COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF DIFFERENT FLUORIDE CONTAINING ANTI CARIES AGENTS ON SCHOOL GOING CHILDREN USING CARIOGRAM: AN IN-VIVO STUDY

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ABSTRACT
Background: Caries risk assessment is an essential component in the decision making process for the prevention and management of dental caries. The cariogram which is a simple pie chart representation used to prescribe targeted preventive programs. It is appreciated by the patient as it is economically beneficial and rational. Aim: To evaluate & compare the efficacy of two fluoride containing commercially available anti-caries agents- CCP-ACPF & Bioactive glass on school going children. Materials & Method : This in vivo study was conducted at DJ College of Dental Sciences and research, Modinagar, for a period of 15 days. BIOMINF,CPP-ACPF and one non fluoridated dentrifice were distributed to a group of 30 healthy individuals(n-10 each) of the age group 5-15 years. Cariogram was constructed using the details that were obtained via questionnaire, interview, oral examination and salivary analysis. Two cariograms were constructed for each individual using the details collected before and after using respective dentrifces. The percentage change in each sector were tabulated and interpreted. Statistical Analysis was done using the SPSS statistical software 19.0 Version. Results: BIOMINF had shown a significant increase in the green sector (percentage of chances to avoid caries sector) and light blue sector(susceptibility) as compared to other two Groups. Circumstances and diet sectors(yellow and dark blue sector) showed negligible changes. Conclusion: BIOMINF is an effective preventive intervention that can alter the cariogram by increasing the green sector of an individual.

INTRODUCTION:
Dental caries is the most common infectious disease among children and adolescents[1] which if not treated, can worsen the situation. So its better to early diagnose and prevent the disease[2].

Cariogram (1997), a Caries risk assessment tool is a pie diagram that illustrates a possible overall caries risk scenario for the individuals and provide preventive strategies[3].

BIOMINF & CPP-ACPF are considered as very effective preventive agents used to rebuild the tooth surface.

Thus the aim of the study is to evaluate & compare the efficacy of two fluoride containing commercially available anti-caries agents- Bioactive glass & CCP-ACPF using a cariogram.

Materials & Method :
This in vivo study was conducted at pediatric and preventive dentistry, DJ college of dental sciences and research centre, Ghaziabad, Uttar Pradesh for a period of 15 days. The study was designed as a longitudinal field trial with before and after comparisons to assess the changes in the caries risk profiles following the use of BIOMINF,CPP-ACP and a non fluoridated dentrifice.

Inclusion and Exclusion Criteria
Thirty healthy school going children falling in the age group of 5-15 years with no related general diseases were invited to participate in the study. The subjects were equally divided into three groups(n-10 each). Group I- Control Group(non fluoridated dentrifice), Group II- Experimental Group (CPP-ACPF) and group III- Experimental Group(BIOMINF) respectively. The subjects were recruited from the general OPD of our pediatric department, DJ college of dental sciences and research centre, Modinagar.

Those having respiratory diseases, use of fluoride toothpaste over the last three months, having fixed orthodontic appliances and taking antibiotics over the last month were excluded from the study. In order to prevent confounding errors due to intake of antibiotics or other factors, every subject was continuously monitored throughout the study period. All subjects were asked to report immediately on the occurrence of any Side effects. It was decided that under such circumstances the concerned subject will be excluded from the study.

Recording Cariogram Scores:
A proforma was designed to document all the information required for constructing the cariogram model. The Cariogram, a pie circle-diagram is divided into four sectors in the following colors: dark blue, red, light blue and yellow indicating the different groups of factors related to dental caries. In addition, there is a fifth sector that is obtained by subtracting all the other four sectors from the pie diagram called "the chance to avoid cares" which is given the green colour. Details about fluoride usage medical history, diet contents and frequency were recorded by taking a detailed case history. Each of these criteria was then allotted scores based on the key provided in the

cariogram manual (Bratthall et al., cariogram Manual 2004, Internet version 2.01). All oral examinations were then carried out by a single investigator.

Recording Caries Status and Plaque Levels:
Decayed, Missing, Filled Surface index (DMFS) WHO 1989 was used to root caries experience. A plane mouth mirror and straight probe was used to record the index. The Silnesss and loe index was used for assessing the plaque amount. The DMFS and plaque scores were calculated and the corresponding cariogram scores were than entered in the proforma

Sample Collection and Salivary Flow Rate :
Unstimulated salivary samples were collected in a 5ml sterile vial to evaluate the salivary flow rate, buffer capacity and streptococcus mutans levels. The subjects we asked to be seated upright in a relaxed position and collect their saliva in the given sterile vial. The time taken for them to collect 5 ml was noted and salivary flow rate per minute was calculated.

Salivary pH and Buffer Capacity:
The pH and buffering capacity were identified using a hand held pH meter with digital display.

