

# IMPACT OF THE BITEWING RADIOGRAPHY EXAM INCLUSION ON THE PREVALENCE OF DENTAL CARIES IN 12-YEAR-OLD STUDENTS IN THE CITY OF FRANCA, SÃO PAULO, BRAZIL

## IMPACTO DA INCLUSÃO DO EXAME RADIOGRÁFICO INTERPROXIMAL NA PREVALÊNCIA DE CÁRIE DENTÁRIA DE ESCOLARES AOS 12 ANOS NO MUNICÍPIO DE FRANCA, SÃO PAULO, BRASIL

Soraya Fernandes MESTRINER<sup>1</sup>, Luiz Carlos PARDINI<sup>2</sup>, Wilson Júnior MESTRINER<sup>3</sup>

1- Professor of courses of Preventive and Sanitary Dentistry and Supervised Training, University of Franca (UNIFRAN).

2- Associate Professor, Department of Stomatology of FORP-USP.

3- Associate Professor, Department of Child Clinic and Social Dentistry of FORP-USP.

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**Corresponding address:** Wilson Mestriner Júnior - Telephone: (16) 6023949 / (16) 6205179 / (16) 91318008 - Fax: (016) 6330999  
Av do Café s/nº Faculdade de Odontologia de Ribeirão Preto - USP - e-mail: mestri@forp.usp.br - pardini@forp.usp.br

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### ABSTRACT

**I**ntroduction: The pattern of development of carious lesions has changed. The carious lesion has been progressive and reaches the dentin without showing alterations in the clinical aspects. Objectives: To determine the prevalence of caries in 12-year-old students in the city of Franca – São Paulo, Brazil, during the year of 2003, and to evaluate the additional value of bitewing radiograph to detect hidden carious lesions in permanent molar dentin. Materials and Methods: A probabilistic sample composed of two hundred and fifty six (256) students, from public and private schools, was submitted to a cross-sectional study through examination by a calibrated examiner, in order to detect the caries prevalence, using the methodology recommended by the World Health Organization (WHO). For 66% of the sample, bitewing radiographs of the permanent molar region were obtained. The images were analyzed by a calibrated examiner, who established the presence of hidden caries in teeth with radiolucency in dentin, yet considered healthy in the epidemiological survey. Results: The prevalence of dental caries in epidemiological exam without (WHO) and with (WHO/R) the inclusion of hidden caries lesion was 54% and 64%, and the DMFT index was 1.73 and 1.92 respectively. Conclusion: Utilization of the method of bitewing radiographic diagnosis significantly increased ( $p < 0.001$ ) the prevalence of caries in the studied population.

**Uniterms:** Dental Caries, epidemiology; DMFT index; Bitewing radiography; Caries diagnosis.

### RESUMO

**I**ntrodução: Ocorreram mudanças no padrão de desenvolvimento da lesão de cárie. As lesões tem progredido e atingido a dentina, sem demonstrar alterações nos aspectos clínicos. Objetivos: Determinar a prevalência de cárie em escolares de 12 anos no município de Franca - SP, Brasil, no ano de 2003 e avaliar o valor adicional da radiografia interproximal para detecção de lesões de cárie em dentina de molares permanentes na prevalência de cárie. Materiais e Métodos: Desenvolveu-se um estudo transversal com uma amostra probabilística; em que foram realizados exames epidemiológicos por um examinador calibrado, em 256 escolares das redes de ensino público e particular, utilizando a metodologia recomendada pela OMS; e em 66% da amostra, foram obtidas radiografias interproximais da região de molares permanentes. As imagens foram analisadas por um examinador calibrado; considerando dente com lesão de cárie oculta, aquele que apresentava radiolucidez em dentina no exame radiográfico e no entanto, estava hígido no levantamento epidemiológico. Resultados: A prevalência de cárie dentária no exame epidemiológico sem (OMS) e com (OMS/R) a inclusão da lesão de cárie oculta foi de 54% e 64%, e os índices CPOD, 1,73 e 1,92 respectivamente. Conclusão: O emprego do método de diagnóstico radiográfico interproximal aumentou significativamente ( $p < 0,001$ ) a prevalência da cárie na população estudada.

