UNIVERSITY OF MEDICINE AND PHARMACY CRAIOVA

DOCTORAL SCHOOL

THE ABSTRACT OF Ph. D. THESIS

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CRAIOVA
2014

CURRENT CONCEPTS ON THE USE OF IMAGING METHODS IN DETECTION OF EARLY CARIES LESIONS

CONTENTS

Key words: incipient caries, questionnaire, bite-wing radiography, CBCT, sensitivity, specificity, ICDAS scores, DIAGNOdent, periapical radiography, stereomicroscopy.

INTRODUCTION

Reasons for choosing this subject

What has determined me to choose this subject for my Ph D thesis has been the high frequency of carious lesions and the lack of a clear caries diagnostic protocol, associated with the availability of a large number of devices for diagnosing caries.

The aim of the Ph D thesis is to establish the role and the importance of using classical and modern imaging techniques for the detection of incipient carious lesions.

Clinical significance of the research

- it demonstrates there is a need of correlation between clinical examination and other specific methods, especially when diagnosing incipient caries.
- It is established that the DD device shows the most reliable results in detecting enamel caries while bite-wing radiography shows the most positive results in detecting dentin caries.
- Digital bite-wing radiography shows better results in detecting incipient caries than classical bite-wing and periapical radiography.
- CBCT is able to detect all caries.

The first part of the thesis which is a review of the literature in this field begins with the chapter on “Modern principles of interpretation and clinical evaluation of incipient caries” and presents modern concepts like CAMBRA(caries management by risk assessment), standardised visual inspection system of caries (ICDAS) and highlights the sensitivity and specificity which have been used in order to describe and quantify the ability of a diagnostic test compared to a standard.

Diagnostic performance could be enhanced by the association of clinical examination with modern complementary means.

The second chapter entitled “Imaging diagnostic techniques for dental caries “reviews the classical radiography methods and the new light-systems for caries detection, devices based on the measurement of electrical current, light-fluorescence devices, computed cone bean technology, ultrasounds.

The third chapter presents the effects, doses and x-ray exposure risks.

PERSONAL RESEARCH

The second part of the thesis comprises six chapters, with the fourth one representing the scientific research methodology.

CHAPTER 5

A statistical study regarding dentists' degree of interest in the use of imaging techniques for incipient dental caries detection

The aim of the study was to evaluate the interest and need of medical staff working in the dental area in imaging techniques as complementary methods currently used in the detection of early dental caries.

5.2 Material & method

The study was carried out by means of an electronically submitted questionaire to a number of 147 dentists from Craiova, with a mention that all respondents would remain anonymous. (annex 1)

5.3 Results

Of the total of 147 electronically submitted questionnaires, only 120 were returned (annex 2). This represented an 81% response rate; 35% of respondents were males and 65% women.

The age of the respondents ranges between 31-40 years old (57%), 41-50 years old (20%), younger than 30 years old (18%) and over 50 (5%).(fig. 5.3).

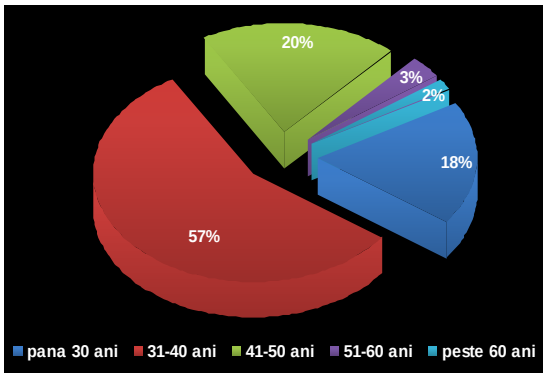


Fig. 5.3. Age distribution of the respondents

Data on x-ray use for early caries diagnosis

Frequently, early caries detection is obtained through clinical examination. 73% of the respondents detect early caries in their practice in about 1 to 15 minutes and out of those, 67% need 1 to 5 minutes for the detection.

Regarding the use of x-ray in detecting early caries, 34% of the dentists recommend it in about 0-25%of the cases, 28% recommend it in about 25-50%, the lowest percentage (8%) recommend it in 75-100% of cases.

Another part of the questionnaire researched the association of clinical examination with x-ray indication. The results showed that while 53% of the respondents use x-ray for proximal caries detection in 75-100% of cases, a similar percentage use x-ray to detect occlusal caries but in only 0-25% of cases.

It has also been shown that when professional experience is in between 11-20 years, the association of clinical examination and x-ray indication is often used (40%).

All the results were statistically processed and the Pearson correlation coefficient has been calculated in order to establish correlations between professional experience and complementary use of x-ray in detecting dental caries.

