Research Article

PERIODONTAL TISSUE HEALTH IN ENDEMIC FLUOROSIS AREAS: A CASE STUDY

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ABSTRACT

Aim: The objective of the study was to determine if there is any reduction in periodontal disease in people living in areas where the drinking water contains fluoride in more than optimum level- as compared to its definite proven anti caries activity.

Methodology: A survey with 320 patients in two groups of 160 each in Sengattur [4.4ppm] Salem District, Tamil Nadu and Nalgonda [3.5ppm], in Andhra Pradesh, with a control of 200 patients from Mamandur in Chengalpet District Tamil Nadu with fluoride in a level of less than optimum, by using the OHI(S) Greene and Vermillion index for oral hygiene, PI., Periodontal Index Of Russell DMF index for caries, and Deans index for assessing Fluorosis of the teeth. The sample was divided into four groups of age as A (10-15 years), B (16-30 years), C (31-45 years), D (46-60 years). The socioeconomic status and oral hygiene habits were held constant and the following indices were used to assess the oral health condition. The accumulated data were statistically analyzed using the 'Z test' and student 't test'.

Results: The results showed a lesser severity of periodontal disease with a slight reduction in OH1(S) scores also. There was a definite decrease in DMF and a direct positive correlation between DMF and PI.

Conclusion: The study clearly indicates that DMF and periodontal scores are less in populations with excess fluoride in their drinking water; than in people drinking water, with fluoride in less than optimum level.

Key Words: Endemic fluorosis, Fluoride, Gingival diseases, Gingivitis, Periodontitis

INTRODUCTION

The prevalence of the periodontal diseases dominates among all the oral and dental diseases. The prevention, cure and control of them have been attempted by various methods. In the case of caries its lesser incidence was noted in certain geographical areas wherein there existed natural presence of fluorides in the drinking water . This fluoride by incorporation into the enamel and increasing the re-mineralization apart from enzymatically inhibiting the bacteria had reduced the susceptibility of the teeth to caries .

With this knowledge of the effects of fluorides on bacteria that cause caries many studies have been conducted using both local and systemic forms of fluorides to study and recognize their similar effect, if any, on the bacteria that cause the periodontal diseases .

This opened the eyes of some authors and lead them to further investigate, whether there is any reduction in periodontal' disease in people living in areas where the drinking water contains fluoride in more than optimum level . Consequent to such an idea a few studies were conducted in which the periodontal health and the oral hygiene status of people in endemically high fluoride containing areas were assessed and also compared with those living in areas where the fluoride content in drinking water is less . Some of these studies even included the analysis of intraoral radiographs to detect the effects on the alveolar bone. But all these studies did not reveal many differences between the two groups .

Hence the aim of the present study is to assess the periodontal health and the oral hygiene status of people residing in endemic fluorosis areas; to compare these data with those from a population living in an area with negligible fluoride in water; and also to recognize and correlate the periodontal health with that of caries incidence and its relation to fluoride level in the drinking water, so that it will throw more light on the periodontal health in fluoride variant areas.

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These studies were followed by studies on the effects of local application of different forms of fluorides. Bjarne svatun 1978 studied the influence of stannous fluoride on pH changes on dental plaque in vivo after use of mouth rinses or a toothpaste. 0.2% solution of stannous fluoride reduced the fall in the pH markedly for at least 7 hours, measured using gold , glass electrodes.

The stannous fluoride adsorbed to the bacterial cell wall disturbed membrane transport mechanisms and also inhibited the enzyme systems from forming of the sugar for energy production. Previous researchers reported that sucrose rinses lead to higher acid production in residents of low fluoride area thereby implying inhibition of bacterial metabolism by fluoride on an altered plaque ecology as a result of fluoride ingestion . This finding was also recorded by Houte et al., where he said that was found to be less in plaque and subsequent plaque formation and maturation, because of presence of fluorides .

