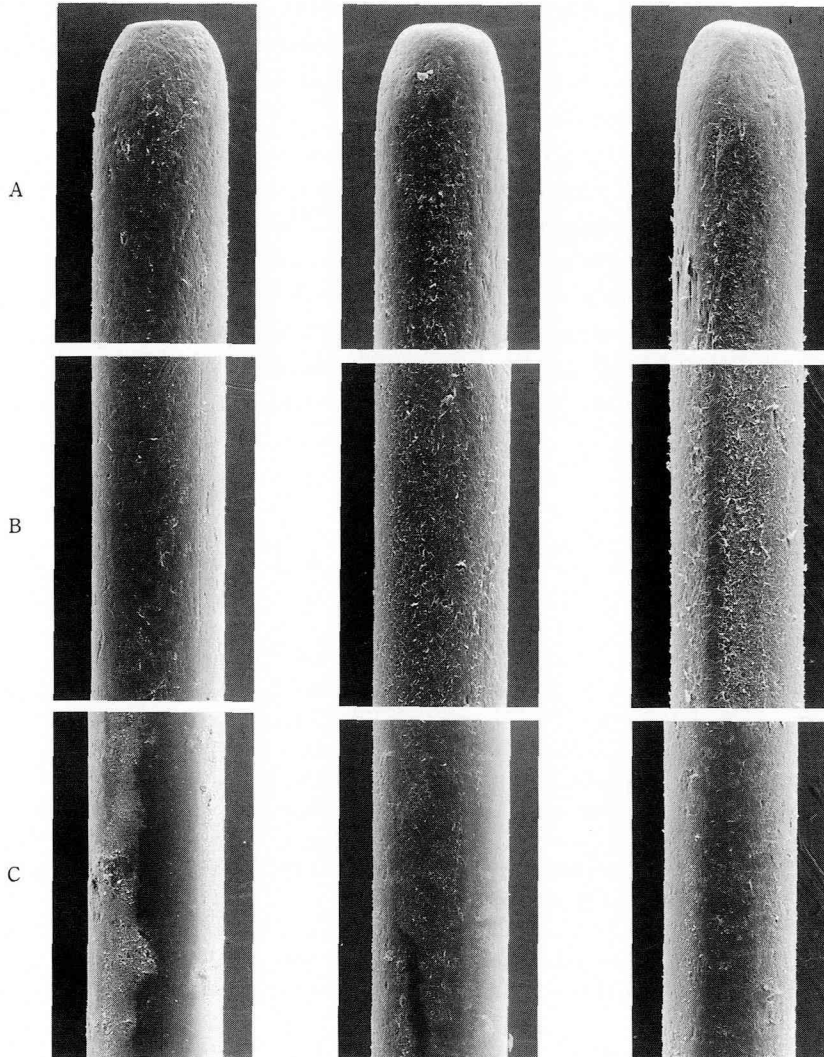
When the filament body of the former experiment was changed since the toothbrush yielding the best cleaning effect was selected in each brushing technique, the toothbrush filaments were worn significantly, and deep ditches and scratches were observed along the longitudinal axis.

But in this experiment, ditches were not as deep after two weeks of using the Bass and scrub techniques, where the filament edge was mainly in contact with the tooth surface, and the wear of the filament in the case of the worst dental plaque removal was less.

The filament peeled at the far end and snaps were observed when using the rolling and Stillman techniques. There were deep ditches in the edge and center area of the filament. This was the same result as in the former experiment, regardless of the effectiveness of plaque removal.

#### References

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**Fig. 1.**

The edge of the tooth brush filament worn rectangularly after 2 weeks of using the Bass techniques :

The filament shafts(c) are still smooth after use. (SEM×190)

Tooth brush H : Diameter of filament 10 mil

Plaque removal rate : 95.5%  
(Second best plaque removal effect)