CHAPTER 6

IN VIVO occlusal caries evaluation using clinical examination, bite-wing radiography and the DIAGNOdent device

The aim of the study was to “in vivo” compare the precision of three diagnostic methods used for occlusal caries detection in posterior teeth (molar and premolar).

6.2. Material & method

The study was carried out on a group of 40 patients of both sexes (25 women and 15 men), aged between 16-36 (average=27,19), who showed occlusal caries on premolars and molars. (n = 640).

6.3. Results

In the table below, the centralised distribution of dental surfaces with and without caries is presented.(tab. 6.XI)

	Detection methods					
	Clinical exam. (C)		**x-Ray (BW)**		**DiagnoDent (DD)**	
	No. cases	%	No. cases	%	No. cases	%
Sound	**299**	**46.7%**	**324**	**50.6%**	**280**	**43.7%**
Caries	**341**	**53.3%**	**316**	**49.4%**	**360**	**56.3%**
Total	**640**		**640**		**640**	

Collected data were processed in R Programming language and the Kendall correlation coefficient for the 3 tests was calculated. The obtained values range between 0,77 – 0,83 and set a significant correlation between the three types of data. Clinical and Diagnodent examination showed the strongest correlation.

For each of the 3 methods, sensitivity, specificity, posite predictive value, negative predictive value, conjunction and disjunction tests were calculated as validation tests.

CHAPTER 7

A Comparative (statistical) „IN VITRO" study regarding the accuracy of periapical radiography, bite-wing radiography (classic and digital) and CBCT in detection of premolar and molar proximal caries

The aim of the study is to "in vitro" compare the performances of bite-wing (both classic and digital) radiography, periapical radiography and CBCT in detecting and in depth determining proximal caries, using histology as standard.

7.2 Material & method

The study was carried out on 44 molars and premolars, extracted from orthodontic/periodontal/ surgical reasons. Every tooth showed at least one restored or unrestored proximal carious lesion, in an early or extended stage, toward or beyond the ECJ. Following clinical examination, the teeth were divided in 4 groups according to the ICDAS criteria.

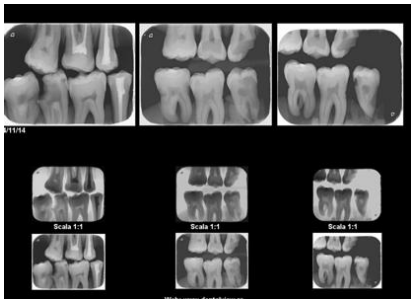
Groups of 2-4 teeth were fixed on plastic teaching models, at 3mm distance from ECJ, simulating as much as possible the real interdental contact. Bite-wing and periapical x-rays and CBCT were then carried out.

7.3 Results

7.3.1 X-ray examination

a) Digital bite-wing radiography

b) Classic bite-wing radiography



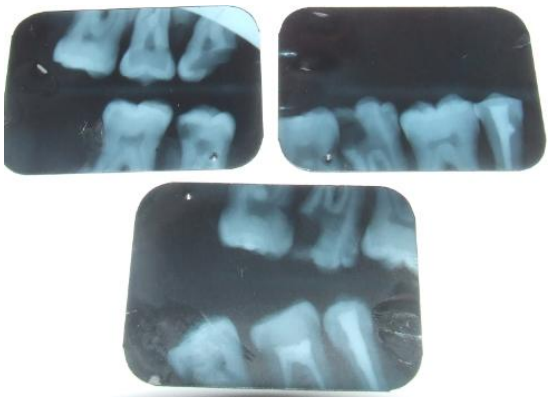


Fig. 7.8 Digital bite-wing x-rays board (a); Fig. 7.9 Classic bite-wing x-rays board (b)

