ORIGINAL ARTICLE

In Vivo Assessment of Plaque Accumulation for Caries Risk in Children

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Abstract

Introduction: Most approaches to caries viewed that catastrophic change in normal plaque biofilm is responsible for the disease. The behavior and the composition of the biofilm are a reflection of the oral environment, and the caries is a reflection of the adverse changes occurring in that environment. Thus, it is important to identify the plaque biofilm so as to predict the caries risk.

Aim: The present study was aimed to determine and compare the role of plaque toward caries risk during their mixed dentition.

Materials and methods: Fifty children of 6–12 years age group of both sexes were examined for plaque status of subjects using "Turesky–Gilmore–Glickman modification of the Quigley Hein plaque index" and caries using deft and decayed missing filled index (DMFT) separately and caries risk assessment tool (CAT).

Statistical analysis: The data were collected and tabulated and were analyzed using the SPSS software V.22, IBM., Corp. Descriptive analysis of all study variables was done using the number and the frequency for categorical data whereas in terms of mean and standard deviation for continuous data.

Results: The high caries risk group demonstrates significantly a higher mean plaque index (PI) score ($p = 0.04$) and mean dental caries score ($p = 0.03$) compared to the low and the moderate caries risk group.

Conclusion: The present study sample consists of a higher proportion (44%) of the high caries risk group which necessitates oral health promotion specifically adopting the common risk factor approach.

Keywords: Caries, Caries risk assessment, Dental plaque.

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Introduction

Dental caries is a multifactorial disease. Factors like the type of diet, oral hygiene practices, use of fluoride, dental visits, socioeconomic status, and other preventive measures modify the prevalence of caries[1] and it is still considered a public health problem resulting in a negative impact on the quality of life among children.

Dental plaque is a soft deposit that forms the biofilm adhering to the tooth surface or other hard surfaces in the oral cavity, including removable and fixed restorations.[1] Antoni van Leeuwenkoek observed it first in the seventeenth century and was associated with all of the most common oral diseases: caries and periodontal disease.[2] There are 108 bacteria present in 1 mm^3 of dental plaque weighing approximately 1 mg.[3]

The composition and the behavior of the biofilm are the reflection of the oral environment, and the caries is a reflection of the adverse changes occurring in that environment. It is important to identify the plaque biofilm so as to predict the caries risk. The first step in caries management is caries risk assessment (CRA).[4] Risk assessment is defined as the identification of factors known or believed to be associated with a condition or disease for purposes of further diagnosis, prevention, or treatment.[5] At the end of CRA, we will come to know the history and current clinical data of the patient. By eliminating the risk factors before disease occurs, the disease process can be prevented in the immediate future as well as in long term.

Early detection and lesion progression of caries are important, particularly in primary teeth where caries can progress rapidly. Studies have focused on the use of visual ranked scoring systems, the DIAGNOdent laser fluorescence instrument, CarieScan PRO, and, to a lesser extent, digital radiography. The available literature concerning plaque for the detection of caries in primary teeth is limited. Considering these facts, the present study was done to determine and compare the role of plaque toward caries risk during their mixed dentition.

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Materials and Methods

Source of the Data

A study population of 50 children aged 6–12 years of both genders registered for dental care at the Department of Pediatric Dentistry was randomly selected for this study.

Selection Criteria

Inclusion Criteria

- Healthy children who had not used mouth rinses or any medication for the past 6 months that might have influenced their oral hygiene condition.

- Children without any orthodontic or prosthetic appliances which may have the ability to modify surface characteristics.
- Children with no history of oral habits.

Exclusion Criteria

- Special children.
- Children with developmental anomalies of teeth.

Study Design

Assessment of Plaque with Two-Tone Plaque Disclosing Agent

The plaque index score was first completed for each participant with the use of two-tone disclosing solution, using "Turesky–Gilmore–Glickman modification of the Quigley Hein plaque index" (Table 1). The two-tone disclosing agent was applied (Fig. 1) with a microbrush on all the tooth surfaces and left undisturbed for 2 minutes. With the help of water spray and high volume suction, the tooth surfaces are then gently rinsed for 30 seconds, and then the plaque color changes were observed (Fig. 2). The color-stained plaque was scored.

Assessment of Caries

Caries experience was assessed with DMFT and deft indices separately and the average was calculated.

Assessment of Caries Risk

The caries risk was assessed using the CRA form proposed by the American Dental Association (Fig. 3). Scores include low risk = 0, medium risk = scores 1–10, and high risk = score >10.

Recorded plaque, caries, and caries risk scores were taken and a correlation between them was done using the Pearson correlation test.

