RADIATION FIELD SIZES AND SKIN EXPOSURES IN ORAL RADIOGRAPHY

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INTRODUCTION

The increasing use of x-rays in preventive and diagnostic dentistry in Brazil has been cause of concern because dentists, in general, are not acquainted with the basic principles of radiation protection. Recently, the Brazilian Ministry of Health has urged the Departments of Health at the state level to develop actions to register dental x-ray units in their area of jurisdiction and to issue operating permits to those facilities which satisfy some basic technical requirements. On the basis of these recommendations the Instituto de Radioproteção e Dosimetria of the Brazilian Commission of Nuclear Energy has initiated a postal program to assess the performance of dental x-ray sets in the State of Rio de Janeiro (1). The postal kit used in that survey was similar to the one developed by the Bureau of Radiological Health of the U.S. Department of Health, Education, and Welfare (2). In continuation to that study, the Nuclear Energy Department of the Federal University of Pernambuco initiated a survey of dental x-ray apparatus to evaluate the operating conditions of that kind of equipment in Recife, the capital of the State of Pernambuco. The objectives of the survey were: a) to assess the degree of compliance of the equipment and procedures adopted by the dental practitioners in Recife with the accepted radiation protection standards, and b) to estimate the magnitude of the exposure to the patient resulting from a typical dental radiographic procedure.

METHODOLOGY

Data collection was made through both office visits and irradiation of dosimetric packs similar to the postal packs used at the survey carried out in the State of Rio de Janeiro (1). Each pack contains four LiF thermoluminescent chips (TLD-100), a 3-mm aluminum filter and two periapical films which are used to determine beam filtration, radiation field size, and skin dose to the patient. In each facility to be inspected the dosimetric pack was placed over a cubic water phantom and the end of the cone of the x-ray equipment was positioned over the center of the pack. The irradiation was performed by the dentist according to the procedure he (she) would use to get a standard maxillary molar radiograph. Therefore, it would be possible to compare the results of different technical procedures aiming to get the same radiographic picture. Besides, the dentists were asked to fill a form answering questions concerning the number and type of film used, the exposure time, the use of radiation protection devices, etc. The data gathered were used to determine patient skin exposure, radiation field size, and total beam filtration. This preliminary study comprised 76 x-ray sets, the majority of them made in Brazil. Most of the units operate at 50kV or 60 kV, since 70 kV x-ray sets are not common in dental offices in Recife.

RESULTS AND DISCUSSION

Figure 1 shows the range of beam diameters determined in this study. The data show that 34% of the units surveyed have beam diameters below the limit set by the Brazilian Association for Technical Standards - ABNT (4) and that 76% of the sets have beam diameters within the limit recommended by the NCRP-35 (3). It can be noticed that, despite the fact that most of the units are made in Brazil , the manufacturers adopted the NCRP limit of 7.5 cm as the standard for the beam diameter. On the other hand, 24% of the inspected units present field diameters exceeding the 7.5 cm limit. It means that a larger than necessary area of the skin face of the patient is being exposed, and that both patients and staff members receive higher radiation doses due to scattered radiation than they would receive if proper field sizes were used.

Figure 2 illustrates the distribution of skin exposures resulting from simulated maxillary molar radiographs taken in the offices surveyed. The results show that 67% of the x-ray units produce radiation exposures above the recommended value of 500mR (3). Moreover, 13.5% of the skin exposures were six times greater than the acceptable exposure for that type of radiography.

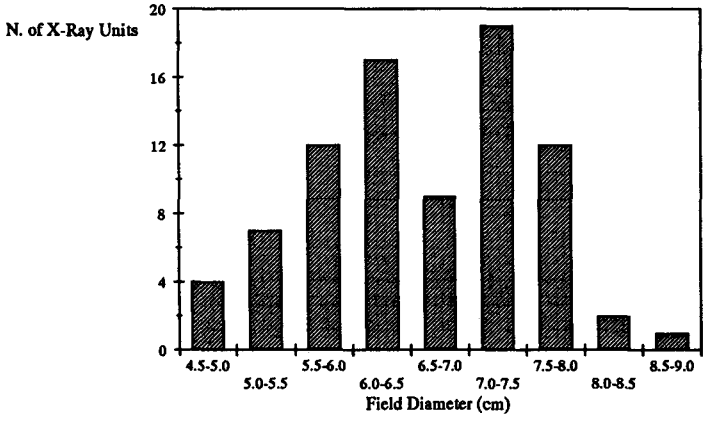

Fig. 1- Beam diameter distribution for the units surveyed.

