

# Pilot Investigation of Correlations Between Supragingival Plaque, Subgingival Plaque and Gingival Crevice Depth

by

CAROL P. FUNDAK,\* R.D.H., M.S., M.P.H.  
MAJOR M. ASH,\*\* D.D.S., M.S.

THE POSITIVE CORRELATIONS of supragingival plaque and calculus with gingivitis and periodontal disease has been demonstrated in several studies.<sup>1-3</sup> A review of the literature, however, disclosed no studies which ascertained whether a quantitative correlation exists between supragingival plaque and subgingival plaque. Such information would be beneficial in determining the true value of these clinical scoring indexes, which score only supragingival plaque. In addition, although evidence exists that there is a direct correlation between the quantity of calculus present and the depth of the gingival crevice,<sup>2, 3, 4</sup> there is no evidence that there is any relationship between the amounts of supragingival plaque or subgingival plaque and crevice depth.

The objectives of this pilot investigation were:

1. To determine if a relationship exists between the amounts of supragingival plaque and subgingival plaque.
2. To determine if the amounts of supragingival plaque and subgingival plaque are correlated with the depth of the gingival crevice.

## MATERIALS AND METHODS

Eighteen males and 17 females participated in the study; scores were obtained on a total of 204 teeth. Ages of the participants ranged from 16 to 69 years with a mean age of 40 years. These 35 subjects were divided into three groups according to the type of surgical procedure that was performed—the embellished periodontal flap, the unembellished flap, or tooth extraction. In the “embellished flap” procedure, an oral prophylaxis

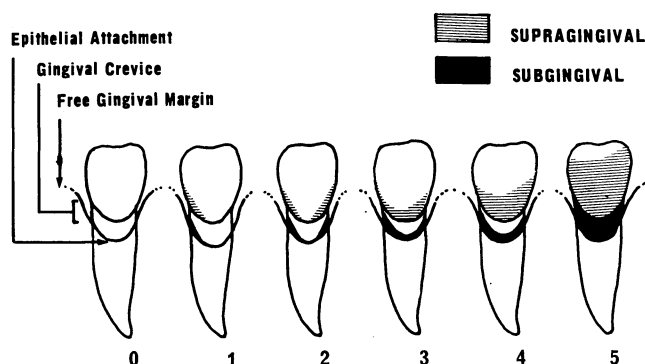


FIGURE 1. Supragingival and subgingival plaque scoring indexes.

is performed, and when the gingival tissues reach a hygienic phase, the periodontal surgery is done. In this group, five quadrants with a total of 26 teeth were used in this study. In the “unembellished flap” procedure, a flap is laid, and the teeth are scaled during the periodontal surgery. In this group, 13 quadrants were included, with a total of 72 individual teeth. In the third group, a total of 106 extracted teeth from 19 patients were studied.

For this investigation, supragingival plaque was defined as plaque found on the tooth surfaces above the free gingival margin. Subgingival plaque was plaque found only on tooth surfaces within the gingival crevice. The index used for scoring supragingival plaque was the Kobayashi and Ash<sup>5</sup> modification of the Ramfjord plaque index. Depending on the degree of surface coverage, plaque was scored from 0 to 5. Facial and lingual surfaces of the teeth were scored separately. This same index was used to score subgingival plaque; in this case, the base of the sulcus was equivalent to the free gingival margin as used in the supragingival index (Fig. 1).

A brief description of the supragingival plaque scoring index follows:

- 0—No plaque.
- 1—Plaque on one interproximal surface or on the middle of the facial or lingual gingival margin, but not covering more than one third of the gingival half of the facial or lingual surface.
- 2—Plaque on two interproximal surfaces or any gingival marginal surface, but not covering more than one third of the gingival half.
- 3—Plaque extending from mesial to distal, but not covering more than one third of the gingival half.
- 4—Plaque covering one third of the gingival half, but not more than half the coronal surface.

This paper was presented at the 47th General Meeting of the International Association for Dental Research held in Houston, Texas, March 22, 1969.

\*The paper was prepared while the senior author was a graduate student at the School of Dentistry, University of Michigan. Present address is the Dental Health Center, Public Health Service, Department of Health, Education and Welfare, 14th Avenue and Lake Street, San Francisco, California 94118.

\*\*Professor of Periodontics, Department of Periodontics, School of Dentistry, University of Michigan, Ann Arbor, Michigan 48104.

