

Evaluation of light filter of portable dark chamber and its influence on radiographic image quality

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ABSTRACT

Introduction: The Ordinance 453 of the Brazilian Ministry of Health recommends processing intraoral radiographic films in opaque portable dark chamber without display and using the temperature x time method. However, the processing using the visual method in dark chambers with acrylic polymer display is still frequent. The aim of this study was to evaluate and compare the filtering capacity of four portable dark chamber (Unemol[®], VH[®], MPG[®] and a camera without identification) with the capacity of a conventional dark chamber (control) and check its influence on image quality in different radiographic films (Kodak[®]: DF-58 Ultra-Speed, E-Speed and IP-21 Insight; and Agfa[®] Dentus M2). **Methods:** The films were exposed with a step wedge of aluminum and a lead plate and processed in Kodak[®] solutions ready for use in each portable dark chamber and in the conventional dark

chamber (control). The films remained three minutes in the developer and at every minute the films were approximated to the display, simulating the clinical condition, followed by intermediate bath and fixing for six minutes. Photodensitometric assessment was made and the data were analyzed by Mann-Whitney and Kruskal-Wallis tests. **Results:** The first test showed that in relation to the control group there was no statistically significant differences with the Unemol[®] chamber when using IP-21 Insight and E-Speed films and the VH[®] chamber when using IP-21 Insight film. The second test showed a significant statistical difference when comparing one film to each other. **Conclusion:** This research suggested that the acrylic display increases the base veiling density, jeopardizing the quality of the radiographic image.

Keywords: Dental radiography. Diagnostic imaging. Radiography.

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Introduction

Auxiliary diagnostic methods are extremely important for planning treatment and radiographic examination is one of the main methods. A radiographic image quality requires knowledge and control of all processing steps.¹ With limited space and relatively small amount of radiographic exposures in a dental office, beyond the need for execution of the trans-operative radiographs in some specialties, it became feasible to use portable dark chamber by offering greater flexibility in processing radiographic without the need to shift the patient to a specialist clinic.²

In 1998, the Department of Health Surveillance of the Ministry of Health issued the 453 ordinance regulating the use of Dental Radiology. This ordinance allows the use of portable dark chamber for intra-oral radiographs, provided they are made of opaque material and are fitted with clock and thermometer for the realization of radiographic processing by temperature-time method. However, the display in dark rooms with red acrylic, are still widely used in clinics, to perform the processing by visual inspection.

The operating conditions in a portable dark room should be such as to enable greater efficiency and image quality. Any failure during processing can compromise the image and hinder the diagnosis.³ Currently, intra-oral films have become more sensitive, being essential the quality control of portable dark chamber and the knowledge of its handling by the professional.

The lack of studies on the effectiveness of red acrylic polymer filter adequately the components of the light spectrum in the dark chambers used in the dental office with films of different groups of sensitivity, led to this research, whose objective was to evaluate the relationship between the light filtering capability of four portable dark chambers brands and check their influence on the quality of radiographic imaging in intra-oral films of different sensitivities.

Materials and Methods:

This study evaluated four portable dark chamber types with viewers in red acrylic polymer with varying sizes: Portable Dark chamber UNEMOL[®], MPG[®] (Manoel Pereira Goncalves Ind.), VH[®] and portable dark chamber without identifying the manufacturer and in use at the Dental Clinic of the Brazilian Association of Odontology of the Federal District (Fig 1).

The periapical films used in this research were periapical Kodak group D (DF-58 Ultra-Speed), Group E (E-Speed), Group F (Insight) and Agfa[®] Dentus M2. The dark chambers were placed on a table, located under two fluorescent lamps, daylight 40 watts of Osram brand, located at a distance of 2.17 m.

A dental X-ray machine Dabi Atlante[®] Spectro 70X with 70 kVp and 8 mA, with total filtration equivalent to 2.5 mm aluminum was positioned with a finder cylinder perpendicular in a focus-film distance of 30 cm from the radiographic film. The film was placed on a sheet of styrofoam to avoid back-scattered radiation. An aluminum step wedge with eight steps thickness covered part of the film and the remainder was covered by a lead plate which prevented completely the passage of the X-ray (Fig 2). For each film, several exposures were made in different times, and three evaluators determined the optimal exposure time for each group of film.

