
Local and Systemic Influences in Periodontal Disease:

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Upon Sulcus Depth**

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Local and Systemic Influences in Periodontal Disease: III. Effect of Prophylaxis and Natural Versus Synthetic Vitamin C Upon Sulcus Depth*

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INTRODUCTION

In an earlier report,¹ the effect of prophylaxis with and without synthetic and natural vitamin C concentrate and with and without bioflavonoids upon gingivitis was considered. Since gingival scores represent only one measure of periodontal pathosis, it was thought advisable to re-examine the effects of the same local and systemic regimes on sulcus depth. The literature review on this subject has already been released.¹

METHOD OF INVESTIGATION

One hundred and two subjects (all Caucasian but one) participated in this study. The selection was as nearly random as possible from volunteers at the University of Alabama Medical and Extension Centers and from the Birmingham Fire Department. Table 1 shows the patient distribution in terms of age and sex.

All subjects reported to the Department of Oral Medicine following a 12-hour fast period. At this time a fasting venous blood sample was obtained. The

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oral examination was conducted with the patient comfortably seated in a dental chair. The mouth was illuminated with a dental spotlight. In all cases, the examination started in the maxillary region of the right canine and progressed across to the left canine. The same pattern (right to left) was followed in the lower jaw. One examiner (G.M.A.) made all of the observations on all of the patients.

Calculus Scores: Although the quantity of calcareous deposits undoubtedly has a bearing upon the degree of pathosis, it was felt that the location of these deposits was of major importance. Hence, in this investigation, the evaluation was based upon whether there was an absence of calculus or whether supra-gingival, subgingival or both supra- and subgingival calculus was present on each tooth examined. The inspection was done with an explorer and mirror. Compressed air was used to retract the gingiva for better detection of the subgingival deposits. The legend for calculus scoring is shown in Table 2. In the individual with all anterior teeth, 12 scores were recorded. The scores were then added and divided by the number of teeth to

TABLE 1—PATIENT AGE AND SEX DISTRIBUTION

Age Groups	Male Group		Female Group		Total Group	
	Number	Percentage	Number	Percentage	Number	Percentage
20-29	25	25.5	27	26.5	52	51.0
30-39	17	16.7	9	8.8	26	25.5
40-49	12	11.8	6	5.9	18	17.7
50-59	2	1.9	4	3.9	6	5.8
Total	56	54.9	46	45.1	102	100.0

obtain mean values for the right and left sides.

Sulcus Depth Scores: Periodontal probes (Starlite Special, scored in 2 mm.) were used for determining pocket depth surrounding the 12 anterior teeth on the labial, lingual, mesial and distal aspects of each tooth. Thus, in a subject with all anterior teeth, 48 measurements were made. From these individual scores, mean values for each side were derived.

Measurement of Vitamin C State: The Method of Mindlin and Butler² was utilized to measure plasma ascorbic acid. The test was always performed twice from equal portions of the same blood sample. These duplicate determinations served as a check on the accuracy of the procedure ($r = +0.988$, $P < 0.001$). For the determination of tissue ascorbic acid status, the ligual vitamin C test was employed.³⁻⁵ In order to evaluate the reproducibility of the test the procedure was always performed twice. The correlation between the first and second lingual time readings was found to be highly significant ($r = +0.989$, $P < 0.001$).

Bioflavonoid state was not ascertained since there are no known laboratory tests.

By means of a table of random numbers, the patients were arranged into

two groups: 1) those to be scaled on the right side, and 2) those to receive prophylaxis on the left side. Also, the patients were randomized to receive one of the systemic regimes. Thus, in terms of systemic therapy, four groups were developed. Table 3 shows the composition of the capsules. All capsules were compounded to look exactly alike. Thus, neither the patient nor the examiner was aware at any time during the study which preparation was being administered.

