*Correlation Between Plaque and Gingivitis**

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ALTHOUGH it is generally believed that a positive correlation exists between dental plaque and gingivitis, the results of a toothbrush study by Hoover and Robinson,[5] and an earlier study by Massler, Schour, and Chopra,[6] have been interpreted[5] as indicating a lack of correlation between plaque and gingivitis. However, in a study of bacterial plaque and its relation to periodontal disease by Chawla, Nanda, and Mathur,[1] some positive correlation ($r = 0.37$; $P = 0.1034$) between plaque and gingivitis was noted. Also, the results of a study by O'Leary, Shannon, and Prigmore[7,8] suggested a positive correlation between plaque and gingivitis ($r = 0.68$; $P = 0.01$). In the latter study the mean periodontal score using the Ramfjord index[9] was less than three and reverted to a gingivitis score, and no direct correlation between plaque, and only gingivitis was indicated.

The objective of the present study was to determine the degree of correlation between plaque and gingivitis.

METHODS AND MATERIALS

Data from a prior study by Smith and Ash[11] in which the effectiveness of an electric toothbrush and a two row natural bristle hand toothbrush were compared was utilized in the present study. In the study[11] plaque, gingivitis, and periodontal disease indices were utilized to evaluate the comparative effectiveness of the two brushes in two comparable groups of patients.

The formation of comparable groups of 39 patients in each group was based on initial plaque, gingivitis, and periodontal disease indices as well as scores of these criteria observed 5-7 days after prophylaxis. Groups were comparable statistically for all indices at the 1 per cent level of confidence. Each patient was given detailed instruction in the use of the toothbrushes. Groups were scored after 30 and 60 days' use of the brushes. After 60 days the brushes were switched for each group. One group changed to the electric brush and the other group to the hand-brush. The groups were again scored at 90 and 120 days from the beginning of the study. There was no statistically significant differences in the effectiveness of the two brushes at the 30, 60, 90 and 120 day scoring periods.

Prior to the beginning of the study the single observer was calibrated for scoring error. The scoring error for plaque was $\pm$ 0.019 units, $\pm$ 0.05 units for gingivitis, and $\pm$ 0.008 units for periodontal disease. The possible range for plaque scores was 0-3, 0-3 for gingivitis and 1-6 for periodontal disease. Plaque, gingivitis, and periodontal disease was scored separately using the Ramfjord indices[11] as modified by Shick and Ash.[10]

The subjects in the study were periodontal maintenance patients from the Dental Clinic of the University of Michigan. All periodontal therapy and operative dentistry was completed prior to the study. Oral hygiene and periodontal status can be evaluated from the range of initial scores. Plaque scores ranged from 0.63 to 1.92 units, gingivitis 0.33 to 1.92 units and

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Table I

BETWEEN GROUP DIFFERENCES IN MEAN PLAQUE SCORES WITH t VALUES

Group	II				30 + 60
Day	5-7	0	30	60	
N	39	39	39	39	39
$\bar{X}$	0.733	1.138	1.073	1.138	1.106
S. D.	0.262	0.197	0.181	0.243	0.203
S. E.	±.042	±.032	±.030	±.039	±.033

Group	Day	N	$\bar{X}$	S. D.	S. E.	t					
I	5-7	39	0.705	0.248	±.040		0.482				
	0	39	1.163	0.156	±.025			0.617			
	30	39	1.054	0.106	±.017				0.556		
	60	39	1.161	0.155	±.025					0.501	
30 + 60		39	1.107	0.121	±.019						0.026

periodontal disease index from 2.42 to 4.88 units.

In the present study the evaluation of the correlation between plaque and gingivitis is based on the scores derived from the two comparable groups (or one group of 78 patients) observed for four months and scored for plaque and gingivitis at 0, 30, 60, 90, and 120 days. Since the groups changed brushes at the end of 60 days, the present evaluation of plaque and gingivitis can be concerned primarily with the 60, 90 and 120 day scores, and will hereafter be referred to as 0, 30, and 60 day respectively.

The data obtained were analyzed for differences between the groups, and then coefficients of correlation between plaque and gingivitis were obtained. In addition, within and between the group mean differ-

Table II

BETWEEN GROUP DIFFERENCES IN MEAN GINGIVITIS SCORES WITH t VALUES

Group	II				30 + 60
Days	5-7	0	30	60	
N	39	39	39	39	39
$\bar{X}$	0.468	1.104	0.628	0.891	0.759
S. D.	0.271	0.248	0.289	0.308	0.292
S. E.	±.043	±.040	±.047	±.054	±.047

Group	Day	N	$\bar{X}$	S. D.	S. E	t					
I	5-7	39	0.449	0.296	±.047		0.298				
	0	39	1.073	0.270	±.043			0.525			
	30	39	0.750	0.223	±.036				2.062		
	60	39	0.984	0.284	±.046					1.315	
30 + 60		39	0.867	0.237	±.038						1.776

