Oral Health of Children with Congenital Heart Disease following Preventive Treatment

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Congenital heart disease (CHD), abnormalities in the structural development of the heart, occurs in approximately 8:1000 live births. The causative microorganism for infective endocarditis in more than 60% of the patients with positive hemoculture of viridans streptococci (s.mutans, s.mitior) thus making it mandatory for these children to maintain their oral health. The present study assessed the oral health of children with congenital heart disease following preventive treatment. A total of 74 children with congenital heart disease were selected for the study with 30 healthy controls between the ages 5-16. The oral health was assessed by measuring the microbial counts, the OHI-S and the gingival indices. The data thus obtained were subjected to paired and unpaired t - test. Poor oral health was prevalent among these children of the study group as compared to the controls indicating a lack of sound knowledge of the maintenance of oral hygiene. Following preventive treatment the oral health improved considerably.

Keywords: *oral health, congenital heart disease, preventive treatment, children*
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INTRODUCTION

Congenital heart disease (CHD) is a devastating complex of diseases resulting from defects of development of the heart. It affects more than 1 of every 100 live births.[1] The epidemiology of heart disease in children has changed over the past 3 to 4 decades. There is an increased survival rate of children with congenital heart disease with an overall decrease in rheumatic valvular heart disease in the developed countries, and CHD now constitutes the predominant underlying condition for Infective Endocarditis (IE) in children over the age of 2 years in these countries.[2] The three main concerns when providing dental care for patients with valvular heart disease: are the a) risk of infective endocarditis, b) risk of bleeding in anticoagulated patients, c) risk of exacerbating any co-existing heart failure.[3]

The causative microorganism for infective endocarditis in more than 60% of the patients with positive hemoculture are streptococci with *viridans streptococci*, especially *streptococcus sanguis, s mitior and s mutans*.[4] It was reported that children with congenital cardiac disease (CCD) had higher levels of dental caries, enamel hypoplasia and periodontal disease, compared with healthy children.[5] Also open carious lesions, extensive deposits of plaque, and widespread areas of gingival inflammation represent an enormous bacterial loading of *Viridans streptococci* within the mouth. This is important in further development of dental disease and the potentially life threatening condition of bacterial endocarditis from *Viridans streptococci*.[6] Several authors have focussed on the prevalence and severity of dental diseases such as caries, hypoplasia, poor gingival health, malocclusion and the inadequate professional and home care given to these children.[4,5,6,7] Some of the studies address the use of a suitable preventive protocol to be followed in these children so as to prevent dental diseases and thereby reduce the chances of infective endocarditis.[4,5,8]

MATERIALS AND METHOD

Seventy-four children between the ages 5–16 years with congenital heart disease were selected for the study. Thirty healthy siblings belonging to the same age group, with no other underlying systemic problem evaluated by the pediatrician were included in the control group. Children with dental carious lesions and who were uncooperative were

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excluded from the study in both the groups.

The oral health was evaluated using gingival index and OHI-S index.[9] The antibiotic prophylaxis recommended by American Heart Association was followed prior to dental treatment for the children in the experimental group.[10] The microbiological evaluation of *s mutans* was carried out following the collection of 1ml of whole unstimulated saliva in sterile tubes and the subsequent determination of bacterial counts by plating saliva samples on Mitis-salivarius agar supplemented with bacitracin incubated aerobically for 48 hours. The colonies were then counted visually.[11] On collection of the baseline data the children were introduced to predefined pattern of preventive protocol.

Models of the dentition and a toothbrush were used for the patient and parent education. The home care measures included oral health education regarding tooth brushing (horizontal scrub) technique[12] and the use of 0.2% chlorhexidine, 10 ml twice daily for 20 minutes post tooth brushing.[13] The professional care measures included oral prophylaxis followed by application of pit & fissure sealants[14] and topical fluoride application using 1.23% of APF gel[15] for 4 min.

Oral health of the children in study and control group was assessed prior and post (15 days later) preventive in office and home care measures recommended uniformly to both the groups.

The results obtained were subjected to statistical analysis using paired and unpaired t-test.