At the first visit, each patient received thorough scaling of the teeth on one side of the mouth. Jaquette and McCall scalers were employed to remove the calculus. Moistened flower of pumice was applied with a revolving rubber cup in a contra-angle handpiece to polish the accessible crown and root surfaces. Finally, dental tape and pumice were utilized to polish the interproximal surfaces of the teeth. At the completion of the first visit each patient was instructed to take by mouth three capsules per day for three weeks. Thus, 25 subjects received a placebo, 25 were given 300 mgm. synthetic vitamin C daily, 25 were administered 300 mgm. synthetic vitamin C and 300 mgm. citrus bioflavonoids per day, and the remaining 27 were supplemented with 300

TABLE 2—CALCULUS SCORING SYSTEM

0	= no calculus present
1	= supragingival calculus covering not more than one-third of the exposed tooth surface
2	= supragingival calculus covering more than one-third but not more than two-thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both
3	= supragingival calculus covering more than two-thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both

TABLE 3—CODES AND COMPOSITION OF THE CAPSULES

#1	100 mg. milk sugar per capsule
#2	100 mg. synthetic vitamin C
#3	100 mg. synthetic vitamin C plus 100 mg. citrus bioflavonoids
#4	100 mg. natural vitamin C concentrate plus 100 mg. citrus bioflavonoids

TABLE 4—CALCULUS DISTRIBUTION (Initial Scores)

<i>Calculus Scores</i>	<i>Number of Examinations</i>	<i>Percentage of Examinations</i>
0	585	49.3
1	466	39.2
2	112	9.4
3	25	2.1
<i>Total</i>	1188	100.0

TABLE 5—DISTRIBUTION OF INITIAL SULCUS DEPTH SCORES

<i>Sulcus Depth Scores</i>	<i>Number of Examinations</i>	<i>Percentage of Examinations</i>
0	15	0.3
1	1180	24.8
2	3050	64.2
3	413	8.6
4	94	1.9
5	11	0.2
<i>Total</i>	4763	100.0

TABLE 6—PATIENT DISTRIBUTION IN TERMS OF INITIAL PLASMA ASCORBIC ACID

<i>Plasma Ascorbic Acid Groups</i>	<i>Number of Patients</i>	<i>Percentage of Patients</i>
0.00-0.59	36	35.3
0.60-0.99	45	44.1
1.00-1.40	21	20.6
<i>Total</i>	102	100.0

TABLE 7—PATIENT DISTRIBUTION IN TERMS OF INITIAL LINGUAL TIME

<i>Lingual Time Groups (Seconds)</i>	<i>Number of Patients</i>	<i>Percentage of Patients</i>
Less than 20	28	27.5
20-30	50	49.0
More than 30	24	23.5
<i>Total</i>	102	100.0

mgm. natural vitamin C concentrate plus 300 mgm. bioflavonoids each day.

Approximately 21 days later each of the patients returned. All participants were re-examined clinically and biochemically without reference to the earlier records or the nature of the supplementation.

RESULTS

Pretherapy Findings: Table 4 summarizes the initial calculus scores. It is clear that about one-half of the examined areas are without deposits. The initial sulcus depth scores are also shown (Table 5). It will be noted that the greatest number of sulci (64.2 per cent) were about two millimeters in depth. Table 6 demonstrates the patient distribution in terms of the initial plasma ascorbic acid levels. It was found that the scores ranged from zero to 1.38 mgm. per cent. The patient distribution in terms of the lingual times (tissue vitamin C status) is also included (Table 7). The values ranged from a low of 12 to a high of 60 seconds.

The relationship between calculus and sulcus depth is pictorially portrayed (Figure 1). The illustration shows that the subjects with low calculus scores also have low mean sulcus depth values. Conversely, those individuals with high calculus ratings are associated with the high mean sulcus depth findings. A significant correlation was found between calculus and sulcus depth ($r = +0.452$, $P < 0.001$).

Figure 2 illustrates graphically the correlation of plasma ascorbic acid level to sulcus depth. The chart points out that the subjects with the highest mean sulcus depth scores are associated with the lowest vitamin C levels. On the other hand, those persons with the lowest mean sulcus depth values are in parallel with the highest plasma ascorbic acid levels. This relationship of plasma vitamin C to sulcus depth was found statistically significant ($r = -0.240$, $P < 0.001$). The correlation of the lingual times to sulcus depth is also included (Figure 3). Subjects with high

mean sulcus depth values were associated with long lingual times. Conversely, individuals with low sulcus scores have short lingual times. A statistically significant correlation was obtained ($r = +0.224$, $P < 0.005$).