**Unitermos:** Cárie dentária, epidemiologia; Índice CPOD; Radiografia interproximal, diagnóstico.

## INTRODUCTION

The pattern of development of carious lesions has changed. Some time ago, the progression of carious lesions was fast and precocious presenting cavity. This happened due to its fast progress in dentin, leading to collapse of the enamel walls; consequently, lesions were easily detected by clinical method. Nowadays, the progression is slow and can be developed under the enamel; it grows and reaches the dentin without showing alterations in the clinical aspects<sup>26</sup>. This type of evolution of the disease has been explained by the topic action of fluoride methods<sup>6,11,17,21,22</sup> which maintain the dental surface healthy and relatively well mineralized.

The usual methods of diagnosis for lesions that grow without being noticed are the visual inspections, associated or not with tactile inspection, which are, however, ineffective<sup>20</sup>. According to Weerheijm, et al.<sup>22</sup> (1990) an available method for diagnosis of these lesions are bitewing radiographs, which are not commonly used in epidemiological surveys conducted according to the criteria of the World Health Organization<sup>28</sup> (WHO). However, the authors consider that these types of caries are active lesions, and it would be worthy to consider this criterion.

Some researchers admit that enamel caries prevalence is high. That point of view should be considered for epidemiological surveys<sup>1,8,19</sup>; as well as the inclusion of hidden caries<sup>10,22</sup>. Nowadays, it is still questionable what concerns the sub or supra estimative of carious lesions in epidemiological surveys<sup>3</sup>.

The use of the method of radiographic diagnosis increases the prevalence of dental caries<sup>2,6,10</sup>. Bloemendal, et al.<sup>3</sup> (2004) considered that the use of radiograph had no additional value on the caries prevalence. However they emphasize that investigations of radiographic exams should be done using subsamples of epidemiological studies comprising clinical exams.

The aim of the present study was to determine the prevalence of caries in 12-year-old students in the city of Franca – São Paulo, Brazil, in 2003, and evaluate the additional value of the bitewing radiograph in order to detect hidden caries lesions in permanent molar dentin in the prevalence of caries in this population.

## MATERIAL AND METHOD

The study population was constituted of 12-year-old students, from public and private schools in the city of Franca, in 2003.

The city of Franca has approximately 304 thousands inhabitants and is situated at the northeast region of the state of São Paulo, Brazil, where 98% of the houses<sup>4</sup> have treated and fluoridated water (0,7 to 1 ppm), being predominantly an industrial city, the most important producer of male shoes in the country.

The research was approved by the Institutional Review Board of University of Franca (registration number 010/02B).

The study comprised a cross-sectional observational drawing, a prevalence study. The variable attack of dental caries measured by the DMFT index produced in Franca in 1998<sup>16</sup> was adopted to calculate the size of the sample<sup>18</sup>, considering a significance level of 95%, design effect equal to 2 and admitting a loss of 20%.

The reference system to the sample plan was the names of schools, provided by the State Secretary of Education Office. Twenty public and private schools were selected by the drawing technique of the systematic sampling type (sample units); and by the technique of the systematic casual sampling, resulting in a sample of 300 male and female students.

The epidemiological survey to verify the conditions of dental caries in permanent dentin (DMFT) was conducted in 256 students, by a calibrated dental surgeon, applying the codes and criteria advocated by the WHO<sup>28</sup>. The exam took place at the schools, with natural light, and with the use of a flat mouth mirror (number 5) and a WHO probe (IPC probe).

About 66% of the original sample, 169 students were submitted to bitewing radiographs. The x-ray used was 127v - 70kv - 8mA (Spectro 70X - Dabi Atlante). The film used was Ektaspeed Plus from Kodak size 2, with the exposure time recommended by the manufacturer. The radiographic technique was the bitewing, at the region of the right and left molar, with the use of a bitewing radiograph film holder (Prisma Instrumentos Odontológicos – Brazil), adding up to 338 bitewing radiographs. Radiographies were developed by the temperature/time method, as suggested by the film manufacturer (Kodak), with utilization of a fixation developing solution (Kodak); drying was made in a stove (Eletr Médica).