Standard pH pellets of pH 4.0 and 7.0 were used for the calibration of the pH sensitive electrode. The test samples were then titrated with 250 µL of lactic acid (pH 3. 15 mM). The pH values of the titrated samples were then noted using the same pH meter.

Microbial Analysis:
For microbial analysis the salivary samples were diluted and vortex mixed. Aliquots of 0.1 mL from the diluted samples were inoculated on the surface of mitis salivarius agar base Himedia. The petri plates were then incubated fox 48 hours at 37° C. The colony forming units were counted after identifying the organisms based on their colony morphology.

Constructing the Cariogram
All data required for constructing a cariogram were first obtained from all the subjects for baseline(Table No.1) and were entered into the cariogram software and the pie chart was constructed. At the start of the study 30 cariograms were constructed based on baseline value.

Once the baseline cariograms were built respective dentrifices were distributed to the subjects. The subjects were instructed to follow similar oral hygiene measures for a period of 15 days. Again at the end of 15 days, data was collected pertaining to salivary analysis for flow rate buffer capacity and Streptococcus mutans level and the plaque scoring alone. These scores were utilised to construct the new cariogram for all the 30 subjects. Thus sixty cariograms were constructed for each subject with the values obtained before and after usage of fluoridated dentrifices(BIOMINF ,CPP ACPF) and non fluoridated dentrifices (Fig. No.1) . The percentage changes in each sector were noted and tabulated using SPSS 19.0.

Table No.1: Caries Related factors for constructing a cariogram

RESULTS:
Table 2: Score given for each parameter based on the data collected to construct the cariograms at baseline and after 15 days

Groups	Caries experience	Related	Diet content	Diet frequency	Plaque amount		Streptococcus Mutans		Fluoride program	Buffer capacity	
					baseline	After 15 days	baseline	After 15 days		Baseline	After 15 days
I	0	0	2	2	1	1	2	2	3	2	2
II	0	0	2	2	1	0	2	1	2	2	1
III	0	0	2	2	1	0	2	0	2	2	1

All subjects completed the study with good compliance. The (Table No.2) shows the cariogram models constructed for one of the study subjects at baseline and after 15 days. Changes in values are markedly seen only in Streptococcus mutans count and pH value.

Table 3: Change in percentage of all the five sectors for all the three Groups

Groups	Light blue sector(%)		Red sector(%)		Dark blue sector(%)		Yellow sector(%)		Green sector(%)	
	Baseline	After 15 days	Baseline	After 15 days	Baseline	After 15 days	Baseline	After 15 days	baseline	After 15 days
I	14.3	14.4	14.7	13.2	8.8	8.7	3.9	3.9	58.3	59.4
II	14.7	12.7	16.2	13.6	8.3	8.2	4.3	4.3	56.7	61.8
III	14.2	10.30	14.7	9.70	9.0	9.0	3.8	3.8	58.3	68.1

Results of the field trial show an increase in the percentage of green sector after 15 days in all the subjects. The central tendency value of the green sector has significantly improved after the use of BIOMINF as compared to CPP-ACPF and non fluoridated dentrifice. The magnitude of difference in green sector percentage among the subjects of BIOMINF Group ranges from 68.1 to 58.3% (Table No.3).

The change in percentage of the four sectors for the BIOMINF group on comparing the pre and post intervention cariogram models are shown in Figure no.1. A dip in the percentage of light blue sector from 14.2% to 10.3% is seen. This sector shows the maximum range of difference when compared to the other three sectors indicating that BIOMINF improves the salivary flow rate and buffering capacity. Light blue sector is subsequently followed by red sector with a mean difference value of 5.0% signifying the antimicrobial action and plaque reduction potential of BIOMINF. The yellow sector and dark blue sector show insignificant alterations from baseline values.
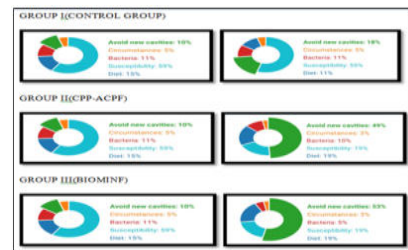

Fig.1:Cariogram showing all the sectors at the baseline and after 15 days for all the three Groups

