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Effects of Periodontal Treatment on the Salivary pH (**)

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INTRODUCTION

The pioner work bearing the hydrogen ions concentration in the salivary environment was carried out by SMITH (14), in 1922.

SHARP (13) performed several researches concerning this subject. The author reported that the mean value of the salivary pH is 6.7, and he investigated the changes resulting in salivary pH related with different conditions of the oral cavity. He also stated that the pH of saliva decreased in presence of oral ulcers and cancers occurring in the oral mucosa. According to SHARP, it seems that the ulceration of oral tissues is a factor giving rise to the decrease in pH.

BRAWLEY (4), in 1935, reported in an article that the pH of normal resting saliva is related with age and sex. According to the results of this study, the mean pH of normal resting saliva is 6.75 in 3405 healthy male and female subjects whose ages varried between 3 weeks and 101 years. In addition, he could not observe a

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considerable difference concerning the average pH of normal saliva related with age and sex.

GROSSMANN and BRICKMANN (7), in 1937, reported, that the human salivary pH varied between 5 and 8, that values below and over these figures were exceedingly rare, that pH of saliva underwent changes at any hour in a day, and that the lowest values occurred during sleep at night.

EISENBRANDT (6) investigated the changes of pH of saliva for a period of 24 months and found that the values of pH of saliva were maximum in October and November, whereas minumum in May.

SCHMIDT and NIELSON (12), in a research bearing on 40 adult subjects, assessed the values of pH of resting saliva of parotid and submandibular glands, and found that the average pH of the parotid saliva was 5.81; the extremes were 5.46 and 6.06; the mean of pH of submandibular saliva was 6.39 while the extremes were 6.02 and 7.24.

ANDERSON (2) insisted on the fact that the value of pH of saliva is related to the presence of carbon dioxide in the saliva and the abundance the flow of saliva, and observed that there was statistically considerable change in the value of salivary pH following the administration of some drugs giving rise to an acidic or alkaline environment.

OSTER and his co - workers (11); in an attempt to evaluate the value of pH of saliva, in 385 subjects, placed sublingually a glase electrode and they found the mean pH to be 5.97 and the extremes being 5.75 and 6.15.

TURNER and ANDERS (15) reported that the pH values of saliva varied between 6.4 and 8.24 in 315 children with a marked increase concerning the amount of caries lesions. Similar results were also obtained by JENKINS (9). This author carried out pH measurements on the close vicinity of the salivary duct, in order to avoid the total loss of carbonic gas.

AFONSKİ (1) reviewing the literature concerning oral diseases and the salivary particulars, explained the changes in concentration of the hydrogen ions related with sex and age, the changes in pH due to the stimulation of salivary secretion and the relations between pH of saliva and the abundance of dental plaques and caries.

KLEINBERG (10) investigated the relations between mixed pH of saliva and pre-and post-prandial bacterial plaques.

In JENKINS' work (9), the results of several researches about the relationships between caries and pH; pH an bacterial plaques; pH and oral inflammation; pH. gingivitis and periodontitis were encountered.

In papers dealing with this topic, several writers pointed out to the decrease in pH as a result of the decrease of the flow rate of the saliva during sleep. Due to the increase of the rate of flow of saliva, at meals, pH increases; and the value of pH reaches again the same level one or two hours following meals (3, 2, 9, 13).

In a comparative study, by JENKINS (9), bearing on human beings and animals, it was observed that pH in animal such as hamsters, sheep and dogs, was higher, namely 8.5.

Recently, in 1971 BOUTBOUL (3) reported the results of a research based on the relation between gingivitis, periodontitis and pH of saliva in man. In this research, the severity of gingivitis and periodontitis, the depth of pockets, PMA indices were evaluated, and no marked relationship between pH of saliva and PMA index was put into evidence.

In a careful review of the literature concerning this subject, no comparative study was to be found about the pH measurements in pre-and post-periodontal treatments. For this reason, the purpose of this paper is to evaluate whether the periodontal treatment effects the pH of saliva or not.

