

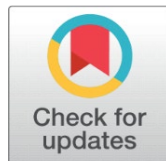


INTERPRETATION OF PERIAPICAL RADIOGRAPHS IN PEDIATRIC ODONTOLOGY: A STUDY OF PREDOCTORAL DENTAL STUDENTS AT FDC

Maria Mtalsi ¹, Aicha Elbouachraoui ¹  , Mouna Hamza ², Mohammed Alsbbah ¹, Sid'ahmed Dedah ¹, Samira Elarabi ¹

¹ Department of Pediatric Dentistry, Faculty of Dental Medicine, University Hassan II, Casablanca, Morocco

² Department of Pedodontics and Laboratory of Community Health, Epidemiology and Biostatistics, Faculty of Dental Medicine, University Hassan II, Casablanca, Morocco



Received 16 April 2022
Accepted 18 May 2022
Published 06 June 2022

Corresponding Author

Aicha Elbouachraoui,
aa.bouachraoui@gmail.com

DOI
[10.29121/granthaalayah.v10.i5.2022.4602](https://doi.org/10.29121/granthaalayah.v10.i5.2022.4602)

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Copyright: © 2022 The Author(s). This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

With the license CC-BY, authors retain the copyright, allowing anyone to download, reuse, re-print, modify, distribute, and/or copy their contribution. The work must be properly attributed to its author.



ABSTRACT

In pediatric dentistry, intra oral periapical radiography is a useful or even indispensable diagnostic aid before any treatment and therefore an essential part of pre-doctoral training. A study was carried out among the students in the process of completing their thesis at the Faculty of Dental Medicine of Casablanca (FMDC), with the objective of determining their abilities and aptitudes as well as their weaknesses and limitations with regard to the interpretation of a periapical radiograph taken in children.

The present study involved a sample of 30 students randomly selected and assembled in a room willing to fill out survey forms and shown a POWER POINT presentation of periapical radiographs. The results showed that 83.3% of the students were able to identify technical pitfalls, 93.3% were able to recognize oral anatomical structures, and 96.7% were able to detect carious and traumatic pathology on the radiographic images. However, some deficiencies were reported such as the ability to identify certain anatomical traps such as the maxillary sinus and the chin hole as well as the ability to detect apical complications of dental pathology.

In order to remedy the observed weaknesses and to strengthen the students' skills, it is necessary to revise the teaching methods and to make available new technical means.

Keywords: Radiological Interpretation, Periapical Radiographs, Traps, Child, Difficulties

1. INTRODUCTION

In pediatric dentistry, oral radiology is a useful and indispensable diagnostic aid and an essential part of pre-doctoral training [Espelid et al. \(2003\)](#), [Whaites \(2002\)](#). periapical radiography is the most commonly used complementary dental examination in children due to its accuracy, ease of use and low radiation dose

absorption. [Valachovic and Lurie \(1982\)](#) It allows to objectify the temporary and permanent teeth, to detect carious lesions, the proximity of these with the pulp, the lesions of the interdental septum, the inter- radicular osseous attacks, the relations of the temporary tooth with the underlying permanent tooth germ, the degree of resorption of the root(s) of the temporary teeth, the degree of edification of the root(s) of the permanent teeth... [Valachovic and Lurie \(1982\)](#), [Rushton et al. \(2005\)](#)

Although this examination requires a low dose of radiation, the associated risks must not be neglected, especially in children who are more susceptible to carcinogenesis by low dose radiography [López-Jornet et al. \(2010\)](#), [Martin et al. \(2017\)](#)

The use of X-rays must therefore be justified and requires a mastery of radiological techniques to avoid retakes, and a knowledge of anatomy as well as the different pathologies in order to avoid reading traps [Euwe and Meiden \(2020\)](#), [Taheri et al. \(2010\)](#)

Some previous studies have shown that dental students, at the end of their studies, have difficulties and weaknesses in the interpretation of periapical dental radiology, especially taken in children. [Rushton et al. \(2005\)](#), [Minston et al. \(2013\)](#), [Mirza et al. \(2018\)](#), [Kumar and Gadbury-Amyot \(2019\)](#) Thus, in order to evaluate their abilities, skills, weaknesses and limitations in the interpretation of a pediatric intraoral dental radiology, a study was carried out by students during the process of completing their thesis at the Faculty of Dentistry of Casablanca (FDC).

2. MATERIALS AND METHODS

This is a descriptive cross-sectional epidemiological survey, focusing on the difficulties encountered during the interpretation of intraoral periapical radiography in children, at the FDC 30 students pending thesis.