Table 1: Quigley Hein Index (modified by Turesky et al., 1970)

Scores	*Criteria*
0	No plaque
1	Separate flecks of plaque at the cervical margin of the tooth
2	A thin continuous band of plaque (up to 1 mm) at the cervical margin of the tooth
3	A band of plaque wider than 1 mm but covering less than one-third of the crown of the tooth
4	Plaque covering at least one-third but less than two-thirds of the crown of the tooth
5	Plaque covering two-thirds or more of the crown of the tooth

Fig. 1: Application of the disclosing agent

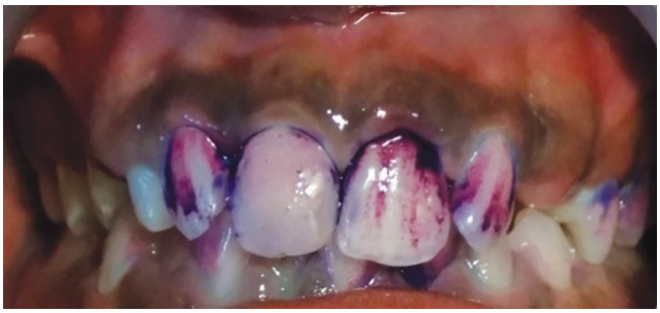

Fig. 2: Observed color changes

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) for Windows, Version 22.0, was used to perform statistical analyses. Descriptive analysis of all study variables was done using the number and the frequency for categorical data, whereas in terms of mean and SD for continuous data. The Kruskal–Wallis test followed by Mann–Whitney *post hoc* analysis was used to compare the difference in the mean PI and dental caries between different caries risk categories. A similar comparison was also done among the participants based on their age. The Mann–Whitney *U* test was used to compare the difference in the mean PI and dental caries between the genders. The Karl Pearson correlation was used to establish a correlation among the CAT scores, PI, and dental caries among the study participants. The level of significance (*p* value) was set at $p < 0.05$.

Results

Table 2 shows a comparison of mean plaque index and dental caries between different caries risk category using the Krusal–Wallis test. The mean plaque index scores for high risk, medium risk, and low risk were statistically significant with a *p* value of 0.04. Similarly, deft and DMFT show statistically significant scores between risk categories with a *p* value of <0.001 and 0.03, respectively.

Table 3 shows multiple comparisons for different parameters using the Mann–Whitney *U* test. The plaque score was significantly higher in the low- vs the high-risk group (0.04) and the moderate- vs the high-risk group (0.03) compared to the low- vs the medium-risk group (0.82). In the same way, deft scores and DMFT scores were higher in low- vs high- (<0.001) (0.04) and medium- vs high-risk groups (<0.001) (0.04) compared to the low- vs the moderate-risk group (0.54) (0.30).

Table 4 shows a correlation among CAT scores, PI, and dental caries scores using the Pearson correlation test. The CAT scores for plaque index, deft, and DMFT were statistically significant.

Discussion

Dental caries is a multifactorial disease, so redefining the method of diagnosis and treatment planning in an effective and efficient manner is necessary. Hence, it is important to identify the risk-associated environment and the changes taking place in it from time to time.

Bacterial plaque, presence of active caries, and microbiological loads in each patient are the risk factors which have an influence on the oral environment. A number of clinical diagnostic tools like visual ranked scoring systems, the DIAGNOdent laser fluorescence instrument, CarieScan PRO, and, to a lesser extent, digital radiography have developed to assess caries. Despite their ready availability, it is expensive. Hence, the concept of plaque and

ADA American Dental Association®
America's leading advocate for oral health

Caries Risk Assessment Form (Age >6)