MATERIALS and METHODS

This research bears on 3 groups each of which consisting of 16 human subjects with complete dentition arch and good general health.

The first or control group consisted of individuale with a perfect oral hygiene, that is to say free from a periodontal disease. In this group, including subjects of both sexes, the ages varied from 17 to 51 (Table : 1).

The second group consisted of subjects with chronic marginal gingivitis or periodontitis with surgical indication for gingivec-

tomy. The subjects, in this group, were of both sexes and their ages varied between 18 and 56 (Table : 2).

The third group consisted of subjects of bth sexes between 29 and 48 years of age with chronic periodontitis with surgical indication for flap operation (Table : 3).

The cases with full post-operative recovery in the second and third groups were included in the present research.

In all of these groups, in order to discard the effects of dental caries on the pH of saliva, these lesions were treated before the first measurements of the pH of saliva, in the patients with dental caries. The assessments of pH saliva in the control group, were carried out three times at weekly intervals.

As to the second and third groups, the pH measurements were performed three times at weekly intervals before any periodontal treatment, once more three times at weekly intervale beginning one month after the last periodontal operation.

The pH measurements were always done in the afternoon between 4 and 5 o'clock.

In case a more considerable difference rather than 0.2 or 0.3 units was found, concerning three pH values in the same subject, the measurements were done 5 times with the same intervals and the mean pH values were calculated.

The pH measurements were colorimetrically performed by means of the Universal Indicator strips of «R - Merck - Darmstadt» no : 9542 and 9543, able to measure pH values between 4.0 and 7.0; and 6.5 and 10.0 respectively.

One of the pH strips was sublingually introduced to the patient for 5 seconds with closed mouth and while the strip was moist, pH value was evaluated comparing with the colour scale running between 0.2 or 0.3 units on the box. In order to avoid any error, the value of pH of saliva of every subjects was evaluated using successively at least two strips, and the colour comparison was performed under sunlight.

FINDINGS

In Table 4 the mean values of pH concerning 16 subjects was

found to be 6.78 in the control group (group : 1). In this group, the extreme values of the salivary pH were 6.2 and 8.4; the standard deviation being ± 0.34.

Table 5 shows that the mean of salivary pH before the treatment of the periodontal disease in the gingivectomy group (group 2) was 6.05; whereas after treatment 6.67; the extreme values of the salivary pH before treatment being 4.7 and 7.0; and 5.9 and 7.6 after treatment. The standard deviation was ± 0.58 before and ± 0.29 after treatment.

Table 6 shows that the mean of salivary pH was 5.91 before and 6.68 after treatment in the flap group (group 3); the extreme values being 5.0 and 7.0 before, and 5.7 and 7.2 after treatment. The standard deviation was ± 0.39 before, and + 0.20 after treatment. In some patients of these groups, it became obvlous that one - week - interval values of pH of saliva always showed a difference between 4 and 5 p.m. o'clock. But it was observed that such a difference was of a minimal importance.

A close relationship was noted between the mean value of the salivary pH in periodontal disease - free subjects and those of periodontal disease - treated patients (Table : 7). As seen in Table 7, the difference of the mean pH values between pre-and post-treatment in the gingivectomy group was 0.62; as to the «student t'test, it was 3.75 and p was very significant ($0.01 < p < 0.001$), whereas in the flap group, the difference was 0.77 and «t» was 7.02 and p value was exceedingly significant ($p < 0.001$). Meanwhile the mean of salivary pH in flap operation - requiring group was found to be less, as compared with the cases requiring gingivectomy (5.91 and 6.05). This difference was 0.14.

The mean of pH salivary values in the control group and the means of pre-and post-treatment in the gingivectomy and flap group are shown in Fig. 1.

The means of the first, second and third pH measurements concerning all of three groups are shown in Fig. 2.

