

EXPOSURE SURVEY IN ORAL RADIOLOGY USING A POSTAL SYSTEM

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The authors present the results of an exposure evaluation program in Oral Radiology carried out by the Institute of Radiation Protection and Dosimetry (IRD) of the Brazilian Nacional Commission on Nuclear Energy. They are related to approximately 1000 dental X-rays units surveyed in the area of Rio de Janeiro from 1981 to 1983 (Pe82).

The postal system used in the survey has to be exposed by the dentists and they also have to answer questions concerning the technical characteristics of the X-rays machine, the radiographic film and the average number of examinations performed per month. The exposures at the skin entrance for a single exposure of a standard dental irradiation (upper molar region) were measured with TLD dosimeters.

This survey shows four main results of interest in future programs:

1. the exposure distribution at the skin entrance for the standard examination ranges from 2 mGy to 40 mGy, what can be seen in the histogram presented in figure 1. The exposures measured above 5 mGy are mainly due to the lack of proper use of the exposure time control, and consequent incorrect film processing (HEW76).

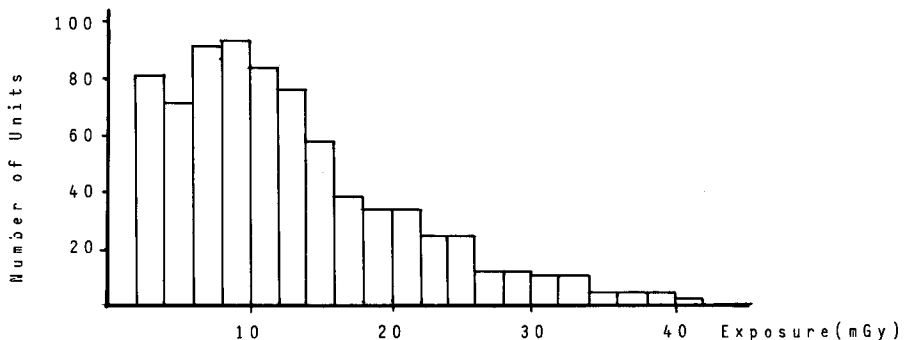


Figure 1. Distribution of the skin entrance exposures for the upper molar region examination measured with the postal kit.

2. the frequency distribution of the number of examinations performed monthly indicates that is possible to identify groups of dentists responsible for the exposure of large fractions of the

examined population. Two groups of professionals were identified. To the first group belong the dentists who make from 10 to 100 examinations per month. They are 85% of all professionals but they make only 26% of the examinations. This means that in the second group are found just 15% of the dentists, who are responsible for 74% of the examinations.

3. making provisions so that the data obtained in the survey will be used in the evaluation of organ doses and, consequently, collective effective dose equivalent to the population undergoing dental examinations, the postal system measures the field size at the plane of the skin entrance and the half value layer of the X-rays beam.

4. X-rays machines surveyed come from different factories with the predominance of equipment made in Brazil. In regard to the film supply, it is done only by two factories, and Kodak has approximately 90% of the market.

As it was stressed before, incorrect processing of the film is one of main causes of the high exposures detected. In order to provide a more comprehensive approach to the program, it was recently developed a method using a postal system for testing the development of intraoral radiographs in dental offices.

Basically, the method consists of sending to a dentist a postal kit containing two pre-exposed periapical films, both having the same image. The right half registers the latent image of the molar region of a mandible phantom, and the left half contains four optical densities (base+fog, 0.25, 1.00 and 2.00 above base+fog density, when the film is appropriately developed). The four optical densities are used to determine the mean optical density (\overline{OD}) of the image.



2	4	5
1	3	

1. BASE + FOG DENSITY

2. REFERENCE DENSITY 1

3. REFERENCE DENSITY 2

4. REFERENCE DENSITY 3

5. MANDIBLE PHANTOM IMAGE

Figure 2. Standard image used in the film development tests.

A questionnaire is also included in the kit to obtain the necessary data for the evaluation of the resulting images. The questions concern to the developing procedure adopted by the dentist, the darkroom or portable sink's maintenance procedures, dentist's speciality, comparison of the obtained images in the routine praxis and the standard image sent in the kit, etc...

Currently, the following scheme has been adopted: one film is developed according to the dentist's normal procedure, and the other for three minutes in the same developer solution. By comparing these two developed films with a similar standard image (processed at the IRD), and by applying a statistical method specially developed for this purpose, it is possible to evaluate the procedure followed by the dentist in developing the radiographs, the developer solution activity, and the darkroom or portable sink integrity (HHS83).

The statistical method used to evaluate the developing procedure adopted by the dentists correlates the variation of the mean optical density ($\Delta\%OD$) of the images sent to them, and developed in their offices, with the probability of concordance that these images are identical to a standard one. The probabilities of concordance were obtained when a so called "judges test" was applied. In this test, films having the same latent image and developed from 0.5 minute to 8.0 minutes, were submitted to dentists of different specialities (radiology, endodontics, surgery, general practice, etc.). They pointed out those in which the obtained image was considered to be identical to the standard image. Taking the judges's answers, the probabilities of concordance were determined and plotted against the percent variation of the mean optical density ($\Delta\%OD$) of the image, as shown in figure 3.

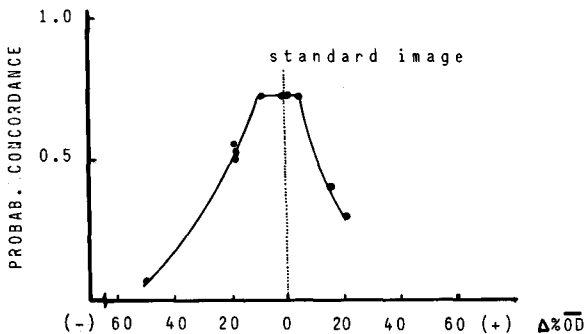


Figure 3. Probability of concordance of judgements as function of variation of the mean optical density of radiographic image.

According to the "judges test" , it was established acceptance limits for the mean optical density of the image developed in the dentists' offices. Images having mean optical density (\overline{OD}) between -10% and +5% of the \overline{OD} of the standard image have 72 % of probability of being considered as identical to the standard image.

In 31 dental offices surveyed by this program, 26 have presented images with \overline{OD} either lower than -10% or higher than +5% of the \overline{OD} of the standard image, with predominance of films processed at very short developing times. It can be seen from the fact that in 18 images the \overline{OD} was lower than -30% ! Besides, 7 images have presented intense film darkening (fog) and only 8 developing solutions could be considered well active.

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