**Fig. 2.**

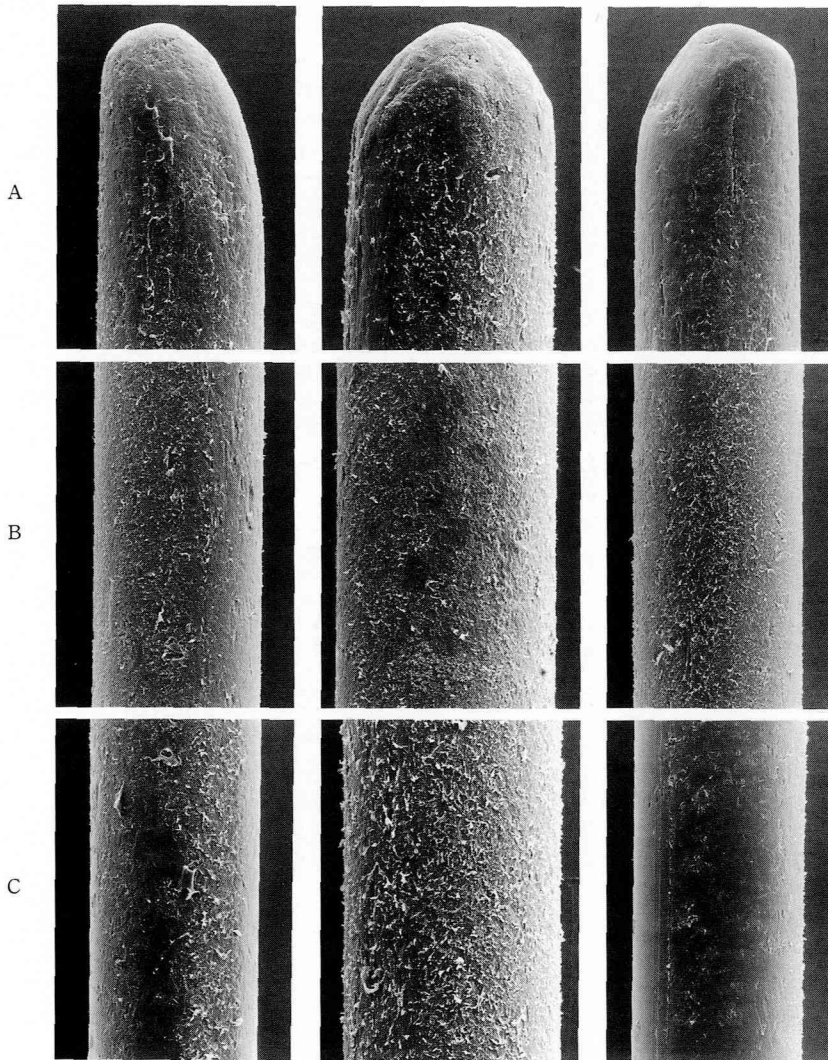
The edge of the tooth brush filament worn rectangularly after 2 weeks of using the Bass techniques (SEM×190)

Tooth brush S : Diameter 6 mil  
Plaque removal rate : 59.7%  
(worst effect)

**Fig. 3.**

The edge of the tooth brush filament worn rectangularly after 2 weeks of using the Scrub techniques : The edge was slight peeling-off and snaps. (SEM×190)

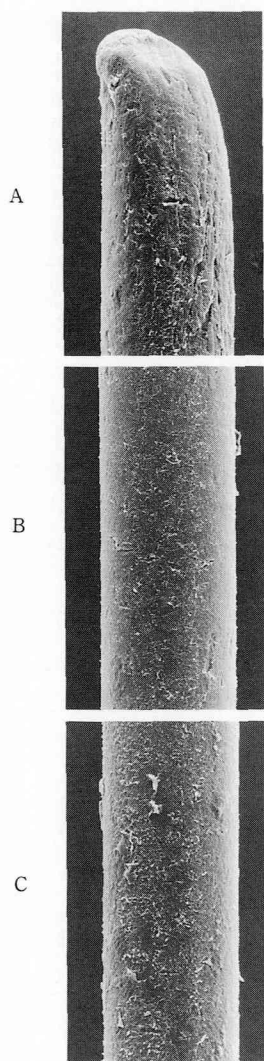
Tooth brush S : Diameter 6 mil  
Plaque removal rate : 97.3%  
(Second best effect)



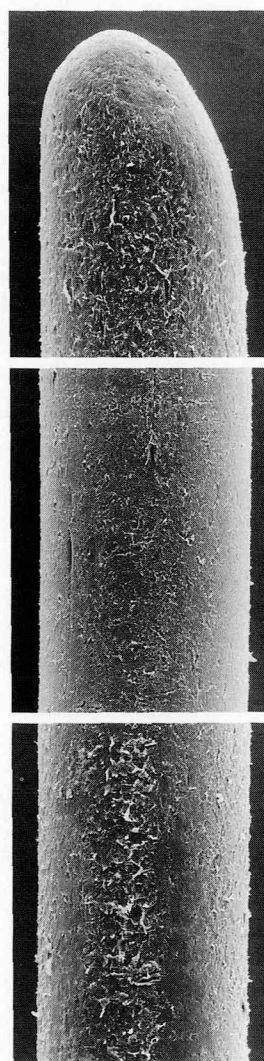
**Fig. 4.**  
The edge of the tooth brush filament worn rectangularly after 2 weeks of using the Scrub techniques (SEM×190)  
Tooth brush H : Diameter 8 mil  
Plaque removal rate : 60.2%  
(Worst effect)

**Fig. 5.**  
The edge of the tooth brush filament worn semi-spherically after 2 weeks of using the Roll techniques :  
The filament was peeled off at the far end and snaps were observed. The round-cut area and the moving area of filament body was worn. (SEM×190)  
Tooth brush M : Diameter 8 mil  
Plaque removal rate 91.3%  
(Second best effect)

**Fig. 6.**  
The round-cut filament triangularly using Roll techniques :  
The filament shafts(c) are still smooth after use. (SEM×190)  
Tooth brush Open-tufted :  
Diameter 8 mil  
Plaque removal rate : 59%  
(Worst effect)



**Fig. 7.**  
The filament peeled off at the far end :  
The snaps were observed after 2 weeks using  
the Modified Stillman techniques. (SEM  $\times 190$ )  
Tooth brush M : Diameter 8 mil  
Plaque removal rate : 92.4%  
(Second best effect)



**Fig. 8.**  
Deep ditches in the edge and center area of the  
filament after 2 weeks using the Modified Still-  
man techniques (SEM  $\times 190$ )  
Tooth brush M : Diameter 8 mil  
Plaque removal rate : 62%  
(Worst effect)