To collect the data for this study, a survey form consisting of four parts was developed [Table 1](#) as well as a PowerPoint presentation of the intraoral periapical radiographs was projected as the student completed the questionnaire.

Data processing was performed in the FDC Community Health Epidemiology and Biostatistics Laboratory using SPSS software.

Table 1

Table 1 Representative Table of The Variables Studied

Identification of students	Learning methods	Perception of capabilities and knowledge of quality criteria	Identification of pitfalls and difficulties of interpretation
<ul style="list-style-type: none"> - Age - Gender - Academic background 	<ul style="list-style-type: none"> - Learning Methods at FDC - Self-learning methods 	<ul style="list-style-type: none"> - Self-assessment of dental radiography interpretation skills - Need to introduce a complementary clinical course - Detection of the quality criteria of intraoral periapical radiography (RA) (optimal magnification, distortion, sharpness, density, and contrast) 	<ul style="list-style-type: none"> - Anatomical traps (Maxillary sinus and chin hole) - Technical traps (Errors in setting and positioning the tube) - Means of reading the RA (Negatoscope, magnifying glass, telephone, daylight...) - Ability to identify anatomical structures (Lamina dura, nasal cavity, zygomatic arch)

3. RESULTS

The present study included a randomly drawn sample of 30 FDC thesis students with a mean age of 23.31 ± 0.884 years. An almost equal distribution of the two sexes was noted. 9.9% of the students had repeated one or two grades during their time in the faculty.

As for the learning methods, 90% of the students attended the various lectures, 80% attended tutorials and only 33.3% said they had benefited from learning by clinical reasoning. Other self-learning methods were mentioned by 90% of the participants in this study (Global Internet Research, online courses, continuing education...).

90.0% of the students were interested in the implementation of a complementary clinical course in dental radiology. They differed in their opinion as to the ideal year for the introduction of this course in their curriculum.

Regarding the ability to interpret the periapical radiograph, 90.0% said they were able to do so.

Only 23.3% of the students were able to recognize the different quality criteria of a periapical radiograph image.

When assessing the students' ability to recognize anatomical traps, 16.7% of the students were able to identify the maxillary sinus and only 10% were able to recognize the mental foramen [Table 2](#) On the other hand, they were able to identify most of the technical traps on the exposed periapical radiograph radiographs. Thus, 96.7% recognized the film showing incorrect vertical angulation of the X-ray tube and 76.7% could identify the film showing kinetic movement of the tube/patient/film [Table 2](#)

Table 2

Table 2 Distribution of Students According to Their Ability to Identify Anatomical Traps

	N	%
Anatomical traps:		
Maxillary sinus		
- Correct answer	5	16.7
- In Chin hole correct answer	25	83.3
- Correct answer	3	10
- Incorrect answer	27	90

Table 3

Table 3 Distribution of Students According to Their Ability to Identify Technical Traps

	N	%
Technical traps:		
Incorrect vertical tube angulation		
- Correct answer	29	96.7
- Incorrect answer	1	3.3
Incorrect vertical placement of the film		
- Correct answer	24	80
- Incorrect answer	6	20

Insufficient exposure intensity		
- Correct answer	21	70
- Incorrect answer	9	30
Incorrect cutting plan		
- Correct answer	21	70
- Incorrect answer	9	30
Movement of the tube/patient/film		
- Correct answer	23	76.7
- Incorrect answer	7	23.3
Excessive exposure intensity		
- Correct answer	21	70
- Incorrect answer	9	30
Film curvature artifact		
- Correct answer	22	73.3
- Incorrect response	8	26.7
Incorrect horizontal location of the film		
- Correct answer	23	76.7
- Incorrect answer	7	23.3
Double exposure		
- Correct answer	21	70
- Incorrect answer	9	30
Incorrect horizontal tube angulation		
- Correct answer	17	56.7
- Incorrect answer	13	43.3

Several means of reading radiographic images were mentioned by the students. However, only 6.7% of our sample used a large viewer and/or the chair viewer to interpret a periapical radiograph image, while 93.3% used other means such as a cell phone lamp, daylight, etc. During endodontic treatment, only 36.7% used a magnifying glass to read the periapical radiograph images.