Table III

COEFFICIENT OF CORRELATION (r)
PLAQUE AND GINGIVITIS
GROUP I

Score	Group	Day	ΣX	ΣX^2	N	Score	ΣY	ΣY^2	ΣXY	N	df	r	t
PLAQUE (X)	I	5-7	27.48	21.75	39	GINGIVITIS (Y)	17.28	10.85	13.10	39	37	.344	2.23
		0	45.36	53.71	39		41.80	47.65	49.64	39	37	.644	5.10
		30	41.14	43.84	39		29.26	23.90	31.25	39	37	.433	2.93
		60	45.30	53.56	39		38.39	40.95	45.66	39	37	.626	4.90
	30 + 60		43.18	48.38	39		33.81	31.51	38.06	39	37	.547	3.98

ences were statistically evaluated for combined groups and combined scores at 0, 30, and 60 days.

Tests of significance of correlation coefficients between groups at 0, 30, 60 and 5-7 days were computed by the method of Fisher[2] involving transforming the values of r to z.

RESULTS

The statistical evaluation of between group differences in mean plaque scores with t value is given in Table I. Between group differences in mean gingivitis scores with t values is given in Table II. It can also be seen in these two tables that within group differences at 0 and 60 days are not statistically significant for plaque and gingivitis.

Statistical evaluation of differences between the means for combined groups and combined scores for plaque or gingivitis

Table IV

COEFFICIENT OF CORRELATION (r)
PLAQUE AND GINGIVITIS
GROUP II

Score	Group	Day	ΣX	ΣX^2	N	Score	ΣY	ΣY^2	ΣXY	N	df	r	t
PLAQUE (X)	II	5-7	28.57	23.60	39	GINGIVITIS (Y)	18.26	11.42	14.00	39	37	.233	1.46
		0	44.39	52.04	39		43.06	49.94	49.93	39	37	.502	3.53
		30	41.87	46.25	39		24.50	18.65	27.47	39	37	.552	4.03
		60	44.40	52.86	39		34.75	35.31	41.88	39	37	.725	6.44
	30 + 60		43.13	49.31	39		29.61	25.80	34.42	39	37	.730	6.49

Table V

COEFFICIENT OF CORRELATION (r)
PLAQUE AND GINGIVITIS
GROUP I AND II

Score	Group	Day	ΣX	ΣX^2	N	Score	ΣY	ΣY^2	ΣXY	N	df	r	t
PLAQUE (X)	I + II	5-7	56.05	45.35	78	GINGIVITIS (Y)	35.54	22.27	27.10	78	76	.285	2.60
		0	89.75	105.78	78		84.86	97.59	99.57	78	76	.536	5.54
		30	83.01	90.09	78		53.76	42.55	58.72	78	76	.487	4.87
		60	89.70	106.42	78		73.14	76.26	87.54	78	76	.686	8.21
	0 + 30		172.76	195.84	156		138.62	140.14	158.29	156	154	.546	7.21
	0 + 60		179.45	212.17	156		158.00	173.85	187.11	156	154	.606	9.47
	30 + 60		86.31	97.68	78		63.42	57.30	72.48	78	76	.660	7.70

showed no statistically significant differences at the 1 per cent level of confidence. A statistically significant difference within the means at 0 and 30 days was noted, but no significant difference was found between groups at 0 and 30 days.

The coefficients of correlation between plaque and gingivitis are shown in Tables III, IV, and V. The t values for test of significance is also given. The coefficient significant at df = 37 is 0.408 at the 1 per cent level.[4] For a correlation coefficient the t value at df = 37 is 2.715 (P = 0.01).[3] The tests of significance for differences between coefficients between groups and combined is given in Table VI. The t value for df = 72 at P = 0.01 is 2.65.[3] From Tables III, IV, and V it can be seen that the coefficients of correlation (r) between plaque and gingivitis at 5-7 days after prophylaxis is 0.344 in group I; 0.233 in group II, and 0.285 in group I combined with group II. These coefficients are not significant at the 1 per cent level of confidence. All other

Table VI

TEST OF SIGNIFICANCE OF CORRELATION COEFFICIENT BETWEEN PLAQUE AND GINGIVITIS FOR GROUPS I AND II

$df = N_1 + N_2 - 6$

Group	II			
Day	5-7	0	30	60
r_2	0.233	0.502	0.552	0.725
N_2	39	39	39	39
Z'_2	0.74	0.55	0.62	0.92
S. D.	0.236	0.236	0.236	0.236

Group	Day	r_1	N_1	Z'_1	$\frac{Z'_1 - Z'_2}{S.D.}$	t				
I	5-7	0.344	39	0.36	0.236		0.508			
	0	0.644	39	0.76	0.236			0.890		
	30	0.433	39	0.46	0.236				0.678	
	60	0.626	39	0.74	0.236					0.763

coefficients at 0, 30, and 60 days and combined score coefficients are significant at the 1 per cent level. It can be seen in Table VI that there is no significant differences between the correlation coefficients of group I and group II.