RESULTS

The microbial count in the study group children before preventive treatment exhibited higher mean value (833.05 CFU*10^8/ml – Graph 2) as compared to the control group (408.93 CFU*10^8/ml – Graph 1). The oral hygiene and gingival indices also showed similar findings. The mean oral hygiene score for the study group was 0.84 as compared to the control group which was 0.532 (Graph 4). Similarly, the mean gingival index for the study group was much higher (1.046), in contrast to the control group (0.653) clearly indicating the absence of good oral hygiene methods in the study group (Graph 3).

After collecting the baseline data (Table 2), the preventive protocol was advocated in both the groups for a period of two weeks after which the data were collected again. The comparison between the pre and post-treatment samples for the gingival and OHI-S indices and the microbial counts showed an overall decrease in the counts in the latter treatment group.

The score value which declined from 1.046 to 0.869 (Graph 3) is an indication of improved gingival health while categorizing the gingival index scores, the no. of children in the mild range (0.1-1.0) increased from 58.11% (43) to 64.86% (48) and in the moderate range (1.1-2.0), decreased from 37.87% (28) to 32.43% (24) (Table 4).

A similar improvement was also noticed with the OHI-S scores that reduced from 0.84 to 0.636 (Graph 4). Categorizing the scores thus obtained pre and post treatment (table 6), showed an increase from 16.22% (12) to 24.32% (18) in the healthy range (0) and 67.47% (50) to 70.27% (52) in the good range (0.1 to 1.2); while a decrease from 13.51% (10) to 4.05% (3) was noticed in the fair range (1.3 to 1.8).

The mean microbial counts reduced from 833.05 CFUx10^8 to 430.68 CFUx10^8 (Graph 2). In the control group the no. of subjects (percentage) in the score group of 300 CFUx10^8 increased from 18 (60%) to 20 (66.67%) following

Table 1.

Paired Samples Test

		Paired Differences			t	P-value
		Mean	95% Confidence Interval of the Difference Lower	Upper		
Pair 1	microb. Count pre - post	402.378	262.568	542.189	5.736	.000
Pair 2	ging. Index pre - post	.1770	.1283	.2258	7.239	.000
Pair 3	OHI-S index pre - post	.2020	.1530	.2510	8.220	.000

The above table shows that when the net microbial count before and after the preventive treatment and oral health education are subjected to paired t-test it shows a P-value of statistical significance. Similar results are seen with the gingival and OHI-S index which also show a P-value of statistical significance.

Table 2. The mean values of Microbial Count, Gingival and OHI-S index scores

Mean	Pre	Post
Microbial count	833.05	430.68
Gingival index score	1.046	0.869
OHI-S index score	0.84	0.636

Table 3. Microbial Count - Control Group - No. of Children (Percentage)

Microbial count (CFU*10^8)	Pre	Post
0	0	0
300	18 (60%)	20 (66.67%)
600	4 (13.33%)	3 (10%)
900	3 (10%)	4 (13.33%)
1200	3 (10%)	3 (13%)
1500	2 (6.67%)	0

Table 4. Microbial Count - Test Group – No. of Children (Percentage)

Microbial count (CFU*10^8/ml)	Pre	Post
0	0	0
300	28 (37.84%)	42 (56.76%)
600	12 (16.22%)	10 (13.51%)
900	7 (9.45%)	3 (4.05%)
1200	5 (6.75%)	2 (2.70%)
1500	4 (5.40%)	2 (2.70%)
1800	3 (4.05%)	0
2100	3 (4.05%)	0
2400	2 (2.70%)	2 (2.70%)
2700	2 (2.70%)	0
3000	3 (4.05%)	0
3300	0	0
3600	1 (1.35%)	0

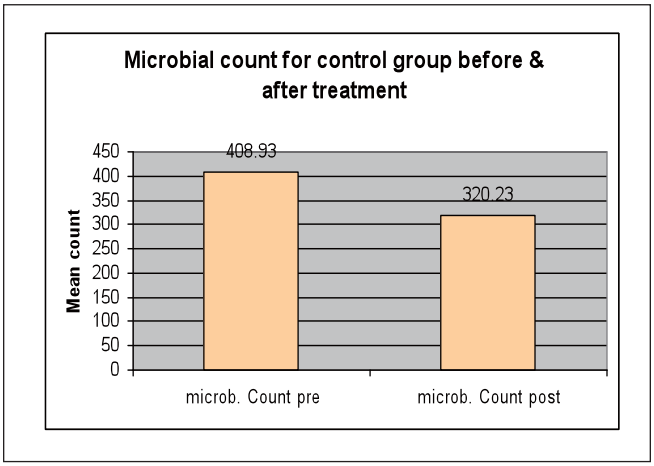
the preventive treatment. Whereas in the score group of 600 CFUx10^8 it dipped from 4 (13.33%) to 3 (10%) but however these values were not statistically significant (Table 3).