A single calibrated examiner interpreted the radiographs on a film viewer, with 3x hand-lens and mask, using the criteria of Ketley and Holt<sup>9</sup> (1993). Teeth with hidden carious lesions were considered as those that were healthy in the epidemiological survey, yet whose radiographic diagnosis suggested presence of caries in dentin.

The verification of the intra-examiner agreement by the Kappa index was obtained from double examination of 10% of the sample of the epidemiological and radiographic exam. The Kappa value was interpreted according to the parameters proposed by Landis and Koch<sup>12</sup> (1977).

The forms were checked and data were kept in an electronic base constituted in the *software* SB 2000 Dados. Statistical analysis of data obtained was performed on the software SPSS for Windows, version 8.0.

## RESULTS

The mean DMFT of the 256 students at the age of 12 was 1.69 (1.41 – 1.96), interval of confidence of 95% to the population average. It was observed that 46.06% of the students were free of caries in permanent teeth (DMFT=0). The prevalence of caries in the study population was low.

Comparison of the mean DMFT values in the sample

that took the epidemiological exam (n=256) and part of the sample that took the radiographic exam (n=169) by the Student's t test did not reveal statistically significant difference (p=0.704); thus, data on dental caries in 169 students were considered as a means of comparison.

The data of the condition of dental caries in permanent teeth in the 169 12-year-old students in the city of Franca that were obtained with the diagnosis criteria of the WHO and the WHO criteria with inclusion of hidden caries lesion detected in permanent molars, using the radiographic exam (WHO/RX), are described in Table 1.

In approximately 16% of students, the prevalence of hidden carious lesions was detected when utilizing the radiographic exam (WHO/RX), noticing that 10% of the students were caries-free (DMFT=0), and 6% of the students had caries experience (DMFT=1), according to the WHO criteria (Table 2).

The percentage of intra-examiner agreement obtained in the epidemiological exam of dental caries condition and in the radiographic exam was 99% and 97%, respectively, with Kappa values of 0.98 and 0.95.

**DISCUSSION**

The prevalence of caries in 12-year-old students in the city of Franca is low, as in other cities in Brazil<sup>5,19</sup>, and it is comparable to industrialized countries.

With the decline in caries prevalence, changes occurred in the pattern of development of carious lesions<sup>26</sup>; this decline and changes are being observed in the city of Franca. Hidden carious lesions in permanent molars were detected in higher number in caries-free students. In a study done by Amerise, et al.<sup>2</sup> (2001) there was no correlation between a previous history of caries and the radiographic diagnosis of the presence of carious lesions in permanent molars that clinically did not have lesions.

These changes are being explained by the topical action of fluoride. According to Weerheijm, et al.<sup>24</sup> (1997), the hidden caries is not a new phenomenon and they emphasize that this lesion is not directly attributed to fluoride ion. Fluoride seems to reduce the occurrence of hidden caries. However, fluoride, whether in water or toothpaste, alters the pattern of caries attack. In the population studied the

prevalence of caries is decreasing, even with the inclusion of hidden caries lesion in 2003 (DMFT=1.93), knowing that in 1998<sup>25</sup>, the mean DMFT was 2,8; it should be emphasized that 98% of houses in the city have access to treated and fluoridated water, besides the use of toothpaste with fluoride; and that the inclusion of hidden carious lesions in this study significantly increased the prevalence of caries in the permanent dentition of the study population; however, the prevalence was maintained in the "low" severity category to the DMFT<sup>27</sup>

Difficulties of diagnosis are observed especially in the absence of visible cavity<sup>11</sup>, and particularly in populations with low caries prevalence<sup>22</sup>. Many authors emphasize the need of the radiographic exam in order to detect the lesion, helping the diagnosis of carious lesions in dentin<sup>6,9,13,21,23,25</sup>. Weerheijm, et al.<sup>24</sup> (1997) say that radiographic exam is important in the diagnosis of hidden caries by contemporaneous professionals, and Espelid, et al.<sup>7</sup> (2003) proposed some procedures in dental radiology and recommended the radiographic diagnosis in children from 12 to 14 years old. With the use of the radiographic diagnosis method, there is an increase in the prevalence of dental caries. Studies<sup>6,10,17,23,25</sup> show an increase of 15% in the prevalence of dental caries, but it can reach 50%. With the inclusion of the radiographic exam there was an increase