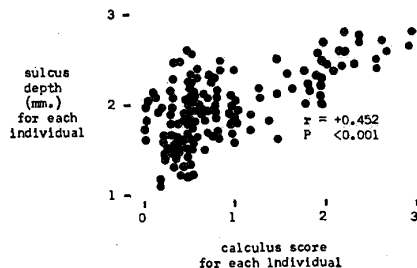


Fig. 1. Pretherapy relationship of a local factor (calculus) to periodontal pathosis (sulcus depth).

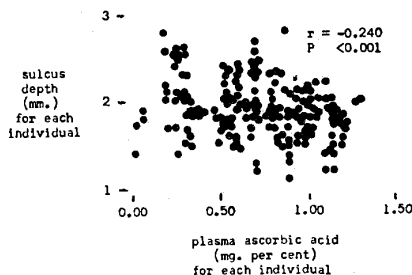


Fig. 2. Pretherapy relationship of a systemic factor (plasma ascorbic acid) to periodontal pathosis (sulcus depth).

The relationship of both calculus and vitamin C state (plasma ascorbic acid levels) to sulcus depth is also included (Table 8). The chart shows well that the persons with the low calculus (0.0-0.5) and high vitamin C levels (0.60-1.40) have the lowest sulcus depth scores (1.7 ± 0.3). On the other hand, those individuals with the higher calculus values (>0.5) and poorer vitamin C levels (0.00-0.59) are associated with the greatest mean sulcus depth ratings (2.2 ± 0.3). As one moves from left to right (irrespective of vitamin C levels)

TABLE 8—PRETHERAPY RELATIONSHIP OF THE MEAN CALCULUS SCORES AND ASCORBIC ACID LEVELS (MG. PER CENT) TO THE SUBJECTS' MEAN SULCUS DEPTH SCORES

Plasma Ascorbic Acid Groups	Calculus Groups	
	0.0-0.5	>0.5
0.60-1.40	1.7 ± 0.3*	2.0 ± 0.3*
0.00-0.59	1.8 ± 0.3*	2.2 ± 0.3*

* Mean and standard deviation sulcus depth scores.

TABLE 9—SULCUS DEPTH CHANGE AFTER PROPHYLAXIS (Placebo Group)

Sulcus Depth Grades	Unscaled Side		Scaled Side	
	Initial Scores	Final Scores	Initial Scores	Final Scores
0	6	7	4	11
1	165	174	188	218
2	337	331	328	305
3	27	39	36	31
>3	26	10	12	3
Total	561	561	568	568
Mean	1.8	1.8	1.8	1.7
S.D.	0.3	0.4	0.4	0.4
Percentage change	0		-10	
P	=0.500		>0.050	

TABLE 10—SULCUS DEPTH CHANGE AFTER SYSTEMIC THERAPY (Unscaled Side)

Sulcus Depth Grades	Natural Vitamin C Concentrate Plus Bioflavonoids		Synthetic Vitamin C Plus Bioflavonoids		Synthetic Vitamin C		Placebo	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
0	0	35	0	33	3	29	6	7
1	134	378	114	377	148	370	165	174
2	430	243	379	166	383	187	337	331
3	56	7	75	10	49	6	27	39
>3	44	1	19	1	9	0	26	10
total	664	664	587	587	592	592	561	561
mean	1.9	1.3	2.0	1.3	1.9	1.3	1.8	1.8
S.D.	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.4
percentage change	-32		-35		-30		0	
P	<0.001		<0.001		<0.001		=0.500	

sulcus depth increases with increase in calcareous deposits. As one proceeds from top to bottom in either column (irrespective of calculus) sulcus depth increases with a decrease in the vitamin C levels.