DISCUSSION

The pH of saliva changes under different effects. Especially, this change results from the rate of the flow of saliva. Several in-

vestigators (3, 6, 9, 11) showed that the salivary pH was decreased due to the almost complete loss of this flow speed during sleep, that the pH saliva increased, at meals, as a result of the increaso of this speed, and that the pH of saliva reached its normal value 1-2 hours following the meals. Therefore, such measurements are to be carried out at given times in a day at which the salivary flow undergoes the least change as possible.

In the present study, the 6.78 pH value in the control group is somewhat higher as compared to the 6.35 value of CASSARATO (5) bearing on 100 subjects; whereas this pH value of ours is in close relationship with 6.75 found by BRAWLEY's research (4) bearing on 3405 subjects. In case we take into consideration our standard deviation of $\pm$ 0.34, our mean value and those of CASSARATO and BRAWLEY may seem to be the same.

We came to the conclusion that the periodontal disease effects on the pH of saliva as a result of pH measurements of pre- and post-gingivectomy and flap operations. HAWKINS (8) reported that in a patient involved by periodontal disease, the pH of saliva was 6.5, and that this value increased up to 7.9 following the extraction of all his teeth. That is to say, the pH of saliva decreases in case of periodontal disease SHARP (13) found that the pH of saliva was 6.7 in healthy subjects (a value close to / or somexhat the same of our finding); whereas 6.5 in patients involved by periodontal disease in different degrees. As to our 6.05 (group 2) and 5.91 (group 3) values in subjects involved by periodontal disease, as compared to 6.5 of that of SHARP is rather low.

Though according to the investigation of BOUTBOUL (3), there is no relation between the pH of saliva and the severity of gingivitis and periodontitis, as a conclusion of our research, it was observed that the means of pH of saliva following treatment in gingivectomy and flap groups were very close to that of the control group; our finding concerning the obvious difference of the mean values between pre-and post-treatment in the gingivectomy and flap groups, and the lower pH mean value in advanced periodontal disease group (flap group), as compared with the mean pH value in chronic gingivitis or periodontitis (gingivectomy group) are in contrast to the results of BOUTBOUL (3) and confirm the findings of SHARP (13).

In the present study, the correlation between the pH of saliva,

sex and age was not investigate because the number of cases was enough. However a decrease in the pH of saliva, even slight, was observed related with the advance of age.

RESULTS and SUMMARY

In the present research, bearing on 3 groups including each 16 subjects, the values of salivary pH were assessed. The first group consisted of periodontal disease - free subjects. The patients in the second group were selected as being indicated for gingivectomy and the third group for flap operation. The pH values of saliva were colorimetrically evaluated in the second and third groups before and after treatment. In the first group, the pH of saliva was also colorimetrically assessed.

As a result, the following conclutions were drawn :

1. The mean pH of saliva was found to be 6.78 in periodontal disease - and dental caries - free subjects.

2. The mean pH of saliva was observed to be 6.05 in patients involved by chronic marginal gingivitis and periodontitis.

3. The mean pH of saliva was 5.91 in patients involved by advanced periodontitis.

4. The mean pH values following periodontal treatments were found to be very close to that of the control group.

5. In conclusion, the periodontal disease seems to be one of the cause of the decrease of salivary pH and periodontal treatment effects on the salivary pH.