DISCUSSION
Dental caries is one of the commonest disease affecting up to 90% of the world's population and more than 40% of Indian children have shown dental caries in both primary and permanent teeth (Chong C, 2016)[1].There is a old belief that "Prevention is better than cure"as prevention of dental caries not only improves oral health but also the systemic health and the quality of life of an individual. Before starting with a preventive program, the first important step is to assess the risk of the individual which will provide information for generating preventive strategies that result in successful outcomes and economic effectiveness. Four models are available to assess the caries risk which includes Cariogram, Caries Management By Risk Assessment (CAMBRA), an in vivo study American Dental Association (ADA), and American Academy Paediatric Dentistry (AAPD), Out of these systems, cariogram is found to be inexpensive, quick inexpensive and acceptable tool5. Cariogram is an expedite tool that acts as both a prediction model and risk model for dental caries. Apart from prophesying occurrence of dental caries, this tool can be used to educate and motivate the patient. The simple pie chart representation, of the risk profile is easily appreciated by the patient. The cariogram can also be used to prescribe targeted preventive programs2. An expansion of the green area in the pie chart proclaims the success of the preventive Streptococcus Intervention and also a decrease in the percentage of another sector or combination of other sectors. This further aids in interpreting the action of the intervention on the risk factor. One study done by Padminee K.et.al.[2] has used the cariogram model to assess the changes in cariogram following the use of CPP-ACP chewing gums. Hence, in this study the changes in the cariogram outcome the use of BIOMINF and CPP-ACPF dentrifices have been assessed.

BIOMINF compounds have remarkable potential to act as caries preventive agents as compared to other two groups[7,8]. The compound is available in the form of dentrifice summated with the benefits of calcium with phosphate system in BIOMINF give the credence of being a caries preventive agent. This statement is in congruence with the result of the present study. The improvement in the caries risk profile after 15 days as indicated by the increase in green sector confirms the anticariogenic effectiveness of BIOMINF. This seeming increase in the percentage of green sector is because of the actual decrease in percentage of the other sectors. Light blue and red sector seems to be the most altered sector followed by the dark blue and yellow sectors showed very negligible changes.

The light blue sector (represents susceptibility) is based on a combination of fluoride program, salivary buffer and flow rate. Studies have shown that BIOMINF can enhance the buffering ability of saliva with the calcium and phosphate ion system. The BIOMINF gets incorporated into the place and releases its cargo of ions to maintain a supersaturated state with respect to enamel as the pH declines, BIOMINF releases calcium and phosphate ions which enhances remineralisation at the crucial time suppressing the demineralisation due to the low pH[9].

The red sector representing bacteria is calculated from weighted values of amount of plaque and Streptococcus mutans. The change seen in the red sector is due to the antibacterial action of BIOMINF on Streptococcus mutans. The Silness and Loe index used for plaque assessment in the cariogram simply objectifies the unmitigated presence of plaque. There was significant reduction in the bacterial colony count and increase in salivary pH seen in group C (BIOMINF) than in group B (CPP-ACPF) and group A(Non fluoridated) where dentifrices has been used for 15 days. In total the mean % decrease in S.Mutans count (CFU/ml) was 52.60% in group C(BIOMINF), 42.52% in group B(CPP-ACPF) and in group A(Non fluoridated) reduction was only 18.97%. Similiar result were seen in the studies done by Sivaranjani S 2018 et al., Srivastava S 2019 et al., N Nagaveni 2022 et al who found BIOMINF to be an effective anti caries agent. In fluoridated toothpaste, fluoride is mostly available in the form of sodium fluoride or sodium monofluorophosphate.

Sivaranjani S et al[10] evaluated and compared the remineralizing potential of three different dentrifices and proved Elsenz to be the most effective remineralizing agent.

Similar results were seen in the study by Patil S et al (2010)[6] in which they did an in-vivo comparison of two commercially available toothpastes children and found a steady reduction of bacterial count in both the Fluoridated as well as herbal toothpaste.

The similar results were also seen in the study conducted by George D et al (2007)[11], where in vitro comparision of antimicrobial efficacy between the two commercially available fluoridated toothpastes (colgate and pepsodent) was done with Aloe vera containing herbal toothpaste and the study demonstrated that Aloe vera was equally effective as the two fluoridated toothpastes.

Moreover, BIOMINF has dual property of both anticalculus and plaque reduction by diminishing the adherence of Streptococcus mutans and Streptococcus sobrinus to plaque biofilm[12].

Circumstances (yellow sector) comprises of past caries experience related general diseases .Results of the study show that changes in this sector is almost nil as dental caries and systemic health conditions take time period longer than 15 days to occur and hence no significant alteration is seen in yellow sector. Diet content and frequency constitute the diet domain (dark blue) which also shows negligible changes as no change in diet pattern was advised for the subjects to follow. A visible increase is seen in the green sector within a span of 15 days due to the use of BIOMINF .

However, cariogram has some limitations as it expresses caries risk only. It does not take into account problems like fillings, discolourations13. Therefore, long-term clinical trials and further research needs to be done in order to establish the efficacy and superiority of these test agents and thereafter, Elsenz may be used in remineralization of early carious lesion in in-vivo conditions.

CONCLUSION
Within the limitations of the present study, it can be concluded on evaluation by cariogram, the BIOMINF(Elsenz) proved to be more effective anti caries agent when compared with CPP-ACPF and non fluoridated dentrifice. Thus, BIOMINF can be recommended as the most cost effective and best preventive anticaries agent.

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