5-Plaque covering more than one half of the facial or lingual coronal surface.

The subgingival plaque was evaluated as follows:

0-No plaque.

1-Dental plaque on one of the interproximal surfaces or on the middle of the facial or lingual marginal aspect of the base of the sulcus, but not covering more than one third of the apical half of the facial or lingual crevice surface of the tooth.

2-Dental plaque on two interproximal surfaces, or any marginal aspect of the base of the sulcus, but not covering more than one third of the apical half of the facial or lingual crevice surface of the tooth.

3-Dental plaque extending from mesial to distal, but not covering more than one third of the apical half of the facial or lingual crevice surface of the tooth.

4-Dental plaque covering one third of the apical half of the facial or lingual surface, but not covering more than half of the crevice surface of the tooth.

5-Dental plaque covering more than one half of the facial or lingual crevice surface of the tooth.

Crevice depth was measured with a periodontal probe. Two measurements, mesiolingual and distobuccal, were taken for each tooth. Actual supragingival plaque scores ranged from one to five, subgingival scores ranged from 0 to five, and crevice depths ranged from 1 to 10 mm.

Supragingival plaque and gingival crevice depth were scored at the first appointment for those patients who were to undergo the unembellished flap procedures and immediately before surgery for the other two groups. Subgingival plaque was scored during surgery when the flap was laid for patients in the two periodontal surgery groups. In the third group, subgingival plaque was scored immediately after the teeth were extracted. An aqueous solution of pulverized Red-Cote Wafers was applied to score both supragingival and subgingival plaque on teeth scheduled for embellished and unembellished flap procedures. With the teeth that were extracted, bismark brown disclosing solution was used to score supragingival plaque immediately before surgery. Immediately after surgery, these teeth were stained with Red-Cote disclosing solution to score subgingival plaque. This was done in order to establish the level of the free gingival margin.

RESULTS AND DISCUSSION

The data were analyzed for supragingival plaque scores, subgingival plaque scores and crevice depth measurements. Individual tooth means were determined

TABLE 1  
Differences of the Means Between Procedures

Procedures	Supragingival Plaque	Subgingival Plaque	Crevice Depth
$\bar{X}_{EM} - \bar{X}_{UN}$	-.175	.125	-.406
t	-1.130	.791	-1.344
$\bar{X}_{EM} - \bar{X}_{EX}$	-1.065	-.747	-.240
t	-8.452**	-23.344**	-.857
$\bar{X}_{UN} - \bar{X}_{EX}$	-.890	-.872	.166
t	-10.210**	-5.626**	1.456

$\bar{X}$  = Mean of individual tooth means

EM = Embellished

UN = Unembellished

EX = Extracted

\*\* = .01 level of significance

by calculating the average of the scores for facial and lingual surfaces. The data were also analyzed by quadrant means for the groups undergoing periodontal surgery. For those patients undergoing extraction, the means for the extracted teeth also were analyzed. Based upon the statistical analysis used, no meaningful differences resulted by grouping the data by quadrants, patients or individual teeth.

A comparison by individual tooth mean scores was then made between each of the three groups to assess the significance of differences for the means of supragingival plaque, subgingival plaque and crevice depth measurements (Table 1). No statistically significant differences in means of crevice depth were found between the three procedures. Also no significant differences in the means of supragingival and subgingival plaque scores were found between the periodontal treatment groups. Between both the embellished and unembellished groups and the teeth which were extracted, there were statistically significant differences in the means of both supragingival and subgingival plaque. This finding indicated that the oral hygiene of the three groups of patients was not similar, although the severity of periodontal involvement of the three groups was similar.

The difference in oral hygiene status probably was due to the fact that the periodontal patients had been made aware of their treatment needs and had been given toothbrushing instructions. The time interval of three to four weeks between the prophylaxis and the surgery for the "embellished flap" group probably accounts for the fact that no difference was found between these groups. It is known that such a rate of accumulation can occur supragingivally,<sup>6</sup> but it had not been demonstrated previously that this would occur subgingivally.