**TABLE 2-** Distribution, in absolute and percentage numbers, of the prevalence of caries measured by DMFT in 12-year-old students, according to the diagnostic criteria used: WHO and WHO associated to the radiograph (WHO/R). City of Franca – SP, 2003

	Diagnostic Criteria			
	WHO		WHO/R	
DMFT	N	%	N	%
0	78	46.15	61	36.09
1	28	16.57	34	20.12
2	14	8.28	22	13.02
3	14	8.28	15	8.88
4	21	12.43	21	12.43
≥5	14	8.28	16	9.46

**TABLE 1-** Mean and percentage composition of the components of the DMFT index, and interval of confidence at 95% to the population mean, in 12-year-old students according to the diagnostic criteria used by the WHO and WHO associated with the radiographic exam (WHO/R). City of Franca – SP, 2003

Diagnostic Criteria	n	D		M		F		DMFT (IC 95%)	
		mean	%	mean	%	mean	%	mean	%
WHO	169	0.52	29.9	0.04	2.41	1.17	67.70	1.72	100
								(1.35-2.09)	
WHO/R	169	0.73	37.61	0.04	2.41	1.17	60.24	1.93*	100
								(1.57-2.30)	

\*Statistically significant differences in the student t -test (p < 0,001).

(statistically significant) of 10% in the prevalence of caries in the study population, resulting from the detection of hidden carious lesions in 10% of the students that were caries-free in the epidemiological exam (DMFT=0); hidden carious lesions were detected in 16% of students: 10% of students were caries-free and 6% with caries experience (DMFT=1); it should be emphasized that the presence of these lesions was not evaluated in anterior teeth and premolars, but only in permanent molars that were healthy in the epidemiological exam.

Verdonschot, et al.<sup>20</sup> (1993) consider that the radiographic method associated with the visual exam does not improve the diagnosis of carious lesions in individuals of populations with low caries prevalence. Poorterman, et al.<sup>14</sup> (2000) observed an increase in the prevalence of interproximal caries in dentin when using bitewing radiographs, however, this difference did not represent a significant increase in the DMFS indexes. Bloemendal, et al.<sup>3</sup> (2004) evaluated epidemiological studies and concluded that the use of radiograph did not have an additional value in the caries prevalence, emphasizing that investigations should be done between the results of the radiographic and clinical exams in subsamples of epidemiological studies.

The methodologies used in the studies that deal with diagnosis criteria in epidemiological studies are various; they are made in different ages, with variations in sample size; Bloemendal, et al.<sup>3</sup> (2004) identified 2,412 studies in *Medline* with key words related to caries, radiograph, adolescent, clinical exam and others on that subject; due to methodological differences, they selected seven; and some of them did not present the observed repeatability: they did not report losses and the proportion of radiographs obtained. In this study we tried to describe the sample, criteria and repeatability of the methods. We emphasize that radiographic exam was done in 66% of the sample, due to the difficulties that we faced in leading the patients. Similar studies obtained radiographs of 25%<sup>14</sup> and 52%<sup>15</sup> of participants when studying the dental health conditions.

Epidemiological studies<sup>5,19</sup> obtained intra-examiner general agreement percentage and Kappa index similar to those observed in the present study, which are considered by Landis and Koch<sup>12</sup> (1977) an almost perfect agreement, demonstrating a great level of repeatability in relation to DMFT, and assure the statistics results.

## CONCLUSIONS

The prevalence of caries in the study population is low. The implantation of the radiographic exam significantly increased the mean DMFT index, however, the prevalence was maintained in the low category of severity to the DMFT. The hidden caries were detected mostly in caries-free students, showing a change in the standard development of lesions. It is suggested that bitewing radiographs should be obtained, even in clinically caries-free patients.

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