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RESEARCH ARTICLE

COMPARATIVE STUDY OF DURABILITY AND DETERIORATION REVEALING AND FIXERS SOLUTIONS FOR IMAGE RADIOGRAPHIC

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ABSTRACT

Background: In Brazil, between 2009 and 2016, the number of diagnostic imaging grew on average 51.35%. Radiographs are complementary tests of extreme importance to close dental diagnosis and map out a plan of treatment.
Objective: The objective of this study was to compare the degradation and durability of processing liquid solutions of x-rays films, the Kodak brand in open containers (unprotected solutions) and sealed in opaque plastic containers and lids (proprietary solutions) within the darkroom.
Methods: For this work we used 20 Ektaspeed periapical films manufactured by Eastman Kodak Company, Rochester, USA, classified as a group and as sensitivity, maturing for 18 months after the experimental phase, processing solutions (developer and fixer) Kodak conventional. The main variables predicting response to this work were the sensitometric properties of processing solutions such as Contrast, Optical Density and Latitude. The main continuous and categorical predictor variables were air oxidation.
Results: The results were analyzed using descriptive statistics and analysis of regression and Durbin-Watson in relation to predicting response and continuous and categorical predictors, following the confidence level of 95%. It was observed that the container was in the liquid solution in a closed container (protected solution) showed less degradation and durability, while the open container was 70% higher degradation of the container to the protected solution. Also, after regression analysis between the response predictor protected degradation and continuous predictor Contrast (P) Optical Density (P) and latitude (P) was obtained in all cases $p = 0.01 < 0.05$ and residue analysis Durbin-Watson of 2.16. The same analysis was performed for the degradation predictor response deprotected and continuous predictor Contrast (D) Optical Density (D) and latitude (D), yielding in all cases $P = 0.03 < 0.05$ and analysis of waste Durbin Watson 2.5.
Conclusion: Already be concluded that both chambers were maintained at the same temperature with the same local light and moisture, at the same time with the same number of films disclosure, this degradation occurred by the action of oxygen.

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INTRODUCTION

In Brazil, between 2009 and 2016, the number of diagnostic imaging grew on average 51.35% (Brasil, Departamento De Informática Do SUS – DATASUS, 2016). The number of X-rays in dentistry has remained constant in developed countries, but has increased substantially in developing countries representing approximately 20% of radiological examinations performed worldwide in recent years (Brasil, Departamento De Informática Do SUS – DATASUS, 2016; Rosa *et al*., 2016). Radiographs are complementary tests of extreme importance to close dental diagnosis and map out a plan of treatment (Rosa *et al*., 2016). The choice of the most sensitive films and higher speed are always preferred, for minimizing the radiation dose received by the patients, thereby reducing the risk radiobiological (Rosa *et al*., 2016; Guimarães *et al*., 2015; Cavenago *et al*., 2014). The choice also following questions

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when the shorter exposure time to x-rays, absence of contrast or resolution loss and obtaining a radiographic image suitable for an accurate diagnosis. These questions can be changed directly by processing solutions and degradation (Guimarães *et al*., 2015). The objective of this study was to compare the degradation and durability of processing liquid solutions of x-rays films, the Kodak brand in open containers (unprotected solutions) and sealed in opaque plastic containers and lids (proprietary solutions) within the darkroom.

MATERIALS AND METHODS

Study Design

For this work we used 20 Ektaspeed periapical films manufactured by Eastman Kodak Company, Rochester, USA, classified as a group and as sensitivity, maturing for 18 months after the experimental phase, processing solutions (developer and fixer) Kodak conventional, portable darkroom brand GOLD LINE - ESSENCE DENTAL VH, X-ray machine - XDENT, Sn.13064700. two dark chambers were used. At first the opaque plastic containers are closed with covers (proprietary solutions) and the second was kept open (unprotected solution) for a period of ten days. During this period it revealed a film in each chamber every day, at 12:00 pm, for 30 seconds in the developer and fixer in 4 minutes, totalizando10 films a darkroom.

Predictors Response

The main variables predicting response to this work were the sensitometric properties of processing solutions such as Contrast, Optical Density and Latitude.

Predictors Continuous or Categorical

The main continuous and categorical predictor variables were air oxidation.

Statistical Analysis

A total of 20 samples and within 10 days, the data were grouped into n = 10 for protected and n = 10 for unprotected solutions. The results were analyzed using descriptive statistics and analysis of regression and Durbin-Watson in relation to predicting response and continuous and categorical predictors, following the confidence level of 95%. 17 Minitab software was used.

RESULTS

It was observed that the container was in the liquid solution in a closed container (protected solution) showed less degradation and durability, while the open container was 70% higher degradation of the container to the protected solution. Moreover, after descriptive statistics, the average for "degradation (Protected)" was 1.00 and for "degradation (Unprotected)" was 2.00. The number of repetitions to "degradation (protected)" relative to "no = 1" was 8 of 10 and "unprotected degradation" with respect to "no = 1" was 1 to 10. Likewise, the number repetitions for "Contrast (P)," "optical density (P)" and "Latitude (P)" in relation to "no = 1" was 7.8 and 10 respectively As for "Contrast (P)", "Optical Density (P)" and "Latitude (P)" in relation to "no = 1" was respectively 1.2 and 2 (Figures 1 and 2). Also, after regression analysis between the response predictor protected degradation and continuous predictor Contrast (P) Optical Density (P) and latitude (P) was obtained in all cases p = 0.01 <0.05 and residue analysis Durbin-Watson of 2.16. The same analysis was performed for the degradation predictor response deprotected and continuous predictor Contrast (D) Optical Density (D) and latitude (D), yielding in all cases P = 0.03 <0.05 and analysis of waste Durbin Watson 2.5.