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Age and sex distribution in the control group

	TOTAL	MEAN AGE	RANGE
MALES	10	$27\frac{8}{12}$	17-42
FEMALES	6	$36\frac{7}{12}$	19-51
TOTAL	16	$31\frac{1}{12}$	17-51

Units of years and months

TABLE 1

Age and sex distribution in the gingivectomy group

	TOTAL	MEAN AGE	RANGE
MALES	8	34	18-56
FERMALES	8	$32\frac{10}{12}$	24-50
TOTAL	16	$33\frac{4}{12}$	18-56

Units of years and months

TABLE 2

Age and sex distribution in the flap group

	TOTAL	MEAN AGE	RANGE
MALES	8	$38\frac{4}{12}$	29-48
FERMALES	8	35	29-40
TOTAL	16	$36\frac{7}{12}$	29-48

Units of years and months

T A B L E 3

pH values in the control group

Sex	age	pH					
		1	2	3	4	5	mean
M	17	6.8	7.0	7.0	-	-	6.93
M	18	6.8	6.8	6.8	-	-	6.80
M	18	7.0	6.8	6.5	7.0	6.8	6.82
M	19	6.8	7.0	7.0	-	-	6.93
F	19	7.0	7.4	7.0	7.2	7.0	7.12
M	24	7.2	7.2	7.2	-	-	7.20
F	26	7.0	8.4	7.0	8.1	7.2	7.54
M	28	6.8	6.5	6.5	-	-	6.60
M	32	6.5	6.2	6.2	-	-	6.30
F	36	5.9	6.2	6.2	-	-	6.10
M	39	6.5	6.8	6.5	-	-	6.60
M	40	6.8	6.8	6.8	-	-	6.80
F	41	6.5	6.8	7.2	7.2	6.8	6.86
M	42	6.8	6.8	7.0			6.86
F	47	6.5	6.5	6.5	-	-	6.50
F	51	6.8	6.5	6.5	-	-	6.60
total mean		6.73	6.85	6.74	-	-	6.78
standard deviation		0.30	0.52	0.33	-	-	0.34

M - male F - female

TABLE 4

pH values in the gingivectomy group

sex	age	1	2	3	4	5	mean
		B / A	B / A	B / A	B / A	B / A	B / A
M	29	5.3 / 6.2	5.5 / 5.9	5.5 / 6.5	- / 6.5	- / 6.8	5.43 / 6.38
F	29	5.3 / 6.8	5.3 / 6.8	5.3 / 6.5	- / -	- / -	5.30 / 6.70
M	30	5.9 / 7.0	5.9 / 6.8	5.9 / 7.0	- / -	- / -	5.90 / 6.93
F	31	6.5 / 6.8	6.8 / 6.5	6.5 / 6.5	- / -	- / -	6.60 / 6.60
M	31	6.5 / 7.0	6.5 / 7.0	6.5 / 7.0	- / -	- / -	6.50 / 7.00
F	33	6.5 / 6.8	6.5 / 6.8	6.5 / 6.8	- / -	- / -	6.50 / 6.80
F	33	6.5 / 6.8	6.2 / 6.8	6.2 / 6.6	- / -	- / -	6.30 / 6.70
M	36	5.0 / 6.5	4.7 / 6.5	5.0 / 6.8	- / -	- / -	4.90 / 6.60
F	36	5.3 / 6.2	5.7 / 6.5	5.9 / 7.0	5.9 / 6.5	6.2 / 7.0	5.80 / 6.64
F	38	6.8 / 7.0	7.0 / 7.6	6.8 / 7.2	- / 7.6	- / 7.4	6.86 / 7.36
F	40	5.9 / 6.5	5.7 / 6.5	5.7 / 6.5	- / -	- / -	5.76 / 6.50
F	40	6.8 / 6.5	6.5 / 6.8	7.0 / 6.8	7.0 / -	6.8 / -	6.82 / 6.70
M	43	7.0 / 7.2	6.5 / 6.8	6.5 / 7.2	6.8 / 7.2	6.8 / 6.5	6.72 / 6.78
M	43	5.9 / 5.9	6.2 / 5.9	5.9 / 6.2	- / -	- / -	6.00 / 6.00
M	46	5.7 / 6.2	5.7 / 6.2	5.7 / 6.5	- / -	- / -	5.70 / 6.63
M	48	5.7 / 6.2	5.9 / 6.5	5.9 / 6.5	- / -	- / -	5.83 / 6.40
total mean		6.03 / 6.58	6.03 / 6.63	6.05 / 6.72	- / -	- / -	6.05 / 6.67
standard deviation		0.62 / 0.36	0.60 / 0.42	0.55 / 0.29	- / -	- / -	0.58 / 0.29

