

Comparison between two visible biofilm indices in the primary dentition

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The aim of this study was to compare two visible biofilm indices in the primary dentition. The sample consisted of 90 children of both sexes, aged up to 4 years old, outpatients of the University Hospital of the Rio de Janeiro State University. A single examiner, aided by an assistant, performed the children's dental examination for biofilm assessment. A simplified visible biofilm index (BF1), which classifies biofilm as absent, thin or thick, in anterior and/or posterior teeth, and provides a score for the patient and not for each tooth, was compared to a conventional visible biofilm index, the visible plaque index, (BF2), which classifies biofilm as absent or present and provides scores for three surfaces of each tooth. A statistically significant association and a strong positive correlation between BF1 and BF2 was found (Kruskal-Wallis $p < 0.001$ / $r_s = 0.81$ $p < 0.001$). The time required to BF1 evaluation was approximately one third of the time required to BF2 evaluation (t test $p < 0.001$). These results suggest that the use of a simplified visible biofilm index is feasible in the primary dentition as it showed similar findings when compared to a conventional one, besides being more practical and quicker.

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INTRODUCTION

The clear association between biofilm accumulation and the demineralization of dental enamel has led to a number of investigations which assess the role of oral hygiene in the development of caries.¹ Over the past ten years, several studies have been evaluating risk factors for caries in infants and preschool children, mainly early childhood caries (ECC). However, most of the surveys involving young children tend to evaluate oral hygiene only by means of oral hygiene habits and frequency of toothbrushing.²⁻¹¹ Their results are controversial as some authors have found association between caries and oral hygiene^{3, 5, 7, 9, 10} while others have not^{2, 4, 6, 8, 11}. As toothbrushing can be considered efficient to control caries only when there is a high quality of biofilm removal¹², oral hygiene should also be assessed by biofilm indices, instead of just by frequency of toothbrushing.

Several biofilm indices have already been developed to estimate the effectiveness of oral cleanliness in population groups. Some of them suggest the use of a disclosing solution to stain the biofilm^{13, 14} and others indicate the assessment of the visible biofilm.^{15, 16} Other indices evaluate all the teeth^{13, 14} or a previously selected group of teeth^{16, 17}. The register of the biofilm can also be made according to the presence or absence of biofilm^{14, 15}, the extension of the tooth cov-

ered with biofilm¹⁷ or the thickness of biofilm.^{16, 18} None of these indices were described to be specifically employed in the primary dentition.

Considering infants and preschool children, not many studies have employed biofilm assessment to evaluate the quality of oral cleanliness¹⁹⁻²⁴ comparing to the number of those which have assessed oral hygiene using other parameters than biofilm evaluation²⁻¹¹. Moreover, there is no agreement about the method for this evaluation. Little attention has been devoted to biofilm indices to be employed in infants and preschool children and the literature does not indicate a specific one which has been repeatedly used in this age group. Surveys with infants and preschool children that have assessed biofilm have employed different indices, such as the modified Greene and Vermillion index²⁰, the Ribeiro *et al.* index²³, the Axelsson and Lindhe index²⁴, the presence of visible biofilm in buccal surfaces of maxillary primary incisors¹⁹, the presence of visible biofilm in buccal surfaces of all the primary teeth²² and the presence of visible biofilm in any tooth surface of any primary tooth²¹.

The aim of this study was to compare two visible biofilm indices in the primary dentition, considering the relevance of a simpler and quicker index to be employed in very young children.

MATERIAL AND METHODS

Sample

The sample consisted of 90 selected healthy patients, of both sexes, aged up to 4 years old, outpatients of the Pediatric Ambulatory of the University Hospital of the Rio de Janeiro State University.

Ethical aspects

This study was approved by the Ethical Committee of the Biomedical Center of the Rio de Janeiro State University (967-CEP/HUPE). All parents signed informed consent forms and received information on caries prevention.

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Biofilm evaluation

All the examinations were carried out in a dental office by a single trained examiner who was aided by an assistant. The children were seated either in the dental chair or in the parent's lap. Dental mirrors, exploratory probes and gauze were used. Two biofilm indices already employed in previous studies were selected.^{15, 18} In both of them, the examiner visually inspects the presence or absence of biofilm, without a disclosing solution. The first one - BF1 - gives a score to the patient according to the amount of visible biofilm accumulated (absent, thin or thick) in anterior and/or posterior teeth¹⁸ and the second one - BF2 - evaluates the presence of visible biofilm in the mesial, buccal and lingual surfaces of all teeth, i.e. the visible plaque index (VPI).¹⁵ The time required for each method was registered by the examiner's assistant.