An important property of fluoride ion is its ability to inhibit enzyme action and so exert a direct effect on plaque bacteria . Bibby 1940, Wright and Jenkins 1954 have shown that small amounts of fluoride ions (1-10 ppm) will decrease acid production by pure cultures or by saliva-glucose mixture . Higher levels of ionic fluoride above 32 ppm are required to reduce acid production by plaque. Such higher levels were not observed in oral cavity but later Dawes etal (1965) found that fluoride was concentrated within the plaque, which fluoride originated from the oral fluid than the Enamel. Only 2-5% of the fluoride is ionic and the rest is bound at neutral pH. The bound fluoride is a fluoride reservoir, since it can dissociate when more acid is produced by plaque organisms.

The concentration of fluoride above 2 ppm in solution progressively decreases transport or uptake of glucose or its analogues into cells of oral Streptococci. When plaque has been depleted of its exogenous sugar supply, Fluoride inhibits the metabolism of the iodophilic polysaccharides by the micro-organisms present in plaque and also by the salivary bacteria, thus indirectly interfering with acid production .

Masanobu mizohata et al., 1988 in their study of rats fed on different dosages orally for three weeks found that the fluoride in small dosage had no significant effect on Dentin, Cementum, Periodontal Ligament and Alveolar bone. Higher doses of 35 mg./kg body weight lead to more formation of Dentin and less volume of Cementum and decrease in the density of the alveolar bone with not much changes in the periodontal ligament. Aim of the present study is to identify the changes after administration of fluoride in the formation of tooth and Enamel, Dentin, Cementum and Alveolar bone and also in their mineralisation.

MATERIALS AND METHODS

The subjects for this study were selected randomly in populations living in endemic areas for fluorosis in Salem District, Sengattur (4.4 ppm) of Tamil Nadu and Nalgonda District, Nalgonda (3.5ppm) of Andhra Pradesh as experimental groups I & II. The control groups were also randomly selected from a non-fluoridated area, Mamandur in Chengleput district, Tamil nadu. Both the experimental and the control groups were subdivided into four subgroups of age as, group A 10-15 years, group B 16-30 years, group C 31-45 years and group D 46-60 years .

Case selection:

In the experimental groups it was confirmed that the subjects were residents in the locality from birth continuously without a break for more than 5 years at a stretch. People with not less than 10 teeth were only considered In both the experimental and control groups the socioeconomic status of the subjects was controlled to be the same and also the oral hygiene habits were noted to be the same .

Those with known systemic diseases were not considered for the study . The field equipment used was a mouth, mirror and an explorer. Adequate light was ensured either artificial or natural. With these parameters the following criteria were observed and indices recorded in the proforma. Oral cleanliness was estimated according to OHI (S) index of Greene and Vermillion . Relative prevalence and severity of periodontal diseases were determined by means of the Periodontal Index Of Russell . The grade of dental fluorosis was estimated with the help of Dean's index . The DMF Index was also utilized to record the caries incidence.

A mouth mirror and an explorer with the aid of adequate light was always ensured for recording the findings using a proforma for the same

Statistical Methods on accumulation of data for the above said indices were tabulated and analyzed using the following statistical methods.

The mean value for each index was subjected to comparison between the two experimental groups with that of the control group. Hence the Mean values were tabulated for these three divisions separately. For each index a separate table was drawn. In each table the variation of the index values along with age were tabulated in order to study the element of progressiveness, if it existed along with age. Detailed discussions of the index values for the different age groups were recorded under each table separately along with their statistical significance. This was further analyzed by using the test of significance between the two means, by using larger sample methods. In view of the fact that the sample size is more than thirty the following formula was adopted for the calculations.

$$Z - \frac{\left(\overline{X}_1 - \overline{X}_2\right)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \sim N(0,1)$$

To elucidate the correlation between PI versus DMF & PI and Dean's index the data are tabulated separately for the two experimental groups. The values of the correlation coefficient have been entered in table (D). The correlation thus computed was evaluated for significance using student's 'T' test' by the application of the following formula

$$t\left(n-2\right) = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

The significant of the correlation coefficient calculated was plotted in table (E).The reduction in the value of PI is appreciably large in the experimental group II when compared to the group I. This important finding indirectly connotes the presence of large amount of fluoride content in the drinking water of the II experimental area.