One hundred and twenty-five films were exposed to radiation in the conditions described above and divided into groups for processing. In each portable dark chamber were processed five films from each brand. In addition, five films from each group were exposed and processed in conventional dark chamber demonstrably protected from light entry, which is the control group.

The radiographic processing was conducted in solutions ready for use from Kodak[®] company, using the method temperature / time, with 3 minutes development time, and in every minute the film was approximated to the acrylic polymer and maintained for about 3 seconds, time required for viewing the image, simulating the dentist routine in the dental office. Then the films were subjected to intermediate water bath for 10 seconds and then, immersed in fixative for 4 minutes. Every 10 processed films, the solutions were changed to prevent damage, avoiding thus the interference of densities of X-ray in the following group (Fig 3).

The photodensitometric evaluation of radiographs was performed in the laboratory of Nuclear Energy, Federal University of Pernambuco (UFPE), using a digital densitometer 600B (Victoreen Inc., Ohio). The collected data were tabulated on a Microsoft[®] Excel 2003 and later were subjected to statistical tests of Mann-Whitney and Kruskal Wallis

with SPSS 13.0 for Windows®. All tests were applied with 95% confidence intervals and numerical variables were represented by measures of central tendency and dispersion measures.

Results

To evaluate the dark chambers, it was used the Mann-Whitney test (compared with two groups) where each brand (Unemol®, VH®, MPG® and