The index proposed by Ribeiro *et al.*¹⁸ (BF1) was modified by uniting some scores. Originally, the patient could be assigned a score ranging from 0 to 5. In the modified index, the scale ranges from 0 to 3, according to Table 1. When there was thick biofilm in both anterior and posterior teeth (visible biofilm that could be seen without drying), the patient was assigned score 3. When only one region, anterior or posterior, presented thick biofilm, the patient was assigned score 2. Score 1 was given when there was thin biofilm in anterior and/or posterior teeth (visible biofilm that could be seen only after drying with gauze). Finally, patients were assigned score 0 when no visible biofilm was present, even after the teeth were dried with gauze. The drying with gauze was performed carefully, without rubbing the tooth surface.

Table 1. Visible dental biofilm index* (BF1).

0	Absence of visible biofilm.
1	Thin biofilm, easily removed, in anterior and/or posterior teeth, visible just after drying with gauze.
2	Thick biofilm, firmly adhered, in anterior or posterior teeth, visible without drying, associated or not to thin biofilm in the other region.
3	Thick biofilm, firmly adhered, in anterior and posterior teeth, visible without drying.

*The original index was proposed by Ribeiro *et al.*, 2002.

After that, the VPI¹⁵ (BF2) was used. The scores, 0 for absent biofilm and 1 for present biofilm, were recorded for mesial, buccal and lingual surfaces of each tooth in a specific form. At the end of the examination, the percentage of tooth surfaces that had visible biofilm was calculated.

Statistical analysis

The data were analyzed in SPSS software release 8.0 for Windows. Kruskal-Wallis and Spearman's correlation coefficient were used to verify the association between the two indices and t test to compare the necessary mean time to perform both biofilm evaluations. Statistical level of significance was set at 1%.

RESULTS

According to BF1, 11 (12.2%) children presented no visible biofilm. More than one third of the sample was assigned the score 1 (34- 37.8%). Forty-five (50%) children had scores 2 (25- 27.8%) or 3 (20- 22.2%), which means that half of the sample had thick biofilm (Table 2). BF2 assessment revealed that the percentage of

surfaces with biofilm ranged from 0 to 83.3%, with a mean of 21.8% (s.d. 16.5).

Table 3 shows a statistically significant association ($p<0.001$) and a strong positive correlation ($rs=0.81/p<0.001$) between BF1 and BF2. When the association between the two indices was performed dividing the sample between children with only incisors (Table 4) and children with

Table 2. Distribution of the sample according to BF1.

BF1	n	%
0	11	12.2
1	34	37.8
2	25	27.8
3	20	22.2
Total	90	100.

Table 3. Correlation between BF1 and BF2 (n=90).

BF1	BF2				
	mean %	s.d.	min %	max %	n (%)
0	0.3	1.1	0	3.9	11 (12.2)
1	14.8	6.7	6.7	33.3	34 (37.8)
2	27.4	15.3	12.1	73.3	25 (27.8)
3	38.5	14.2	16.7	83.3	20 (22.2)

Kruskal-Wallis $p<0.001$ / $rs = 0.81$ $p<0.001$

posterior teeth (Table 5), a statistically significant association was also found ($p<0.001$). A moderate ($rs=0.65$) and a strong ($rs=0.82$) positive correlation between the indices in the group of children with only incisors and in the group of children with posterior teeth are shown in tables 4 and 5, respectively.

The mean time required for biofilm assessment was 22.9 seconds (± 12.3) for BF1 and 60.7 seconds (± 27.7) for BF2. This difference was statistically significant ($t= p<0.001$) (Table 6).

Table 4. Correlation between BF1 and BF2 in children with only incisors (n=30).

BF1	BF2				
	mean %	s.d.	min %	max %	n (%)
0	0	0	0	3.9	4 (13.3)
1	15.4	6.3	8.3	33.3	18 (60.0)
2	32.3	23.9	12.1	73.3	8 (26.7)

Kruskal-Wallis $p=0.001$ / $rs = 0.65$ $p<0.001$

Table 5. Correlation between BF1 and BF2 in children with posterior teeth (n=60).