RESULTS

The results showed a lesser severity of periodontal disease with a slight reduction in OH1(S) scores also. There was a definite decrease in DMF and a direct positive correlation between DMF and PI.

The behaviours pattern of the PI differs from that of the OHI(S). PI declines in both the sampling units in the earlier and older age groups. Though there exists a decline there is no statistical significance at two points. But anyhow the levels of PI decline in the units when compared with that of the control.

The reduction in the value of PI is appreciably large in the experimental group II when compared to the group I. This important finding indirectly connotes the presence of large amount of fluoride content in the drinking water of the II experimental area.

With regards to the DMF the reduction is uniformly highly significant age groups. Hence we can safely expect a due amount of reduction in DMF (table3) with 99% certainly irrespective of the age groups in the sampling units. The most interesting factor is the amount of reduction found to be equally likely in the two units for the four different age groups. This shows that the particular parameter behaves distinctly, without the influence of any other associated extraneous factor. In other words, the behaviour of the DMF is unique in all respects and this factor is not influenced either by OHI (S) or by PI. There exists a distinct and clear positive correlation between PI and DMF in both the experimental groups. This correlation is seen to be statistically significant in almost all the groups. The existence of a positive correlation implies that when there is an-increase in DMF there is a corresponding increase in the PI in both the experimental groups. This means that the value of DMF index is directly dependent on the values of PI irrespective of the area of sampling. This area factor seems to be an additional factor along with the influence of PI as far as DMF is concerned.

DISCUSSION

The existing studies that have been conducted were done in countries where there is good dental care available for people from all walks of life. In contrast to those this study in India, has utilized the subjects for whom there is no such easy availability of dental care. Added to this is the fact that the socioeconomic status is also less here, which has a definite role to play in the periodontal health of the people . As in the study of Englander and Kesel this study did not attempt to quantify calculus. The chance of examiner variability was also nullified by the fact that there was only one examiner for the entire study . From the observations of the study it seems that fluoride in a concentration higher than the optimum is not directly detrimental to the tissues of the Periodontium. This study was subdivided into four subgroups (W.H.O. Report 1978, on oral health surveys).

An objective evaluation of oral hygiene paralleled the periodontal survey in order to detect any effect of the fluoride and also to determine if such differences in oral hygiene could account for any differences, if any, in the prevalence and severity of periodontal involvement. As stated by Russell the factors of socio-economic status, oral hygiene habits, dietary and nutritional habits within each group were controlled to coincide, to eliminate variations . Dental caries experience was also estimated as one aspect of the study so as to observe if it can possibly influence the periodontal disease. The inverse relationship between the caries and water fluoride was also brought to light again.

The study did not make use of radiographs due to the distant and remote locations of the field study in various places The need for the radiographs is obviated with reference to Russell's point on field studies; where he opines that radiographs are not essential for comparisons between populations because their use merely raises the average scores to similar degree and does not affect differences in scores used for comparison. He also emphasizes the need of radiographs in individual patient treatment, and says that such deviations are tolerable in the epidemiological studies, as long as they are random i.e., as apt to occur in one group as in another and adds that, "about the same findings will be returned whether radiograph is used, or whether the estimate is based upon the field examination only".

The table1 gives an idea about the patterns of the OH1(S) scores. The scores in the experimental groups I & II are lesser than that of the control and also statistically significant except in the age groups A and D of the experimental group I.' In the experimental group II all the age groups show significantly less scores meaning that the oral hygiene in experimental group II is better. As seen in the study of Englander the level of dental care was similar in both the groups, ruling out the assumption that dental care would have influenced the difference in the scores.

So we may assume that there, may be a favourable effect of fluoride in drinking water on plaque and calculus inhibition as revealed by earlier investigators who consider the property of the fluoride ion to exert a direct effect on plaque bacteria, and deter the plaque bacteria. This can also be considered as an explanation for the reduction of the OHI(S) score. This is also in concurrence with the study of Ericsson et al (1967) who found that fluoride in enamel surface, by substituting the OH— ion alters the surface energy and thereby alters the depositions of the pellicle and subsequent plaque formation. These studies may be considered to explain the low scores only partially because the scores though less are not dramatically so.