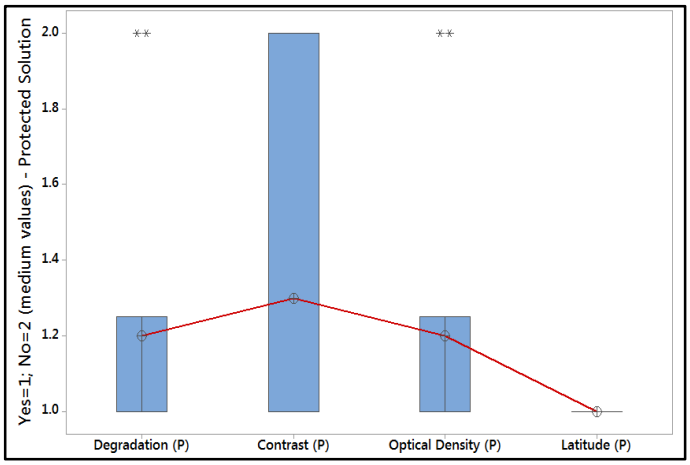

Figure 1. Graph showing the correlation between continuous predictors "contrast (Protected)", "Optical Density (Protected)" and "Latitude (Protected)" response predictor "degradation (Protected)"

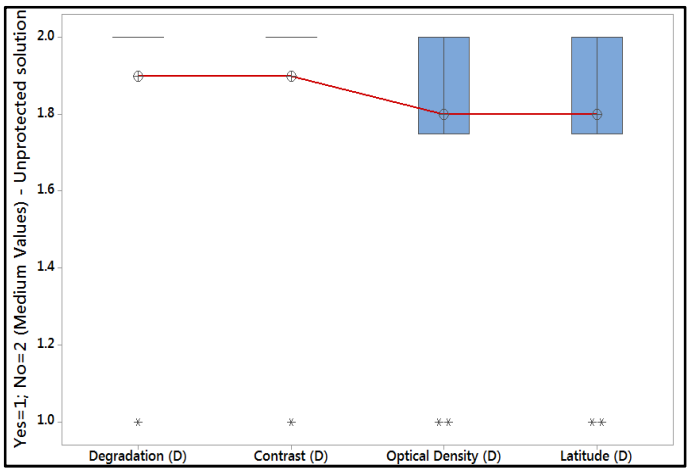

Figure 2. Graph showing the correlation between continuous predictors "contrast (Unprotected)", "Optical Density (Unprotected)" and "Latitude (Unprotected)" response predictor "degradation (Unprotected)"

DISCUSSION

Regarding the results, it was confirmed that the radiographic imaging solution can suffer external influences and compromise the quality of the sensitometric properties, ie there is a significant correlation between loss of quality of these properties with the degradation of the solution when unprotected. The processing solutions can undergo several changes that may interfere with the sensitometric properties

(contrast, optical density, latitude) of radiographic films. Among these changes there is the degradation that is the deterioration suffering these solutions by air oxygen action, security lights, preparation time and quantity of developed films. In the literature, we found results similar to those found in our search for the degradation group where we observed that the developing solution was degraded within 10 days of the study (Rosa *et al*., 2016; Guimarães *et al*., 2015). However, other studies on the degradation occurred over a period of 62 and 180 days, respectively, when it was stored in a tank with a capacity of 5 liters and capped when not in use (Cavenago *et al*., 2014; Baratieri *et al*., 1984). The chemical processing of films is such an important step as patient positioning and the choice of exposure parameters in the search for quality images. The films must be processed in appropriate facilities so that prevent the veil of training. intraoral X-rays can be processed in 31 portable cameras, provided they are made of opaque material (Rosa *et al*., 2016; Guimarães *et al*., 2015; Cavenago *et al*., 2014). Portable cameras are composed wholly or partly by acrylic polymers, and the own film protective filter against the action of light. With gloves have two openings connecting the external environment to the interior (Baratieri *et al*., 1984). Inside the processing chamber are set at least three containers, with developer solution, fixing solution and with at least one with water. However, because they are portable and are subject to various environmental lighting conditions, it is necessary to evaluate and properly establish the location of the lighting parameters (Cavenago *et al*., 2014). These lighting conditions relate both to the type of light source and the intensity of the source in question (Cavenago *et al*., 2014; Baratieri *et al*., 1984). The three light sources commonly used in dental offices are: natural sunlight, artificial light from filament lamps and artificial light from fluorescent lamps. The main chemical processing conditions which affect the diagnostic image is the sealing and cleaning the developing chamber, the concentration and degradation of the solutions (developer and fixer), the developer temperature and film processing time (Baratieri *et al*., 1984; Khademi, 1996; Montebelo, 1991). The processing time in each step may vary depending on the recommendations of the manufacturer of films and chemicals. The developing solutions are also to be changed or regenerated according to the manufacturer. All stages of the chemical processing of the films should be made protected from light (Pistóia and Filho, 2002; Ribeiro and Tavano, 1993; Silveira *et al*., 1986).

Conclusion

Already be concluded that both chambers were maintained at the same temperature with the same local light and moisture, at the same time with the same number of films disclosure, this degradation occurred by the action of oxygen.

Competing interests

The authors declare queue they have no competing interests.

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