Subgingival plaque was scored in vivo for the two periodontal surgery groups, and after the teeth were extracted for the other group. It might be expected that

TABLE 2  
Within Tooth Differences (Means) of Supragingival  
and Subgingival Plaque

Procedure	N	$\bar{\Delta}$	S. D.	t
Embellished	26	.481	1.807	1.355
Unembellished	72	.194	1.517	1.083
Extracted	106	.047	1.282	.373

N = Number of teeth  
 $\bar{\Delta}$  = Mean difference  
 S.D. = Standard deviation

scoring of plaque when a flap has been laid would be advantageous because of the certainty of knowing where the attached gingival line is located. However, the use of two colors of disclosing solution for the extracted teeth (and the application of one color after the teeth were removed) appeared to be more reliable clinically.

Analyses of within tooth differences for supragingival versus subgingival plaque for the three groups disclosed no statistically significant difference on the basis of quadrants, patients, or individual teeth (Table 2). From these analyses, it is concluded that supragingival plaque scores are a good indication of the status of subgingival plaque.

In view of the significant difference in plaque between the extraction group and the periodontal surgery groups, and the lack of a significant difference in crevice depth in the three groups, it would appear that there is no consistent relationship between the means of either supragingival or subgingival plaque and the means of crevice depth. An analysis of correlation coefficients, however, does not bear out this assumption, at least when analyzing the data from those teeth that were extracted.

In order to evaluate more fully the relationship between plaque and crevice depth, an analysis of correlation coefficients was done (Table 3). For the embellished periodontal surgery, there were low negative correlation coefficients which were not statistically significant. However, with the extracted teeth there were statistically significant positive correlations of .220 and .247 which are significant at the 95% level between crevice depth and both supragingival plaque and subgingival plaque. When supragingival and subgingival scores were combined the correlation rose to .335 and was significant at the 99% level. The difference between the "embellished flap" and "unembellished flap" groups as contrasted to the "extracted teeth" group may be due to several factors, particularly the larger sample of scores present in the extracted teeth group and the objectivity of scoring provided by two colors.

The present study indicates that the scoring of supragingival plaque, as carried out in many epidemiological studies of patients with periodontal disease, will give

TABLE 3  
Correlations of Supragingival and Subgingival  
Plaque with Crevice Depth

Procedure	N	Supra- gingival and Crevice	Sub- gingival and Crevice	Combined Plaque and Crevice
Embellished	26	-.198	-.168	-.128
Unembellished	72	-.131	-.126	-.190
Extracted	106	.220*	.247*	.335**

N = Number of teeth \* = .05 level of significance  
 r = Correlation coefficient \*\* = .01 level of significance

an indication of the presence of subgingival plaque. This finding also reinforces the value of oral hygiene procedures which attempt to prevent and/or remove subgingival as well as supragingival plaque.

#### SUMMARY

An investigation of the association between supragingival plaque, subgingival plaque and gingival crevice depth was conducted. The 35 subjects were grouped depending on the type of surgery performed: the embellished periodontal flap, the unembellished periodontal flap and extraction. All subjects were scored for supragingival plaque and gingival crevice depth before surgery and for subgingival plaque either during surgery or immediately afterward.

The statistical analyses used disclosed no significant difference between supragingival and subgingival plaque scores. On the basis of the extracted teeth studied, a positive correlation was found between both supragingival and subgingival plaque and crevice depth.

#### REFERENCES

1. Ash, M. M., Jr., Gitlin, B. N. and Smith, W. A.: Correlation Between Plaque and Gingivitis. *J. Periodont.*, 35: 424-9, Sept.-Oct., 1964.
2. El-Ashiry, G. M., Ringsdorf, W. M. and Cheraskin, E.: Local and Systemic Influences in Periodontal Disease. III. Effect of Prophylaxis and Natural Versus Synthetic Vitamin C Upon Sulcus Depth. *N.Y.J. Dent.*, 34:254-62, Aug.-Sept., 1964.
3. Lovdal, Arne, Arno, Arnulf and Waerhaug, Jens: Incidence of Clinical Manifestations of Periodontal Disease in Light of Oral Hygiene and Calculus Formation. *J. Amer. Dent. Assn.*, 56:21-33, Jan., 1958.
4. Dinoff, B. M.: Rate of Calculus Formation. Thesis, University of Michigan School of Dentistry, 1966.
5. Kobayashi, L. Y. and Ash, M. M., Jr.: A Clinical Evaluation of an Electric Toothbrush Used by Orthodontic Patients. *Angle Orthodont.*, 34:209-19, July, 1964.
6. Lynch, M.: Correlation Between Plaque and Bacterial Flora Following a Prophylaxis. Abstract No. 468, Proceedings of the International Association for Dental Research, March, 1968.