The table 1 of periodontal indices for the experimental groups also shows lesser scores in age groups studied. The lowest scores in the age group D in experimental group II may be because of the loss of already terminally diseased teeth that might have left behind the less affected teeth with less scores, the experimental group II shows consistently lesser scores that the experimental group I which actually has more fluoride in water (4.4 ppm) than the group II (3.5). This may be due to the geographical and a consequential climatic variation which will influence the amount of water consumption daily and thereby may have different effect, on the experimental groups.

The difference between the values though not very drastic but significant enough indicates the basic truth that periodontal disease is equally prevalent in all the communities, held as control and experimental. For the reason that the periodontal index (PI) reflects the incidence and the severity of the periodontal disease; and since we see that the prevalence is equal in all the groups it is only true that the lesser scores in the experimental groups go to prove that the severity of the periodontal disease is less in the experimental groups than in the group held as a control. As an explanation to this less severity the following findings may be cited. Previous researchers found that fluoride had a retarding effect on the resorption of the alveolar crestal bone. Many factors contribute to the destructive periodontal disease and it may well be that fluoride can, "increase the crystallinity of the bone and by that reduce the surface area per unit mass of bone; thus apatite may be less reactive in the presence of inflammation or other catabolic factors", as. noted by Zipkin et al maintain that there is osteosclerosis and peri-osteal bone deposition, respectively due to fluorine in excess of the optimum level. This might have reduced the severity of the bone loss also. But Ramseyer and Kristofferson proved on the contrary that such excess fluoride in the drinking water increased the periodontal disease .

Furthermore, the studies that fluorides in high doses increases the bone density was also confirmed by Jowsey, Schenk & Reutter and well add to the support of the theory and account for the reduction in the severity and the scores of the Periodontal Index, in the experimental groups. But the study of Masanobu Mizohata et al with animals reports that the alveolar bone density decreased with increased fluoride ingestion and adequate maintenance of Vit. D and Calcium such decrease in density is not observed; instead such a measure of fluoride as a therapeutic agent increases new bone formation in patients with Osteoporosis and in patients with Multiple Myelomatosis. With all these views we may safely assume that fluoride in drinking water in endemic areas may act favourably in reducing the periodontal disease.

It can also be said that the lower dental caries experience as denoted by the lesser DMF values in the experimental groups with periodontal disease. Inflammation is often found in gingivae adjacent to carious lesions, and more gingivitis would be expected in groups having more open carious lesions. Russell found that PI tended to be higher around carious than non- carious teeth due to loss of contact and food impaction etc. This might be the reason for the lesser PI scores in the experimental groups compared with that of the control where it is high. The last two tables go to prove this theory by having significant and highly significant positive correlation between the PI and the DMF; meaning that, the periodontal disease is severe when there are many diseased or carious teeth. The PI and DMF are found to have positive relation.

The table on the DMF values reveals that the DMF scores for all the age groups are less, highly significantly in both the experimental groups as compared to that of the control group. This aspect does not need any explanation in specific, since it has been doubtlessly proved that water fluoridation does reduce the caries experience from 50% 35%. The differences in the scores within the experimental group and other such incongruity can be due to the distant geographical locations, climatic alterations, cultural habits which have a definite effect on the epidemiology of diseases.

The fact that these effects have been found in populations that have been resident in the specific locations from birth and so were consuming the fluoridated water continuously, it has to be studied whether addition of fluoride in certain amounts only when periodontal disease is detected and in people who are living in endemic fluorosis areas will have any beneficial effects in contrast to the subjects of this study who had the influence of the fluoride even in the formative stages of the dental tissues in their development.

These studies can further be augmented by involving twins of similar physiology and habits in areas with and without fluoride and studying the effects of fluorides in them. It is also important that studies to specify, the effects on soft tissues and hard tissues of the oral cavity have to be conducted. With many people in the endemic areas being normal and many in the areas also being severely affected by periodontal disease, it is imperative that the mechanism of host response with respect to each individual has also to be seriously considered.