Though interesting, the preceding relationships do not necessarily demonstrate cause-and-effect. These correlations simply indicate that variables co-exist. To try and pinpoint possible cause and effect, it was felt advisable to study the sulcus depth pattern after both local and systemic therapy.

Post-therapy Findings: The nature of the experimental design provided the opportunity to study the changes in sulcus depth after both local (prophylaxis) and/or systemic therapy (synthetic or natural vitamin C with and without bioflavonoids).

Effect of Scaling: In each subject one half of the mouth was scaled at the first visit. Thus, in the placebo group, it was possible to examine the effect of elimination of calculus upon the sulcus depth on the scaled versus the nonscaled side. Table 9 shows the initial and final original and mean sulcus depth scores for the scaled and nonscaled areas in those subjects without systemic treatment (placebo group). There appears to be

a 10 per cent reduction in mean sulcus depth with scaling. The nonscaled side showed no mean change. However, the sulcus depth change on both sides was not statistically significant.

Effect of Systemic Therapy: It was also possible to evaluate the effect of altering the host without local treatment (no scaling). Table 10 shows the initial and final original and mean sulcus depth values of those subjects receiving systemic therapy versus placebo supplementation. These appears to be a reduction of 35 per cent in the mean sulcus depth scores ($P < 0.001$) in the group administered synthetic vitamin C with bioflavonoids. The natural vitamin C concentrate group with bioflavonoids followed with 32 per cent decrease. The synthetic vitamin C group without bioflavonoids had a 30 per cent reduction. Finally, no change was noted in the placebo group.

Effect of Local and Systemic Therapy: Table 11 illustrates that the greatest improvement on a mean basis (38 per cent) occurred in those persons given both prophylaxis and synthetic vitamin C with bioflavonoids. Then followed those with scaling and natural vitamin C concentrate with bioflavonoids (36 per cent). The synthetic vitamin C

TABLE 11—SULCUS DEPTH CHANGE AFTER LOCAL AND SYSTEMIC THERAPY

Sulcus Depth Grades	Natural Vitamin C Concentrate Plus Bioflavonoids		Synthetic Vitamin C Plus Bioflavonoids		Synthetic Vitamin C		Placebo	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
0	1	35	0	50	1	31	4	11
1	142	421	137	390	145	367	188	218
2	425	186	379	144	373	154	328	305
3	64	4	58	4	28	3	36	31
>3	16	2	14	0	8	0	12	3
total	648	648	588	588	555	555	568	568
mean	1.9	1.3	1.9	1.2	1.9	1.2	1.8	1.7
S.D.	0.4	0.2	0.3	0.2	0.3	0.2	0.4	0.4
percentage change		-36		-38		-33		-10
P		<0.001		<0.001		<0.001		>0.050

group with prophylaxis showed a mean decrease of 33 per cent. Finally, the group with prophylaxis only (placebo therapy) had a 10 per cent reduction. On a statistical basis, all groups given both local and systemic treatment had a significant reduction in mean sulcus depth ($P < 0.001$). The group with only local therapy had a statistically insignificant change ($P > 0.050$).

DISCUSSION

It should be recalled that two possible groups of causative factors were investigated. These variables were calculus, representing the local problem, and vitamin C state on the systemic side. The higher correlation ($r = +0.452$, $P < 0.001$) was found between calculus and sulcus depth. Then followed the correlation of plasma ascorbic acid to sulcus depth ($r = -0.240$, $P < 0.001$). A significant relationship of lingual time to sulcus depth was also obtained ($r = +0.224$, $P < 0.005$). It is well to underscore the fact that the correlation of calculus to sulcus depth is greater than that of vitamin C state and sulcus depth.

Figure 4 shows the percentage change in sulcus depth following the eight different forms of therapy. Table 12 summarizes the intergroup statistical significance. It is well to point out that all groups given both local and/or systemic therapy were significantly different from the placebo-treated. It appears that both synthetic and natural vitamin C with bioflavonoids plus scaling netted the greatest improvement.