The results of the evaluation of the students' ability to recognize the different anatomical structures on a periapical image and their ability to interpret dental pathology and treatments are presented in [Table 4](#)

Table 4

Table 4 Students' Ability to Identify Different Anatomical Structures		
	N	%
Anatomical structures		
The lamina dura		
- Correct answer	28	93.3
- Incorrect answer	2	6.7
The nasal cavity		
- Correct answer	28	93.3
- Incorrect answer	2	6.7
The zygomatic arch		
- Correct answer	25	83.3
- Incorrect answer	5	16.7

Table 5

Table 5 Students' Ability to Interpret the Periapical Radiograph		
	N	%
Interpretation of the periapical radiograph		
Dental pathologies:		
Detecting dental structures affected by caries		
- Correct answer	23	76.6
- Incorrect answer	7	23.4
Determine the physiological stage of a temporary tooth		
- Correct answer	22	73.3
- Incorrect answer	8	26.7
Detect complications of caries		
- Correct answer	6	20
- Incorrect answer	24	80
Determine the dental structures affected by trauma		
- Correct answer	15	50
- Incorrect answer	15	50
Determine the stage of root development of an immature permanent tooth		
- Correct answer	10	33.3
- Incorrect answer	20	66.7
Detect complications of trauma		
- Correct answer	1	3.3
- Incorrect answer	29	96.7
Dental treatments: Pulpotomy		
- Correct answer	28	93.3
-Incorrect answer	2	6.7
Pedodontics cap		
-Correct answer	7	23.3
-Incorrect answer	23	76.7
Endodontic treatment		
-Correct answer	30	100.0
-incorrect answer	0	0.0

In order to qualify the degree of mastery of the students of the different aspects of the interpretation of the periapical radiograph images studied in the present work, scores were attributed according to the number of correct answers obtained [Table 4](#). It was found that 80% had a very good command of the knowledge of anatomical structures and 46.7% of the technical traps. 86.7% had a good command of reading a radiographic image. As for the mastery of anatomical traps and technical errors, it was insufficient with respective percentages of 63.4% and 56.7% of cases [Table 5](#)

Table 6

Table 6 Scores Assigned to Radiographic Interpretation Proficiency			
Skills	Insufficient mastery	Good mastery	Very good mastery
Anatomical traps	0 correct answers	1 correct answer	2 correct answers
Technical traps	Less than 6 correct answers	Between 6 and 8 correct answers	More than 8 correct answers

Technical errors	0 correct answer	1 correct answer	2 correct answers
Lack of knowledge	0 to 1 correct answer	2 correct answers	3 correct answers
Ability to read a radiographic image	Less than 3 correct answers	3 to 6 correct answers	More than 6 correct answers

Table 7

Skills	poor mastery	Good mastery	Very good mastery
	N (%)	N (%)	N (%)
Anatomical traps	19 (63,4)	10 (33,3)	1(3,3)
Technical traps	5 (16,7)	11 (36,6)	14 (46,7)
Technical errors	17 (56,7)	13 (43,3)	0 (0,0)
Knowledge of anatomical structures	2 (6,7)	4 (13,3)	24 (80,0)
Ability to read a radiographic image	1 (3,3)	26 (86,7)	3 (10,0)

4. DISCUSSION

10% of the students surveyed have repeated a grade once or several times. This factor can negatively affect their performance. Indeed, a study done at the Office of Student Evaluation of the Direction de l'Evaluation et de la Prospective in France showed that repeating a year negatively affects the motivation and performance of students, because of the feeling of failure experienced by them as either a second chance or a punishment. [Cosnefroy and Rocher \(2004\)](#)

Only 33% of the students in the present study benefited from clinical reasoning learning whereas the study conducted by [Kumar and Gadbury-Amyot \(2012\)](#) found that 71% of the students felt that case- based instruction helped them learn the content in a more comprehensive manner and 77% felt that the class discussion increased their knowledge of radiographic interpretation. [Kumar and Gadbury-Amyot \(2012\)](#)

Mariam T [Baghdady et al. \(2013\)](#) argue that teaching basic science integrated with clinical features produces greater diagnostic accuracy in novices than teaching basic science separate from clinical features. [Baghdady et al. \(2013\)](#) As for Tore a [Nilsson et al. \(2011\)](#) concluded that simulator-assisted training is a valuable supplement to conventional teaching methods in oral radiology. [Nilsson et al. \(2011\)](#)

According to Elham [Soltanimehr et al. \(2019\)](#) virtual learning was superior to the traditional lecture-based method for improving knowledge acquisition in radiographic interpretation of bony lesions of the jaw. [Soltanimehr et al. \(2019\)](#) This was confirmed by Sandra Meckfessel et col, at Hanover Medical University in Germany who showed that the introduction of e-Learning in dental radiology education resulted in students improving their examination scores [Meckfessel et al. \(2011\)](#) However, the FDC class, the subject of this study, benefited mainly from conventional teaching methods (lectures, tutorials).