Previous investigators proposed that frequent use of fluoride induces dramatical decline in past three decades is thought to be main reason for the marked caries reduction in many countries. Fluoride provides significant declines in edentulism among adults and site-specific protective effect in the lumbar vertebrae .

CONCLUSION

It is evident that DMF and periodontal scores are less in populations with excess fluoride in their drinking water; than in people drinking water, with fluoride in less than optimum level. The study also reveals the need for advanced methods of bone and soft tissue analyses to specifically corroborate such properties of fluoride.

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Table 1 :OHI(S) VS AGE compared with control and experimental groups

Age group (years)		Control	Exp. I	Exp.II
A	Mean value	3.05	2.53	2.29
10-15	Sample size	-50	-40	-40
	S.E.M	0.132	0.242	0.146
	Significance		NS	HS**
B	Mean value	4.11	2.96	2.93
16-30	Sample size	-50	40	40
	S.E.M	0.146	0.201	0.15
	Significance		HS**	S*
C	Mean value	3.52	2.41	2.15
31-45	Sample size	-50	40	40
	S.E.M	0.176	0.15	0.227
	Significance		HS**	S*
D	Mean value	3.53	2.77	2.34
46-60	Sample size	-50	40	40
	S.E.M	0.154	0.098	0.256
	Significance		NS	HS**

*S Significant (P< 0.05) **HS Highly significant (P < 0.01)

Table 2: PI VS AGE compared with control and and experimental groups

Age group (years)		Control	Exp.I	Exp.II
A	Mean value	1.27	1.07	0.71
10-15	Sample size	-50	40	40
	S.E.M	0.05	0.101	0.063
	Significance		S*	HS**
B	Mean value	1.42	1.39	1.31
16-30	Sample size	-50	40	40
	S.E.M	0.095	0.098	0.072

Table 2: (Continued)

Age group (years)		Control	Exp.I	Exp.II
	Significance		NS	HS**
C	Mean value	2.54	2.14	2.38
31 - 45	Sample size	-50	40	40
	S.E.M	0.114	0.058	0.088
	Significance		HS**	NS
D	Mean value	2.74	2.19	1.98
46-60	Sample size	-50	40	40
	S.E.M	0.093	0.232	0.167
	Significance		S*	HS**

* S Significant (P < 0.05)
** HS Higly Significant (P < 0.01)

Table 3: DMF VS AGE : compared with control and experimental groups

Age groups(years)		Control	Exp.I	Exp.II
A	Mean value	2.8	2	1.9
10-15	Sample size	50	40	40
	S.E.M	0.188	0.038	0.083
	Significance		HS**	HS**
B	Mean value	2.4	2.2	2.1
16-30	Sample size	50	40	40
	S.E.M	0.101	0.08	0.133
	Significance		HS**	HS**
C	Mean value	4.8	3.1	3.43
31 - 45	Sample size	50	40	40
	S.E.M	0.08	0.131	0.134
	Significance		HS**	HS**
D	Mean value	5.7	3.6	3.25
46-60	Sample size	50	40	40
	S.E.M	0.149	0.148	0.126
	Significance		HS**	HS**

** HS - Highly significant (P < 0.01)

Table 4: PI VS DMF correlation coefficients

Age Groups(years)	Exp no.I (n=40)	Exp no.II (n=40)
A 10-15	0.86	0.56
B 16-30	0.84	0.63
C 31-45	0.34	0.21
D 46-60	0.36	0.16

Table 5: PI VS DMF significance of correlation coefficients (t38)

Age groups(years)	Exp.I	Exp.II
A 10-15	10.39**HS	4.16**HS
B 16-30	9.55**HS	4.99**HS
C 31-45	2.22*S	1.39 NS
D 46-60	2.64*S	1.00 NS

** HS - Highly significant (P < 0.01)
*S - Significant (P < 0.05)
NS - Not significant