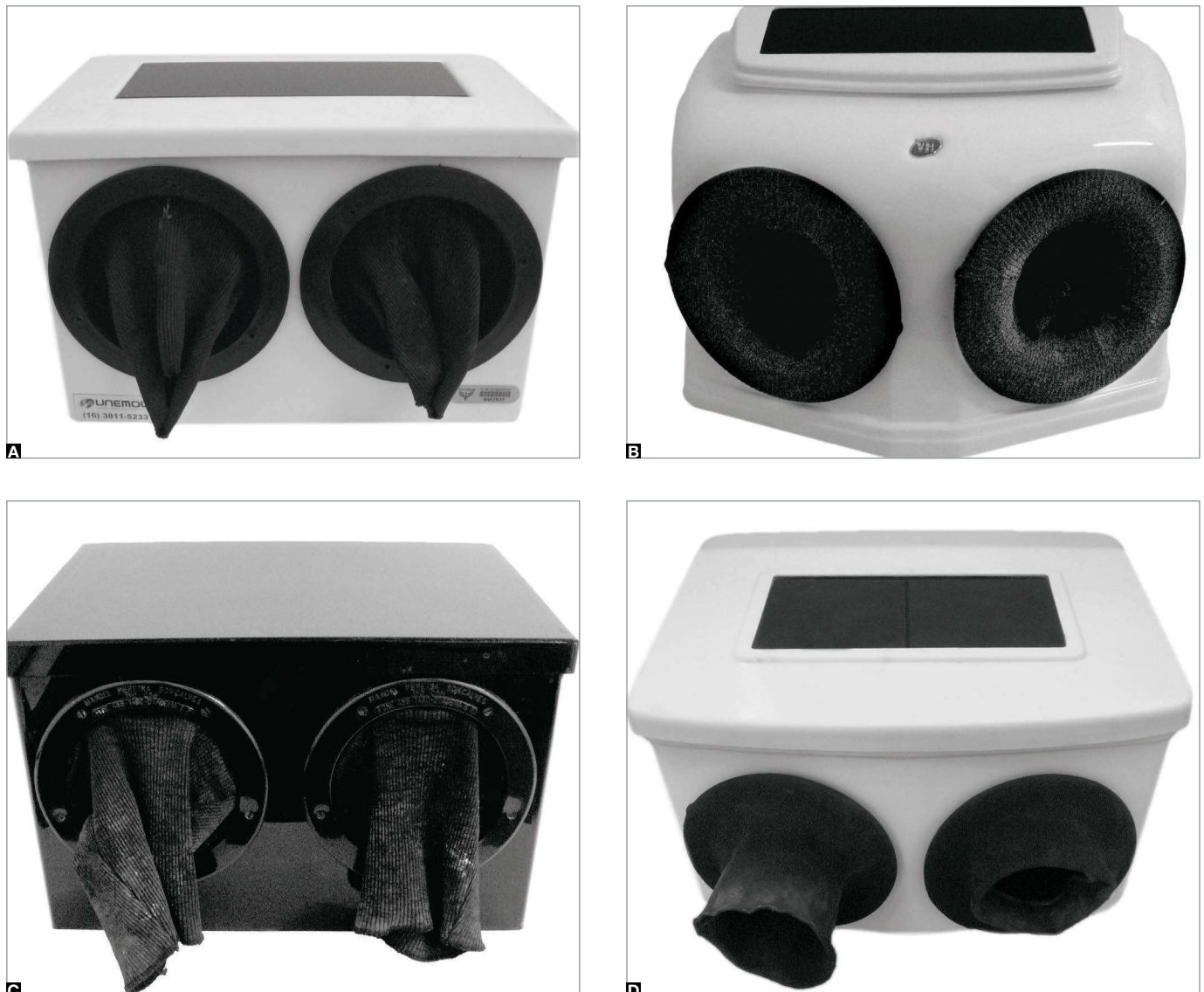


Figure 1. Portable dark chamber used in reseach **A:** UNEMOL® **B:** VH®, **C:** MPG® e **D:** Unbranded dark chamber.



Figure 2. **A)** X-ray machine positioned, radiographic film, lead plate and step wedge on the Styrofoam; **B)** Detail of lead and step wedge on the radiographic film; **C)** Aluminum step wedge.

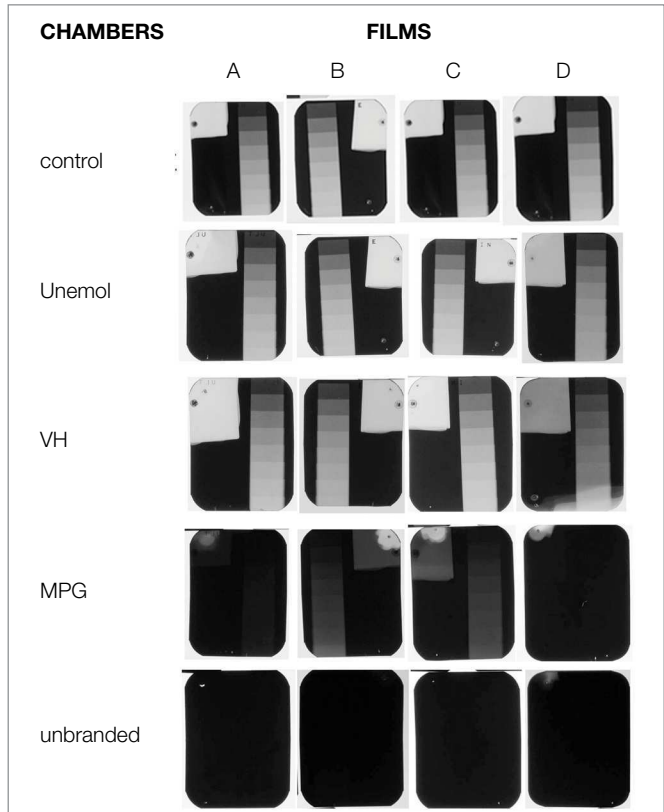


Figure 3. Films processed in the dark chambers: Control, Unemol®, VH®, MPG® and “Unbranded”. **A)** DF58 Ultra-Speed, **B)** E Speed, **C)** Insight (KODAK), **D)** AGFA® Dentus M2.

unbranded portable dark chamber). Then they were compared to the control group, taking into account each type of film used (Table 1). There was a statistically significant difference between the portable dark chamber Unemol® and the control one, when using the Kodak DF-58 and Agfa Dentus M2 films, which did not happen when using the Kodak E-speed and IP 21 Insight. For the brand VH®, there was a statistically significant difference in the control group when using all films except the IP 21 Insight film. For MPG® and unbranded portable dark chamber, there was a statistically significant difference in the control group when using all films.

To compare the films, it was used the Kruskal-Wallis test (compared with more than two groups),

Table 1. Mann-Whitney test comparing each brand of dark chamber with the control group, taking into account the film used.