Patient Name:				
Birth Date:			**Date:**	
Age:			**Initials:**	
		Low Risk	**Moderate Risk**	**High Risk**
Contributing Conditions		**Check or Circle the conditions that apply**		
I.	**Fluoride Exposure** (through drinking water, supplements, professional applications, toothpaste)	☐ Yes	☐ No	
II.	**Sugary Foods or Drinks** (including juice, carbonated or non-carbonated soft drinks, energy drinks, medicinal syrups)	Primarily at mealtimes ☐		Frequent or prolonged between meal exposures/day ☐
III.	**Caries Experience of Mother, Caregiver and/or other Siblings** (for patients ages 6-14)	No carious lesions in last 24 months ☐	Carious lesions in last 7-23 months ☐	Carious lesions in last 6 months ☐
IV.	**Dental Home**: established patient of record, receiving regular dental care in a dental office	☐ Yes	☐ No	
General Health Conditions		**Check or Circle the conditions that apply**		
I.	**Special Health Care Needs** (developmental, physical, medical or mental disabilities that prevent or limit performance of adequate oral health care by themselves or caregivers)	☐ No	Yes (over age 14) ☐	Yes (ages 6-14) ☐
II.	**Chemo/Radiation Therapy**	☐ No		☐ Yes
III.	**Eating Disorders**	☐ No	☐ Yes	
IV.	**Medications that Reduce Salivary Flow**	☐ No	☐ Yes	
V.	**Drug/Alcohol Abuse**	☐ No	☐ Yes	
Clinical Conditions		**Check or Circle the conditions that apply**		
I.	**Cavitated or Non-Cavitated** (incipient) **Carious Lesions or Restorations** (visually or radiographically evident)	No new carious lesions or restorations in last 36 months ☐	1 or 2 new carious lesions or restorations in last 36 months ☐	3 or more carious lesions or restorations in last 36 months ☐
II.	**Teeth Missing Due to Caries in past 36 months**	☐ No		☐ Yes
III.	**Visible Plaque**	☐ No	☐ Yes	
IV.	**Unusual Tooth Morphology** that compromises oral hygiene	☐ No	☐ Yes	
V.	**Interproximal Restorations - 1 or more**	☐ No	☐ Yes	
VI.	**Exposed Root Surfaces** Present	☐ No	☐ Yes	
VII.	**Restorations with Overhangs** and/or **Open Margins**; **Open Contacts** with Food Impaction	☐ No	☐ Yes	
VIII.	**Dental/Orthodontic Appliances** (fixed or removable)	☐ No	☐ Yes	
IX.	**Severe Dry Mouth (Xerostomia)**	☐ No		☐ Yes

Overall assessment of dental caries risk: ☐ Low ☐ Moderate ☐ High

Patient Instructions:

Fig. 3: CRA form

Table 2: Comparison of mean plaque index and dental caries between different caries risk category using Krusal–Wallis test

Variables	*Caries*	*N*	*Mean*	*SD*	*Min*	*Max*	*H*	*p value*
PI	Low risk	7	0.36	0.31	0	0.9	6.023	0.04
	Mod. risk	21	0.48	0.31	0.1	1.4		
	High risk	22	0.85	0.58	0	2.1		
deft	Low risk	7	0.43	0.54	0	1	26.04	<0.001
	Mod. risk	21	1.67	1.24	0	4		
	High risk	22	5.55	3.76	0	17		
DMFT	Low risk	7	0	0	0	0	7.034	0.03
	Mod. risk	21	0.29	0.9	0	4		
	High risk	22	1.09	1.42	0	4		

Table 3: Multiple comparisons using Mann–Whitney *U* test for different study parameters

Variable	*Group*	*Mean diff*	*p value*
PI	L vs M	–0.12	0.82
	L vs H	–0.49	0.04
	M vs H	–0.37	0.03
deft	L vs M	–1.24	0.54
	L vs H	–5.12	<0.001
	M vs H	–3.88	<0.001
DMFT	L vs M	–0.29	0.3
	L vs H	–1.09	0.04
	M vs H	–0.81	0.04

L, low-risk group; M, moderate-risk group; H, high-risk group

Table 4: Correlation among CAT scores, PI, and dental caries scores using the Pearson correlation test

Variable	*Values*	*PI*	*deft*	*DMFT*
CAT score	*r*	0.47	0.69	0.34
	p value	0.001	<0.001	0.02
	N	50	50	50

what it does to the tissue must be made vital and important to the patient by visualization as it never fails to generate in patients a sense of motivation that results in a concern for its removal. The concept of visualization is made possible with the advent of disclosing agents.

This present study was undertaken to compare and determine the role of plaque toward caries risk in the age group of 6–12 years. "Turesky–Gilmore–Glickman modification of the Quigley Hein plaque index" was used to assess the plaque score as it evaluates the plaque both buccal and lingual sides of the teeth. Caries was assessed using DMFT and deft index individually according to the WHO criteria as it is universally accepted and commonly used in research studies.

This study showed the mean plaque index score for high-, medium-, and low-risk categories were statistically significant. Similar results with other previous studies which stated that there was an increase in the plaque score with an increase in the caries score.[6–8] Visible plaque on the labial surfaces of maxillary incisors was strongly associated with caries development, and the best indicator of caries risk was visible plaque compared to other potential indicators. Although contracting to this study supragingival plaque accumulation has not been highly correlated with caries experience,[9–11] studies by Lindhe et al. and Poulsen et al. showed that professional plaque removal could prevent caries, thus, establishing dental plaque as a significant and probable risk factor for dental caries.[6]

Clinical trials have already demonstrated that the biofilm accumulation on dental surfaces for a period of time leads to the development of early signs of enamel demineralization, thus, it becomes clear that the assessment of oral hygiene plays an important role when studying dental caries. However, further longitudinal studies are required to support this observation taking into account factors like age and gender variations along with the assessment of microorganisms which are responsible for the progression of caries.

Conclusion

The present study findings confirmed the relation among plaque, caries, and caries risk. With an increase in the plaque status, there was an increase in the caries risk.

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