In our study, only 23.3% of the students were able to recognize the different quality criteria of a periapical image. In a similar study by VE [Rushton et al. \(2005\)](#) which assessed the ability of final year dental students from two British dental schools to identify defects in a radiographic film, lower results were found. Indeed,

only 2% of the sample at University A achieved a pass mark above 50% compared to 15% at University B. [Rushton et al. \(2005\)](#)

As for the ability of our students to recognize some anatomical traps (maxillary sins, chin hole), the results (Good mastery and very good mastery in 36.6%) were less satisfactory than those found in similar studies in Saudi Arabia [Tter et al. \(2010\)](#) and more satisfactory than those found in Pakistan [Mirza et al. \(2018\)](#) Thus, and following these results, a major question must be raised: Do our students have difficulties in radiological interpretation or do they have gaps in their knowledge of anatomical structures?

As for technical traps, they are very common when taking periapical radiograph radiographs. These can be encountered more in children because of their special psychological profile, the nausea reflex, the size of the oral cavity and sometimes the unavailability of pediatric endo-buccal films. These technical traps can influence the radiological interpretation and mislead the practitioner. In the present study 83.3% of the students showed good to very good proficiency in identifying these traps. A study conducted by Rushton et al. in 2005 at the University of Manchester School of Dentistry on the effectiveness of teaching students to identify technical traps on radiographic films showed that the maximum score achieved by the students was 47.4% of correct answers, 26.3% was average and 10.5% was minimum. [Rushton et al. \(2005\)](#) As for the study conducted by Abdullah et al, it showed that 65.2% of the studied sample were able to identify the pitfalls related to the cutting plane and incorrect angulation of the X-ray tube. [Tter et al. \(2010\)](#)

Only 6.7% of our sample used the most recommended method for reading periapical radiograph images, which is to use a large viewer and/or chair viewer. 93.3% used inadequate methods such as cell phone light, daylight, or surgical light. Our study also showed that 63.3% of the students did not systematically use a magnifying glass to read the periapical radiograph images during endodontic treatment. Thus, we can deduce that the majority of the students in the present study used inadequate means for reading the periapical radiograph films, which may negatively influence the quality of their interpretation.

In the present study 93.3% had good to very good control in the assessment of knowledge of anatomical structures. In the study conducted in Saudi Arabia, which focused on the recognition of anatomical structures (although they were different from those we studied), the performance of the students was high and reproached to that of our students. [Tter et al. \(2010\)](#) As for the study conducted by Mirza et al, it found that 70% of their sample could identify the lamina dura, compared to 93.3% of our sample. [Mirza et al. \(2018\)](#)

The students in this study were in the majority of cases (96.7% showed good to very good mastery) able to recognize carious and traumatic pathology on the periapical radiograph. A study conducted in Pakistan showed that 91% of the students were able to detect caries on a periapical X-ray [Wojtowicz et al. \(2003\)](#) while the study conducted by [Wojtowicz et al. \(2003\)](#) showed that the students detected 54% of carious lesions. [Wojtowicz et al. \(2003\)](#) In contrast to the study done in Saudi Arabia, only 17.4% of the students who correctly judged the stage of caries, [Tter et al. \(2010\)](#) which agrees with the study of [Minston et al. \(2013\)](#) which reported that the detection abilities of proximal caries were poor, in Swedish and Chinese dental students using analog and digital radiographs. [Minston et al. \(2013\)](#)

The detection of apical radiolucency was the least mastered pathology. Indeed, only 23.0% of our students were able to notice it, which is close to the percentage found in the study of [Mirza et al. \(2018\)](#)

5. CONCLUSION

The present study allowed to raise several positive points concerning the ability to identify technical traps (83.3% have either a good or a very good mastery), the recognition of oral anatomical structures (93.3% of the students have a good to a very good mastery) as well as for the ability of the students to read carious and traumatic pathology on radiographic images (96.7% have a good to a very good mastery). However, some negative points were found such as the deficiency in the ability to identify certain anatomical traps such as the maxillary sinus and the chin hole, the use of inadequate means for reading periapical radiograph images, the ability to detect apical complications of dental pathology.