$t = 3.75$

$0.01 < p < 0.001$

M - male

F - female

TABLE 5

pH values in the flap group

sex	age	pH					
		1	2	3	4	5	mean
		B / A	B / A	B / A	B / A	B / A	B / A
M	18	6.5 / 6.2	5.7 / 6.2	5.7 / 6.5	- / -	- / -	6.63 / 6.30
M	19	6.9 / 7.7	5.7 / 7.0	5.9 / 7.0	- / 7.0	- / 7.0	5.76 / 6.74
M	24	6.2 / 6.5	6.8 / 6.8	6.2 / 6.8	- / -	- / -	6.30 / 6.36
F	24	6.7 / 6.5	5.5 / 6.8	5.9 / 7.0	5.9 / 7.2	5.5 / 7.0	5.70 / 6.90
F	24	6.3 / 6.8	5.3 / 6.8	5.3 / 7.0	- / -	- / -	5.30 / 6.86
F	26	6.9 / 6.5	6.9 / 6.5	5.9 / 6.8	6.7 / -	6.7 / -	5.64 / 6.60
F	28	6.5 / 6.8	5.5 / 7.0	6.5 / 7.0	- / -	- / -	6.50 / 6.93
M	28	6.9 / 6.8	6.2 / 6.8	6.2 / 7.0	- / -	- / -	6.10 / 6.86
F	30	6.9 / 6.8	5.7 / 6.8	5.9 / 6.8	- / -	- / -	5.83 / 6.80
F	33	6.9 / 6.8	6.2 / 7.0	6.5 / 6.8	6.5 / -	6.5 / -	6.32 / 6.86
M	34	7.0 / 6.8	6.8 / 6.8	6.8 / 6.8	- / -	- / -	6.86 / 6.80
M	43	6.5 / 6.5	5.9 / 6.8	6.2 / 6.8	6.2 / -	5.9 / -	6.14 / 6.70
F	47	6.9 / 7.0	5.9 / 6.8	6.2 / 6.5	- / 6.5	- / 6.5	6.00 / 6.66
F	50	6.9 / 6.5	5.7 / 7.0	5.7 / 6.8	- / 6.8	- / 6.5	6.76 / 6.72
M	50	6.2 / 6.5	6.2 / 6.5	6.2 / 6.5	- / -	- / -	6.20 / 6.50
M	56	6.3 / 6.2	5.5 / 6.5	5.7 / 6.5	6.5 / -	6.7 / -	5.54 / 6.40
total mean		6.85 / 6.55	6.66 / 6.77	6.97 / 6.70	- / -	- / -	5.91 / 6.68
standard deviation		0.49 / 0.34	0.40 / 0.24	0.39 / 0.19	- / -	- / -	0.39 / 0.20

t = 7.02 $p < 0.001$

M - male F - female

TABLE 6

groups	pH means				
	1	2	3	total	
	B / A	B / A	B / A	B / A	difference
control	6.73	6.85	6.74	6.78	—
g.v.	6.03 / 6.58	6.03 / 6.63	6.05 / 6.72	6.05 / 6.67	0.62
flap	5.85 / 6.55	5.88 / 6.75	5.97 / 6.78	5.91 / 6.68	0.77