Table 5. Gingival Index - Test Group – No. of Children (Percentage)

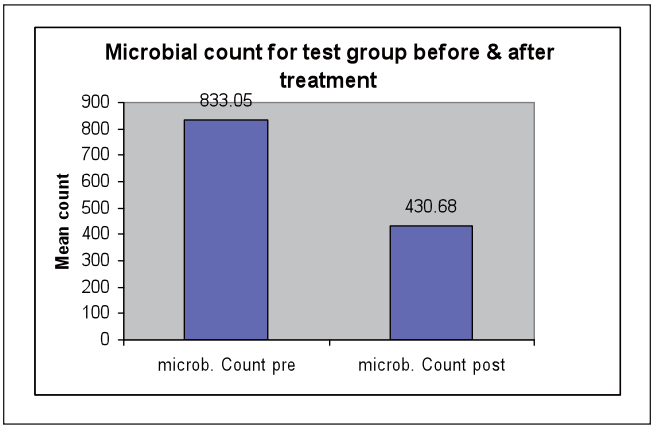
Gingival Index Scores	Pre	Post
0	0	0
0.1-1.0	43 (58.11%)	48 (64.86%)
1.1-2.0	28 (37.84%)	24 (32.43%)
2.1-3.0	3 (4.05%)	2 (2.70%)

Table 6. OHI-S Index - Test Group – No. of Children (Percentage)

OHI-S Index Scores	Pre	Post
0	12 (16.22%)	18 (24.32%)
0.1-1.2	50 (67.47%)	52 (70.27%)
1.3-3.0	10 (13.51%)	3 (4.05%)
3.1-6.0	2 (2.70%)	1 (13.51%)



Graph 1. The control group showed a decline in the microbial counts from 408.93 to 320.23)



Graph 2. The mean S mutans counts which were 833.05*108CFU/ml were reduced to 430.68*108 CFU/ml in the experimental group. So the above values give a clear indication that the preventive treatment that was recommended did have a marked effect in reducing the S mutans counts thus decreasing the incidence of bacteraemia.

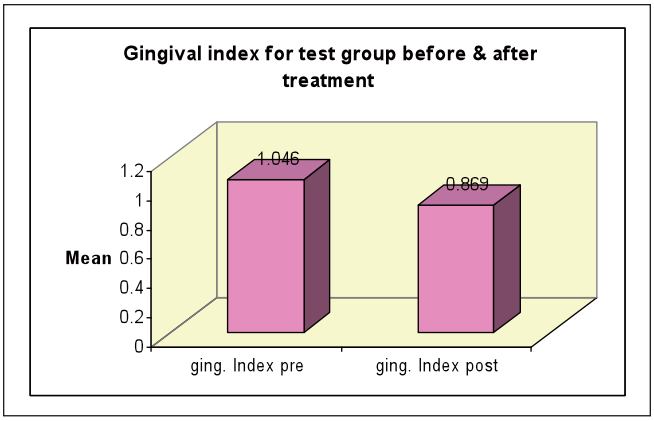
In the test group (Table 4) the no. of subjects in the score group of 300 CFUx10^8 increased from 28 (37.84%) to 42(56.76%); whereas in the score group of 600 CFUx10^8, it dropped from 12 (16.22%) to 10 (13.51%) and was found to be statistically significant (Table 1).

Among 3 of the subjects in the study group who had not followed the preventive protocol as advised, it was observed that the microbial counts either maintained similar levels or increased.