c) Periapical x-ray

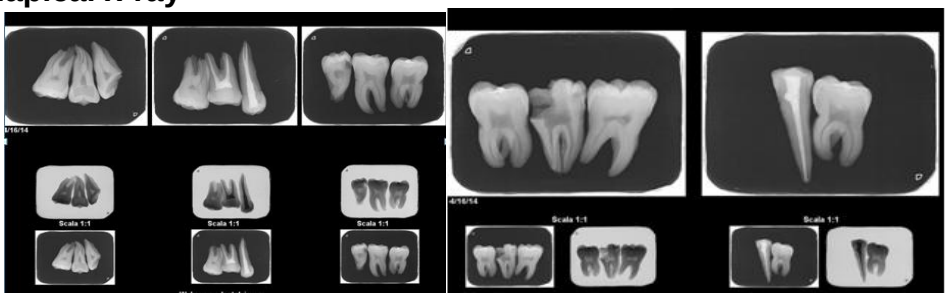


Fig. 7.10 a si b Periapical x-rays board

7.3.2 CBCT

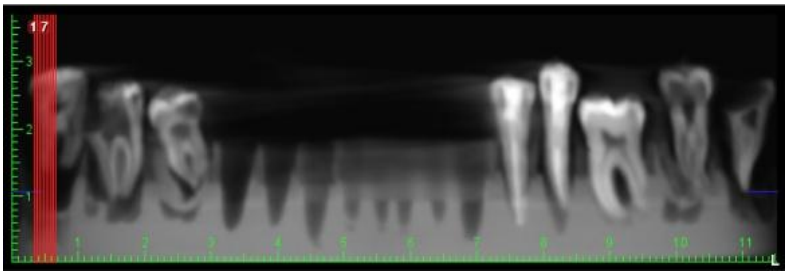


Fig. 7.11 CBCT image

7.3.3 Histology

- 12 molars and premolars belonging to the first group showed caries classified as ICDAS 1 and 2. When histology was carried out, all teeth were enrolled in histological score 1 (demineralization of the outer half of the enamel).
- The second group containing 10 molars and premolars with ICDAS 3 carious lesions showed 2 different histological scores. 5 teeth were found with histological score 1 and other 5 with histological score 2.
- The third group containing 14 molars and premolars with ICDAS 4 carious lesions also showed 2 different histological scores. 8 teeth were found with histological score 2 and another 6 with histological score 3.
- The last group contains 8 molars and premolars with ICDAS 5 and 6 carious lesions. 2 of them showed histological score 3 and the rest (6) showed histological score 4.

All data were statistically processed.

7.3.4.1 The Correlation between clinical ICDAS scores and histological scores

By means of the Table Curve 2D programme, a highly significant correlation was calculated between clinical ICDAS scores and histological scores. (correlation coeficient r = 0,93)

7.3.4.2 Comparing radiological methods

In order to compare the performances of the studied radiological methods, confidence intervals have to be calculated and their averages must be compared. Following an analysis of the obtained values it can be said that there are no significant differences between the performances of the compared methods. But these results could be affected by the relatively small number of teeth included in the study.

There is a significant correlation between the radiological scores for periapical radiography and the histological scores. (correlation coeficient r = 0,88)

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CHAPTER 8

Clinical cases

This chapter contains 8 complex clinical cases with the detailed therapeutic steps.

Case 1. A 37 years old patient visited the dental practice due to the color changes observed on the occlusal aspects of teeth 45, 15 and on the distal aspect of no 45. For the diagnosis, a bite-wing x-ray has been recommended.

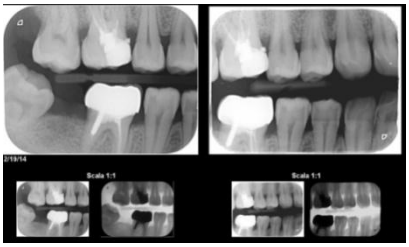

Fig.8.1Tooth no.15-Initial appearance; Fig.8.2 15-Final aspect; Fig.8.3. Bitewing x-ray

The proximal carious lesion on 45 could be seen on the x-ray, being localized in the inner third of the enamel. The occlusal caries are not visible on this radiography. In return, there have been detected early caries on the distal aspects of 12, 13.

CHAPTER 9

Final conclusions

1. The detection of early caries is a concern for the dentists from Craiova.
2. Most of the respondents are aged between 31-40 years and interested in the improvement of the clinical or research activity. They also have over 10 years experience in dentistry.
3. Most of the respondents detect early caries in their clinics, with only about a third not been able to find proofs in order to state a diagnosis.
4. About a half of the respondents use periapical radiography for the detection of early caries.
5. More than a half of the respondents use digital radiography. Those who do not use digital radiography, avoid it because of the price and because they are content with conventional radiography.
6. Laser fluorescence method establishes the depth of enamel caries and whether the dentin is involved.
7. We can say that the most reliable results in the detection of enamel caries are given by the Diagnodent device and the most positive results in detection of dentin caries are given by BW radiography.
8. Diagnodent shows very good sensitivity and specificity in the detection of caries.
9. Visual inspection and Diagnodent showed similar performances in terms of sensitivity and specificity
10. There is a highly significant correlation between clinical ICDAS scores and histological scores. (correlation coeficient r = 0,93)
11. Following the analysis of the entire data, we have observed a better early caries detection in the case of digital bite-wing radiography than in the case of classic bite-wing and periapical radiography.
12. CBCT image detects all caries irrespective of their location and evolution degree.
13. There has been calculated a strongly significant correlation between histological scores and radiological scores for digital BW radiography, a significant correlation between histological scores and radiological scores for periapical radiography and a relatively significant one between histological scores and radiological scores for classical BW radiography.

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