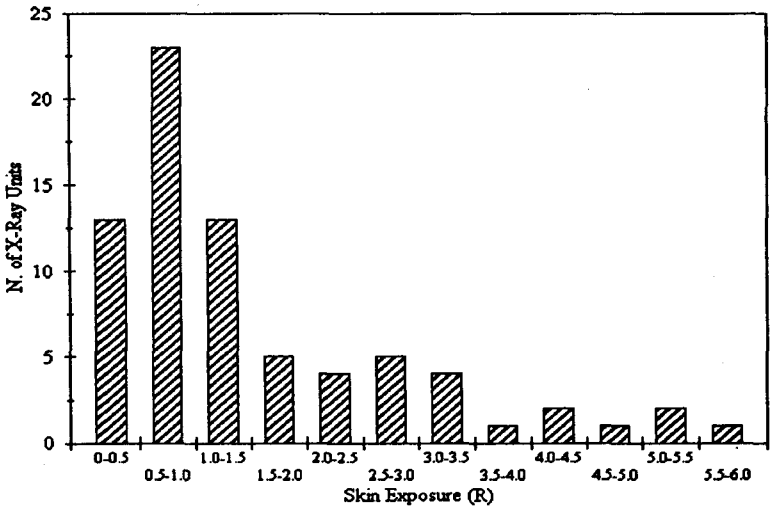

Fig. 2 - Distribution of skin exposures resulting from a standard maxillary molar radiography.

The causes for these excessive exposures are not different from those described elsewhere, specifically, insufficient filtration of the beam, too long exposures, and inadequate film processing. In fact, it was observed that dentists usually use old processing solutions and insufficient film developing times, compensating the inadequate procedure by increasing the exposure time. This is reflected in Fig. 3 that shows the distribution of exposure times used by the dentists surveyed. It can be noticed that 58.7% of the dentists adopt a exposure time around 1.0 s for the maxillary molar radiography, in spite of the fact that the majority of them use Ektaspeed film. Only 8.3% of the dentists utilize exposures of less than 0.5 s, which is considered to be adequate to get images with the Ektaspeed film without loosing radiographic quality. These results support the necessity of educating the dentist with respect to both film processing and radiation protection procedures.

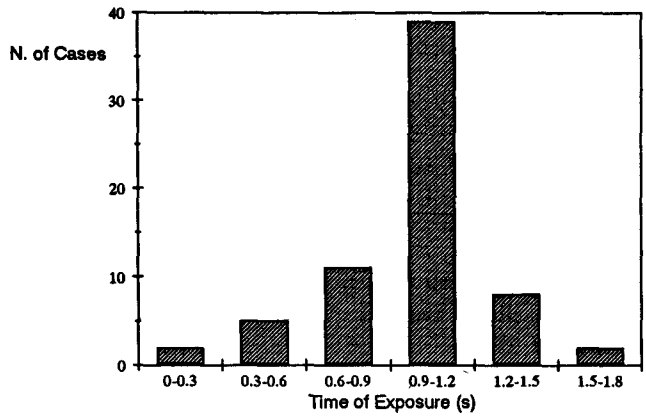

Fig. 3- Distribution of the exposure time used by the dentists surveyed.

The use of adequate beam filtration was also analyzed. The standard adopted recommends that the total filtration of the useful beam should not be less than 1.5mm Al for x-ray units operating at potentials between 50 and 70 kV [3]. However, the results show that 43.6% of the x-ray units surveyed do not meet this standard. The inadequate filtration results in an increase in the dose to the patient and to the dental staff, without contributing to the quality of the radiograph. Both the skin exposure and beam filtration distributions found in this survey are similar to those found by Peixoto and Ferreira (1) in the postal program developed by the IRD, in Rio de Janeiro. These findings reinforce the need of implementing a nationwide program to control the operating conditions of the x-ray dental units in Brazil. This program must be complemented by the training of dentists in the radiation protection procedures.

REFERENCES

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