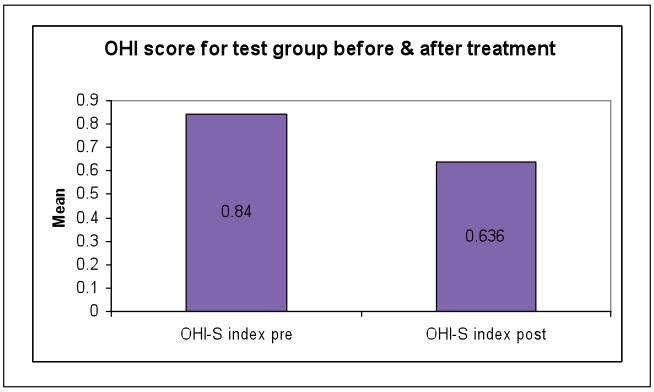
DISCUSSION

Congenital heart diseases (CHD), abnormalities in the structural development of the heart, occur in approximately 8:1000 live births. With improved detection diagnosis and progress of surgical and anaesthetical methods, the number of surviving children is increasing. Early dental health problems are common in children with severe CHD, and there are complicated background factors often associated with nutrition, medication and the demanding situation of their families.[8]

Lower frequencies of regular dental care have been displayed in children with CHD than in those without this medical problem.[16] In this study the oral hygiene status was unsatisfactory indicating deficient awareness regarding oral hygiene practices and consequent visits to the dentist were



Graph 3. The mean gingival index score of the test group which was 1.046 dipped down to a value of 0.869, this clearly indicates that there is an improvement in the gingival health following preventive treatment which is of statistical significance.



Graph 4. The test group also showed a decline but with a greater margin from 0.84 to 0.636

also not very regular. In spite of the importance of congenital cardiac disease to dental treatment and the significant numbers of children affected, there is little information available regarding their dental health and treatment requirements.[5]

In the present study the oral hygiene status were mostly either fair or bad in the children. Only 16.22% of children showed good oral hygiene. The gingival condition was also debatable where the number of the children who had healthy gingiva were nil, two of them even showed signs of severe gingivitis. This study was concurrent with the study by Hayes and Fasules where they found 78% of the cardiac surgical patients with gingivitis.[17] In a study done by Al-Sarheed et al there was an increased gingivitis surrounding primary teeth in the heart transplant group.[18]

The microbiological evaluation of the saliva samples in this study also showed similar results where it was evident that these children have to follow regular and prompt oral hygiene measures for better oral health. However a study by Franco *et al* showed no significant difference between the control and cardiac children with respect to salivary *mutans streptococci* distribution.[19]

The 74 children who formed a part of the study group between 6-16yrs were assessed for their oral health before and after preventive treatment and oral health education. The home care measures included oral health education, where oral hygiene instructions were given and the children were also instructed about proper tooth brushing techniques and were educated about the importance of the use of mouth rinses.

In a study by Albuquerque, chlorhexidine demonstrated remarkable effect in reducing salivary microbial counts of *mutans* group streptococci.[20] Loe and Schiott established in their study that rinsing for 60 seconds twice daily with 10ml of a 0.2% CHX-digluconate solution inhibits plaque regrowth and helps to prevent inflammation of the gums. In the same study he has also indicated a substantivity of 12–14 hours and supports the recommendation for twice daily use of rinses.[21]

In our study 0.2% chlorhexidine mouth rinse, 10ml twice daily for 1 min was recommended 20 minutes post tooth brushing to enhance the retention of chlorhexidine.[22] The patient should be educated about side effects of its use if continued for more than two weeks. Also, the organisms most likely to cause infective endocarditis like *streptococci, staphylococci, enterococci*, yeast and fungi are readily reduced by chlorhexidine when used as recommended.[23] Also there was a significant drop in the microbial counts following rinsing with CHX, except for 2 subjects who did not follow the preventive protocol. The use of topical antibiotic mouthwashes prior to dental procedure may reduce the need for antibiotic prophylaxis as recommended by Hayes and Fasules in their study.[17]

A study by Stephen and colleagues concluded that brushing once a day or less was worse than brushing twice *per* day. In our study the Scrub (horizontal) brushing technique was explained to the children to be practiced twice *per* day as this technique requires minimal manual dexterity and is easily followed by them.[11] The professional care included application of pit and fissure sealants and topical fluoride. The parents of the children in the study group were less knowledgeable on the preventive aspects of fluoride, diet and importance of tooth brushing for maintenance of optimal oral health. Brushing was done either once a day or not at all which may have contributed to the impending oral health problems which the child already had. The parents should be made aware that these measures not only decrease the incidence of bacteremia during dental procedures but also during normal day to day activities like brushing, eating, swallowing etc.[2,19]