BF1	BF2				
	mean %	s.d.	min %	max %	n (%)
0	0.5	1.5	0	3.9	7 (11.7)
1	14.1	7.3	6.7	27.8	16 (26.7)
2	25.2	9.3	13.3	50.0	17 (28.3)
3	38.5	14.2	16.7	83.3	20 (33.3)

Kruskal-Wallis $p<0.001$ / $rs = 0.82$ $p<0.001$

Table 5. Comparison between the time required for BF1 and BF2 assessment (n=90).

	mean %	s.d.	min	max
BF1	22.9	12.3	6	99
BF2	60.7	27.7	14	147

t test p<0.001

DISCUSSION

The ECC has been studied throughout the world and the surveys have attempted to correlate biological and psychosocial factors most strongly associated to the development of caries in infants and preschool children.^{25, 26} Since 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 demineralization¹, it becomes clear that the assessment of oral hygiene plays important role when studying dental caries.

However, considering studies on ECC, the oral hygiene quality has not been assessed routinely. The majority of the studies tends to focus their attention on the oral hygiene habits and frequency of toothbrushing, giving rise to controversial conclusions as some studies have found association between oral hygiene and caries^{3, 5, 7, 9, 10} while others have not^{2, 4, 6, 8, 11}. Assuming that a more frequent habit of oral cleanliness does not necessarily imply a higher quality of biofilm control²⁷, it is important to extend the assessment of oral cleanliness by using biofilm assessment. Cross-sectional studies involving infants and preschool children have demonstrated that the presence of visible biofilm was related to a higher prevalence of caries.^{20, 21, 23, 24} In a longitudinal survey with young children, it has been observed that those with visible biofilm in maxillary incisors at the age of 19 months had experienced more caries during the subsequent one and a half year.¹⁹

Although there is a wide variety of biofilm indices available in the literature, most of them have been designed as periodontal indices. The use of such indices to assess oral cleanliness and establish the association with caries can result in misleading conclusions as biofilm in the gingival margin may be a weak predictor of caries in other tooth surfaces.¹² Besides, as they were described to be employed in the mixed or permanent dentition, there is not a consensus in the literature about a biofilm index to be used in infants and preschool children. The VPI¹⁵ has been often cited in studies since its first description. Despite the fact that it has also been proposed as a periodontal index for permanent dentition, it has been chosen for this study because previous studies in primary dentition have already assessed biofilm based on its criteria.^{19, 21, 22} The simplified biofilm index¹⁸ was indicated to be compared with the VPI¹⁵ due to its practicality and easiness to be applied in young children. Moreover, it has also been used before in primary and mixed dentition, showing a statistically significant association with caries activity^{18, 23} and gingivitis.¹⁸

The results of this study revealed a statistically significant association and a strong positive correlation between the simplified index (BF1) and the VPI (BF2), showing that the children who had thick biofilm had also more surfaces with presence of biofilm (Table 3). The BF1 index presumes that the biofilm accumulation areas, those protected against intraoral mechanical disturbance (occlusal surfaces during the eruption period, interproximal areas below contact

points and along the marginal gingiva)^{28, 29}, are already known, making the examination of all teeth unnecessary. That is why this simplified index gives a score to the patient and not to each tooth surface. Besides, the differentiation which is made between thin and thick biofilm is interesting as it has been suggested that the thin biofilm has a microbiological diversity and tends not to be associated to the development of caries. On the other hand, when biofilm is allowed to mature and remains for a prolonged period of time, the physiological equilibrium between tooth and biofilm may be disturbed, which can therefore result in a cariogenic microflora and lead to the enamel demineralization.^{28, 30, 31}

It is important to consider that when children present only anterior teeth they cannot be assigned the score 3 for BF1. However, even when the comparison between the indices was made only among the children who had no posterior teeth, a statistically significant association and a moderate positive correlation were found (Table 4).

The VPI¹⁵ advocates the evaluation of three surfaces of all teeth, which can be very time-consuming. Preschool children and especially infants comprise a group of very young children who are not mature enough to cooperate during a dental examination. Therefore, it is advisable to make use of a quicker and more practical index, particularly in epidemiologic surveys and clinical trials with large samples. The results of this study revealed a statistically significant difference between the time required for BF1 assessment when compared to the time required for BF2 assessment, showing that the BF1 was quicker, consuming approximately one third of the time necessary for BF2 (Table 5). It should be pointed out that this difference could be even bigger because BF2 was assessed just after BF1, which could have possibly reduced the time necessary for BF2 evaluation. Another consideration is that the recording of BF1 is simple as it does not require any calculation or the register of biofilm for each tooth surface on a specific form.

As a suggestion for further investigations, the simplified visible dental biofilm index should be used together with gingival indices in order to confirm their association with the development of caries in infants and preschool children.

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