FILM	PORTABLE DARK CHAMBER BRANDS				
	Control	Unemol	VH	MPG	Unbranded portable dark chamber
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
DF-58 Ultra-Speed	0.19±0.006	0.21±0.011**	0.28±0.031**	2.42±0.102**	4.59±0.399**
E-Speed	0.16±0.007	0.16±0.004	0.26±0.185**	1.22±0.075**	3.27±0.290**
IP-21 Insight	0.22±0.011	0.22±0.012	0.22±0.014	1.34±0.089**	3.77±0.494**
Agfa Dentus M2	0.24±0.011	0.28±0.021**	0.54±0.077**	3.70±0.230**	4.79±0.344**

(*) Mann-Whitney Test.

(**) P value ≤ 0.05 compared to control group.

Table 2. Kruskal-Wallis test to compare the films to each other.

FILM	Mean	Standard deviation	p-value*
DF-58 Ultra-Speed	1.54	1.792	0.003
E-Speed	1.01	1.230	
IP-21 Insight	1.19	1.439	
Agfa Dentus M2	1.98	1.996	

(*) Kruskal-Wallis Test.

which showed a statistically significant difference between the films evaluated (Table 2).

Discussion

Radiographic examination should present a good image quality because it aims to diagnose bone and soft tissue lesions.¹ The professional must have scientific knowledge and respect all phases of obtaining radiographic image, from the technique execution to the end of the process. The image density, contrast, sharpness and blurring are influenced by processing and may result in different characteristics when the film is subjected to different processing conditions.^{4,5}

Several studies have been conducted in order to verify the influence of types of processing solutions,⁶ the types of radiographic processing,^{5,7} temperature,⁸ revelation,^{9,10,11} exhaustion,^{12,13} degradation⁵ and the final wash¹⁴ in image quality. However, studies of portable dark chamber and its influence on the radiographic image are rare.

The 453 Ordinance of the Ministry of Health began to regulate the exercise of Medical and Dental Radiology in Brazil. This standard requires that for the manual processing of intraoral radiographs is allowed to use portable dark chamber, provided that

they are made of opaque material and is provided with thermometer and timer for the use of the method temperature / time.

Some researches indicate that portable dark chambers with transparent acrylic polymer cause opacification on radiographs and allow the processing realization by the inspeccional method,² which was banned by 453 Ordinance, to lead to a lack of standardization and loss of image quality.⁹ In this study we evaluated the ability of light filtering through acrylic polymer of four portable dark chamber brands and found its influence on radiographic image quality (base and blurring) of four intra-oral films of different sensitivities. Visually, the radiographs processed in VH[®] and Unemol[®] portable dark chambers did not have significant differences in relation to the control group (conventional dark chamber), but statistical analysis showed a significant difference between control groups and all the dark chambers, with the exception of Unemol[®] when using the Kodak E-Speed film and IP-21 Insight and VH[®] camera when using the IP-21 Insight film. These findings corroborate the results obtained by Watanabe et al¹⁵ which indicated that the chambers of clear acrylic allow light passage causing blurring and then, increasing density and contrast of the radiographs.

Among the studied films, the Agfa Dentus M2 showed the highest density base-veiling in the control group and all portable dark chambers. For the control group and the portable camera with the best results (Unemol[®]), the decreasing sequence of base-blurring was: Agfa Dentus M2, Kodak IP-21 Insight, DF-58 Ultra-speed, E-speed. In other portable dark chambers the results were: Agfa Dentus M2, Kodak Ultra Speed DF-58, E-Speed and Insight, except the dark chamber without identifying where there was reversal of the last two films.

It is suggested that further studies be developed on the issue. Other brands should be investigated because, despite advances in intra and extra-oral digital radiographic systems, conventional radiographic systems and portable dark chambers with acrylic display are widely used in dental offices in Brazil¹⁶ and the lack of knowledge by the dentist about the need to follow some rules and procedures

may affect the image quality and diagnosis.

Conclusion

The present study suggests that the acrylic display of portables dark chambers used in dental offices increases the base density and blurring, jeopardizing the quality of the radiographic image and the correct diagnosis.

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