Further, it was noticed that many refrained from brushing effectively for the fear of inducing bleeding, which in turn was a consequence of poor oral hygiene measures in these children.[16] In the current study, before the preventive protocol was followed in these children, the oral hygiene and gingival indices as well as the microbial counts were assessed and it was found that the study group exhibited higher levels of all the parameters as compared to the control group indicating poor oral hygiene practices in the former group. This could be attributed to one or many of the following causes such lack of oral health education, inadequate awareness among the parents regarding the importance of maintaining good oral hygiene in these children, presence of a medical condition which may act as a barrier to receiving primary dental care, inability to access the specialist dental care and the fact that the primary attention of parents and caregivers is usually focused on medical treatment. Several studies have found that the knowledge and awareness regarding maintenance of oral hygiene was unsatisfactory in these patients.[4,7,8]

The gingival and oral hygiene indices and microbial count prior to the preventive treatment showed varied observations when compared between the control and the study group. It was found that the study group exhibited meagre oral hygiene status in general as compared to the control group confirming the fact that neglected oral health is still a persisting dilemma in these children which has been substantiated by the previous studies.[4,5,6] Lack of regular dental care for these children during the first years of life could be one of the reasons for prevalence of poor oral hygiene in these children. Insufficient awareness, knowledge and attitudes with respect to the importance of the maintenance of good oral health for prevention of infective endocarditis could be another factor.

The oral hygiene index in the healthy individual (control group) prior to preventive protocol was 0.53 and dropped to 0.45, and a similar drop from 0.84 to 0.63 was observed in the study group which helps us understand that the preventive protocol has a direct beneficial bearing on the oral health status.

In the current study, the mean gingival index score of the study group which was 1.046 dipped down to a value of

0.869 clearly indicating that there is a significant improvement in the gingival health. The control group also showed a similar decrease in the count, but with a smaller margin.

The colony forming units of *s mutans* in the saliva were counted in both the study and control group. The results showed at least 50% reduction in the colony forming units of *s mutans* after the preventive program. The mean *s mutans* counts which were 833.05 CFU*10^8 were reduced to 406.8 CFU*10^8 in the study group.

The improvement in oral hygiene following preventive treatment could be attributed to the increased awareness regarding maintenance of oral hygiene and dietary practices. The parents were more aware that bleeding of gums could be prevented by brushing daily rather than abstaining from brushing. It could also be attributed to the fact that parents were now more responsive to the certainty that deteriorating oral health could be a predisposing factor for infective endocarditis.

The pediatric dentists are recommended to tailor a preventive protocol regimen to suit the child's needs which should be strictly followed, keeping in mind the severity of the medical condition, the oral hygiene habits, and the medications taken by the child. Culture and sensitivity should be performed before prescribing the antibiotics and if a patient is already taking an antibiotic normally used for endocarditis prophylaxis, it is prudent to select a drug from a different class (like clindamycin, azithromycin, or clarithromycin) rather than to increase the dose of the current antibiotic.[3] Pediatric dentists should stress the importance of preventive treatment in these patients.

The pediatric cardiologists are recommended to emphasize the importance of maintaining oral hygiene from the first appointment itself and to channel the patients from cardiac clinics to a pediatric dentist for effective education regarding the maintenance of oral hygiene.

The increasing survival of children with CHD makes it mandatory for pediatric dentists to take up preventive strategies to improve their oral health as a challenge. Early preventive dental care should be adjusted to the special needs of children with CHD in their first years of life.

Recommendations to the parents

Awareness regarding the importance of preventive treatment in these children and also the maintenance of oral hygiene whereby it should be stressed that these measures not only decrease the incidence of bacteremia during dental procedures, but also during normal day to day activities like brushing, eating, swallowing.

CONCLUSIONS

Poor oral health status was still prevalent among these children as compared to the controls indicating a lack of knowledge of the maintenance of oral hygiene and in most of the cases inadequate measures taken in this regard to maintain oral hygiene.

The Gingival Index, Oral Hygiene Index and microbial counts showed substantial decrease following preventive treatment.

Oral health education in these children should emphasize on preventive dental program.

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