It should be recalled that vitamin therapy was administered on a random basis. Obviously, by this technique, some of the vitamin-supplemented group actually had satisfactory levels to begin with and did not require additional vitamin C. Hence, it was thought proper to restudy sulcus depth patterns in those subjects with the relatively poor vitamin C levels (low plasma ascorbic acid levels and high lingual times) in each group. The ten patients in each group with the poorest scores were chosen. Figure 5

outlines the findings for the entire group (white columns) and those with the poorer levels (black columns).

Two points deserve particular attention. Firstly, in the groups given local and/or systemic treatment, greater improvement occurred in the smaller selected group with relatively poorer vitamin C state than in the entire sample. Secondly, a slight increase in sulcus depth is shown in the relatively sicker group given no local and no systemic treatment.

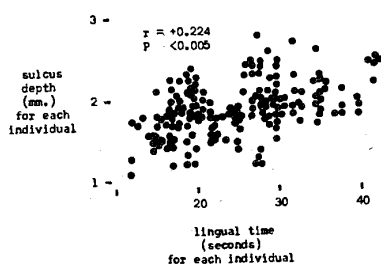
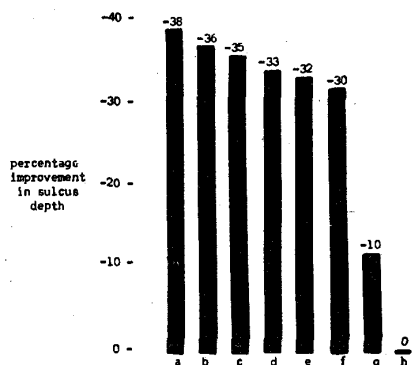


Fig. 3. Pretherapy relationship of a systemic factor (lingual time) to periodontal pathosis (sulcus depth).



- a = prophylaxis with synthetic vitamin C and bioflavonoids
- b = prophylaxis with natural vitamin C concentrate and bioflavonoids
- c = no prophylaxis with synthetic vitamin C and bioflavonoids
- d = prophylaxis with synthetic vitamin C
- e = no prophylaxis with natural vitamin C concentrate and bioflavonoids
- f = no prophylaxis with synthetic vitamin C
- g = prophylaxis with placebo
- h = no prophylaxis with placebo

Fig. 4. Post-therapy percentage sulcus depth change.

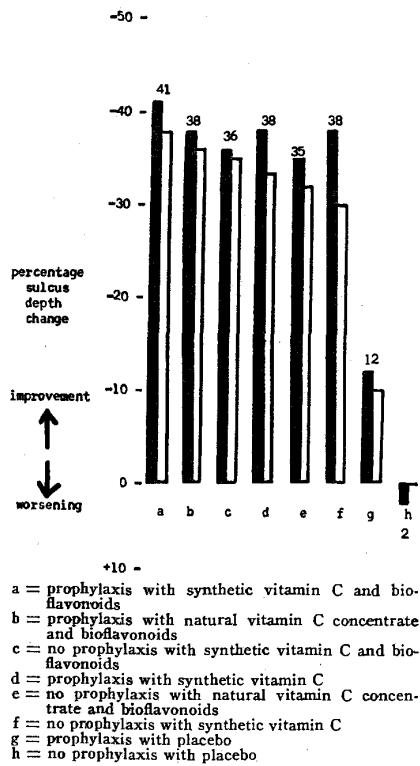


Fig. 5. Comparison of the percentage change in sulcus depth of each group listed above (white columns) with the ten subjects from each group with the poorest vitamin C levels (black columns).

The question arises as to whether the biochemical findings paralleled the clinical changes. No significant alteration in plasma ascorbic acid level and lingual time followed placebo therapy ($P > 0.500$ and $P > 0.100$ respectively). On the other hand, there were significant increases in the plasma vitamin C levels following the natural vitamin C concentrate with bioflavonoids ($P < 0.005$), and synthetic vitamin C with and without bioflavonoids ($P < 0.001$). Also, all vitamin-treated groups showed a significant reduction in the lingual times ($P < 0.001$). Finally, all three vitamin-supplemented groups significantly differed from the placebo-treated subjects. All