DISCUSSION

The correlation between plaque and gingivitis as evidenced by correlation coefficients shows a variation consistent with the period of time elapsed from prophylaxis. The coefficient of correlation at 5-7 days after prophylaxis is 0.285 for the combined groups. Although this coefficient is not quite statistically significant at the 1 per cent level, it is at the 5 per cent level. Comparing the coefficient at 5-7 days with 30 and/or 60 days after prophylaxis suggests that the effect of the plaque on the gingiva is not definitive enough to show a significant correlation. The lack of significance may be due to the variation in the effect of the degree of plaque present. However, the low value of r at the 5-7 days suggests that there may be a refractory period in the effect of the plaque probably due to the degree of plaque present. The mean plaque score at 5-7 days is less than two-thirds of the plaque score at 60 days. The mean gingivitis score at 5-7 days is less than one-half its gingivitis score at 90 days following prophylaxis.

Because of the relatively good oral hygiene present in the patients in this study, and the short period of time involved, calculus was not a significant factor in the 5-7 day and 30 day gingivitis scores. Although minimal calculus was present at 0 and 60 days, the effect of calculus on the gingivitis scores cannot be overlooked.

It is not possible to explain the differences in the correlation coefficient obtained by Chawla[1] and those obtained in the present study. The differences in oral hygiene and the degree of plaque and gingivitis present between the patients in the two studies may be important factors. It is quite possible, although not apparent from the data presented, that the large number of patients in Chawla's study with high plaque and gingivitis scores restricted the range of scores. Such a restriction could account for the low positive correlation between plaque and gingivitis. Probably the scoring indices used are of limited value where most of the subjects have high plaque and gingivitis scores.

The results of the combined 30 and 60 day scores of group I and group II showed a correlation of 0.66 ($P = 0.01$) between plaque and gingivitis, and this correlation agrees with the correlation coefficient found by O'Leary, et al.[7] Plaque and gingivitis score (periodontal disease) ranges in O'Leary's study and those in the present study were quite similar, and probably accounts for the closeness of coefficients of correlation in the two studies.

SUMMARY AND CONCLUSION

A study of the correlation between plaque and gingivitis before and after prophylaxis was carried out on 78 patients who had reasonably good oral hygiene and were on maintenance. Plaque and gingivitis scores were obtained prior to prophylaxis (0 day), and at 5-7, 30, and 60 days following prophylaxis. The results of the study indicate that there is a high positive correlation between the degree of plaque and the degree of gingivitis present.

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A Preliminary Report on the Treatment of the Osseous Defect in Periodontosis

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THE deep intra-alveolar (infrabony, subcrestal, vertical) bone defect constitutes one of the most challenging and one of the most perplexing problems in periodontal therapy. McCall,[1] Smith[2] and Hirschfeld,[3] among others, have shown that by subgingival curettage alone they were able to obtain roentgenographic evidence of bone regeneration in some intra-alveolar bone defects. Prichard,[4] using Goldman's technique for treatment of the infrabony pocket,[5] was able to obtain excellent results in 17 consecutive cases of three-walled intra-alveolar bone defects. Prichard stressed the importance of the presence of three bony walls as a topographic feature necessary for obtaining success in the treatment of these cases. For the one and two-walled† intra-alveolar bone defects, on the other hand, osteoectomy has been widely recommended as the treatment of choice. In addition, almost all previous publications have been limited to the treatment of osseous lesions in the adult patient.

This paper is limited to a discussion of the treatment of vertical osseous defects in the adolescent, and in particular, to those lesions which are limited to the first molar-incisor type occurring in periodontosis.

One of the symptoms of periodontosis is pathologic migration, sometimes rotation and elongation.[7-9] It has occurred to Gottlieb[10] that perhaps in periodontosis we deal with a disease of eruption. The involved tooth or teeth, however, are prevented by their neighbors and, chiefly, by their opponents to move rapidly. An area of cementum which the body wishes to exfoliate has to be placed outside the epithelial covering without active movement of the tooth. Is not the formation of the intra-alveolar bone defect the result of a frustration of the pathologic active eruptive process, the result of a futile effort on the part of the tooth to erupt actively?

If the above hypothesis were true, then one way of testing it would be to take the affected tooth or teeth completely out of occlusion through repeated, deliberate occlausal or incisal grinding. This should permit the tooth to erupt. In the process of this eruption the involved cemental surface as well as the apically located healthy cementum and appertaining bone could move oc-

†Patur and Glickman[6] have shown some improvement of bone contour in the treatment of the two-walled defect by flap approach without the use of bone surgery.

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