comparisons of the means of pH of saliva in 3 groups

TABLE 7

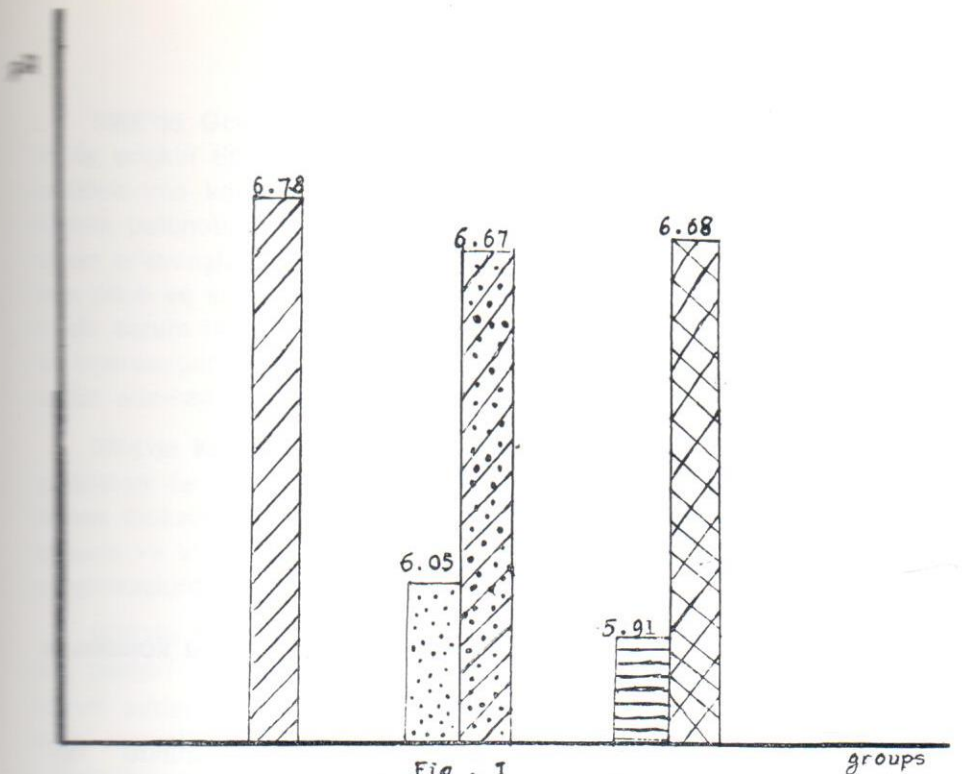

Fig . I

histogram showing the means pH values in three groups

control g.

g.v.g. before op.

g.v.g. after op.

flap g. before op.

flap g. after op

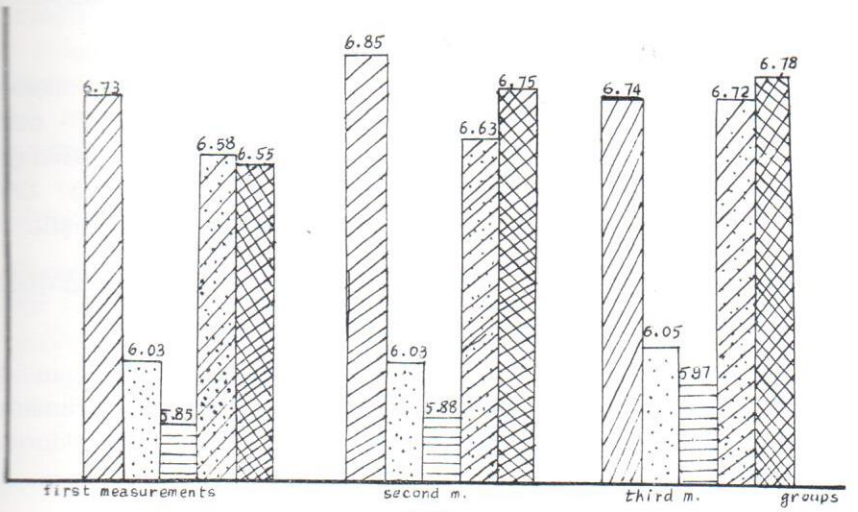

Fig:2

histogram showing the three measurements in three different groups

control g.

g.v.g. before op.

g.v.g. after

flap g. before op.

flap after op