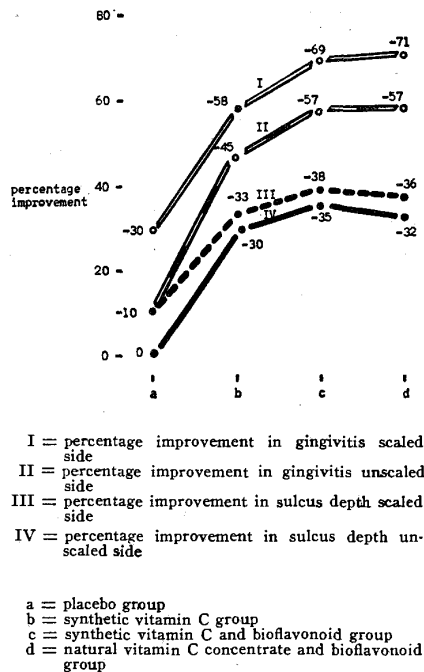


Fig. 6. Comparison of the percentage improvement in gingivitis and sulcus depth with eight different therapeutic regimes.

of these biochemical findings parallel the clinical pattern.

It should be recalled that the effect of these same eight different therapeutic regimes upon gingivitis was discussed in an earlier report.¹ Parenthetical mention should be made that there was a significant initial relationship ($r = +0.579$, $P < 0.001$) between gingivitis and sulcus depth. Hence, it was thought advisable to compare the therapeutic effect of the eight regimes upon gingivitis and sulcus depth (Figure 6). Three points warrant particular attention. Firstly, the percentage improvement in gingivitis (I and II) is always greater than that of sulcus depth (III and IV) irrespective of the type of therapy. Secondly, there was more improvement in both gingivitis and sulcus depth in the scaled (I and III) versus the nonscaled

TABLE 12—COMPARISON OF THE STATISTICAL SIGNIFICANCE OF THE THERAPEUTIC EFFECTIVENESS ON SULCUS DEPTH OF THE VARIOUS SUBGROUPS

		Placebo sc (g)	Synthetic Vitamin C		Synthetic Vitamin C Plus Bioflavonoids		Natural Vitamin C Concentrate Plus Bioflavonoids	
			uns (f)	sc (d)	uns (c)	sc (a)	uns (e)	sc (b)
placebo	uns (h)	ns	s	s	s	s	s	s
	sc (g)	—	s	s	s	s	s	s
synthetic vitamin C	uns (f)	—	—	ns	ns	ns	ns	ns
	sc (d)	—	—	—	ns	ns	ns	ns
synthetic vita- min C + bio- flavonoids	uns (c)	—	—	—	—	ns	ns	ns
	sc (a)	—	—	—	—	—	ns	ns
natural vitamin C concentrate + bioflavonoids	uns (e)	—	—	—	—	—	—	ns
	sc (b)	—	—	—	—	—	—	—
uns = unscaled		ns = not significant						
sc = scaled		s = significant						

(II and IV) sides. Thirdly, there seems to be more improvement systemically without local therapy than local treatment without systemic supplementation. Finally, the overall pattern for sulcus depth parallels that of gingivitis.

SUMMARY AND CONCLUSIONS

This study was intended to evaluate the relative effects of altering a local factor (calculus) and systemic factors (natural vitamin C concentrate versus synthetic vitamin C with and without bioflavonoids) upon periodontal pathosis (sulcus depth).

An attempt was first made to correlate sulcus depth with calculus and ascorbic acid status. The findings indicate a greater correlation between calculus and sulcus depth than between vitamin C state and sulcus depth. Though these relationships were all statistically significant, one cannot ascribe from these data any cause-and-effect.

To attempt possible cause-and-effect relationships, the latter phase of the study involved the appraisal of sulcus depth after the subjects received one of eight different therapeutic regimes. The

treatment involved placebo versus synthetic vitamin C with and without bioflavonoids versus natural vitamin C concentrate with bioflavonoids with and without scaling of one half of the mouth.

Re-examination three weeks later showed a significant reduction in sulcus depth in those individuals subjected to local and systemic therapy treatment alone. However, combined therapy netted the greatest decrease in sulcus depth.

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