In order to remedy the observed weaknesses and to strengthen the students' skills, it is necessary to revise the teaching methods and to make available new technical means such as simulators, digital sensors, small periapical radiograph images.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

- Baghdady, M. T. Carnahan, H. Lam, E. W. N. Woods, N. N. (2013). Integration of Basic Sciences And Clinical Sciences in Oral Radiology Education For Dental Students. 757-763. <https://doi.org/10.1002/j.0022-0337.2013.77.6.tb05527.x>
- Cosnefroy, O. Rocher, T. (2004). Le Redoublement Au Cours De La Scolarisé Obligatoire : Nouvelles Analyses, Mêmes Constats. 73-82.
- Espelid, I. Mejàre, I. Weerheijm, K. (2003). EAPD Guidelines For Use of Radiographs in Children, Eur J Paediatr Dent, 4,40-48.
- Euwe, M. Meiden, W. (2020). Partie 4. Amat wird Meister 47-52. <https://doi.org/10.1515/9783111456287-008>
- Kumar, V. Gadbury-Amyot, C.C. (2012). A Case-Based And Team- Based Learning Model in Oral and Maxillofacial Radiology. 330-337. <https://doi.org/10.1002/j.0022-0337.2012.76.3.tb05262.x>
- Kumar, V. Gadbury-Amyot, C. C. (2019). Predoctoral Curricular Revision For Dental Radiographic Interpretation Competence Based on OSCE Results. J Dent Educ 1233-1239. <https://doi.org/10.21815/JDE.019.112>
- López-Jornet, P. Camacho-Alonso, F. Molina-Miñano, F. (2010). Knowledge and Attitudes About Oral Cancer Among Dentists in Spain. J Eval Clin Pract, 16(1), 129-133. <https://doi.org/10.1111/j.1365-2753.2009.01132.x>
- Martin, L. Naccache, R. Coze, S. Desvignes, C. Panuel, M. (2017). Radiographie Thoracique De L'enfant : D) Règles D'interprétation. J D'imagerie Diagnostique Interv. [https://doi.org/10.1016/S2543-3431\(18\)30075-7](https://doi.org/10.1016/S2543-3431(18)30075-7)
- Meckfessel, S. Stühmer, C. Bormann, K. H. Kupka, T. Behrends, M. Matthies, H. Vaske, B. Stiesch, M. Gellrich, N. C. Rucker, M. (2011). Introduction of E-Learning in Dental Radiology Reveals Significantly Improved Results in Final Examination. 39 :40-48. <https://doi.org/10.1016/j.jcms.2010.03.008>

- Minston, W. Li, G. Wennberg, R. Näsström, K. Shi, X.Q. (2013). Comparison of Diagnostic Performance on Approximal Caries Detection Among Swedish and Chinese Senior Dental Students Using Analogue and Digital Radiographs. 37-79.
- Mirza, A. J. Nazir, M. Akhter, Z. Javaid, M. A. Shafiq, M. K. (2018). Radiographic Interpretation Skills of Clinical Dental Undergraduates Studying in Karachi, Pakistan. 100-104.
- Nilsson, T. A. Hedman, L. R. Ahlqvist, J. B. (2011). Dental Student Skill Retention Eight Months After Simulator-Supported Training in Oral Radiology. 679-684. <https://doi.org/10.1002/j.0022-0337.2011.75.5.tb05094.x>
- Rushton, V. E. Hirschmann, P. N. Bearn, D. R. (2005). The Effectiveness of Undergraduate Teaching of The Identification of Radiographic Film Faults. *Dentomaxillofacial Radiol*, 34(6), 337-342. <https://doi.org/10.1259/dmfr/19829457>
- Soltanimehr, E. Bahrapour, E. Imani, M.M. Rahimi, F. Almasi, B. Moattari, M. (2019). Effect of Virtual Versus Traditional Education on Theoretical Knowledge and Reporting Skills of Dental Students in Radiographic Interpretation of Bony Lesions of The Jaw. 1-7. <https://doi.org/10.1186/s12909-019-1649-0>
- Taheri, J.M. Moshfeghi, M. Anbari, F. (2010). Knowledge, Opinions and Practice of Last Year Dentistry Students of Shahid Beheshti University Regarding Diagnosis and Differentiation of Malignant Lesions. 238-242. <https://doi.org/10.3923/rjmsci.2010.238.242>
- Tter, N. C. U. Nulty, S. Arvazyan, R.S. Uery, M. (2010). E Valuation of U Ltrasound V Elocity. 1451-1457.
- Valachovic, R.W. Lurie, A. G (1982). Risk-Benefit Considerations in Pedodontic Radiology. *Tidsskr Tandlaeger* 2(2), 7-19.
- Whaites, E. (2002). *Essentials of Dental Radiography and Radiology*. 3rd Ed. London, 177.
- Wojtowicz, P. A. Brooks, S. L. Hasson, H. Kerschbaum, W. E. Eklund, S. A. (2003). Radiographic Detection of Approximal Caries : A Comparison Between Senior Dental Students and Senior Dental Hygiene Students. 246-251.