Dosimetría en torno a una unidad de radiodiagnóstico dental

Dosimetry around a dental radiology unit

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Resumen

Mediante dosimetría termoluminiscente se han medido los valores del Kerma en aire en la superficie del rostro de un maniquí, que representa a un paciente odontológico. También se midió la Dosis equivalente ambiental sobre la superficie del cabezal de un equipo de rayos x dentales debido a la radiación de fuga. La dosis en la superficie de entrada del haz en el rostro de paciente fue inferior al nivel orientativo para una radiografía dental. Se encontró que existe fuga de radiación en el cabezal del equipo.

Palabras clave: radioprotección, rayos x, dentales, dosis, TLDs.

Abstract

Dosimetry with thermoluminescent measured values of Kerma in air at the surface of the face of a mannequin, which represents a dental patient. Was also measured the ambient dose equivalent over the surface of the head of a team of x-ray dental due to leakage radiation. The dose on the surface of the beam entrance in the face of patient was less than the guideline level for a dental Radiography. We found that there is leakage radiation at the head of the team.

Key words: radiation protection, x ray, dental, dose, TLDs.

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Introduction

By the images obtained with x-ray x obtained details of the internal structures of the body due to the difference in the densities of the different tissues and organs, this use is called Radiology. Also, x-rays are used as a non-invasive technique for the treatment of tumors (Vega-Carrillo et al., 2008).

The distribution of x-rays as a function of their energy is known as spectrum and this has a continuous part and other discrete (Vega-Carrillo and Baltazar-Raigosa, 2011), which occurs via two mechanisms of interaction between the electrons, and the matter.

The first mechanism of interaction is when an electron beam is accelerated by a voltage difference and are made to collide with a target of high atomic number. In the x-ray equipment usually whites are made of Tungsten, Rhodium or Molybdenum. Due to the difference in voltage (usually expressed in kV) all electrons have the same kinetic energy (expressed in keV) and reaching the target interact through forces Rutherford with the electrons in the orbits of atoms in the target. In this interaction are diverted from its initial trajectory and lose some of their energy which translates into x-rays; This type of rays x are called braking radiation or ***Bremsstrahlung***. X-rays of braking have a continuous distribution of energy ranging from the few eV to the keV for the case of the diagnostic equipment, and even the MeV for radiotherapy equipment.

The second mechanism of interaction occurs with the electrons of the electronic layers of atoms in the target producing their ionization. The generated vacancy is occupied by another electron, of upper layers, which gives the excess energy in the form of x-rays when dealing with that State. As States of energy in the layers of atoms are discrete, the emitted photon has a unique or discrete energy value; you call these photons discrete or characteristic x-ray. Figure 1 shows the spectra of x-rays produced by electrons from 28 keV interacting with white W, Rh and Mo. The figure points out the continuous and discrete part of x rays.

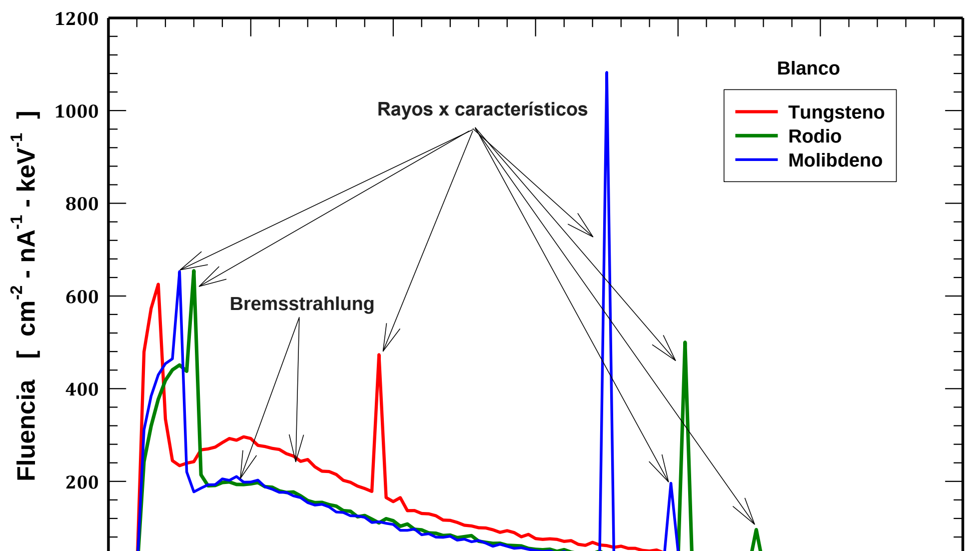

Figure 1. X-ray spectra

One of the functions of radiation protection is to protect the user of ionizing radiation, the values for this maximum allowable annual effective dose for occupationally exposed and the public is established. These values do not apply in the case of patients, however, guidance levels for each type of study are recommended. In the case of a dental x-ray the exact level is 7 mGy (DND 1997). At the international level it has been recommended even perform patient dosimetry and operator of the x-ray unit (ICRP, 1990; IAEA, 1996). For dental radiography equipment have been some studies that have reported varying dose of 5.7 mGy to the air kerma (Ka) on the surface of the patient that is located at the entrance of the beam (face Azorin et al., 2015) and 0.5 to 0.7 mGy for different dental radiographs (Aquino et al., 2010). For the case of a periapical they were reported Ka values ranging from 60 mSv / x to 3 mSv / x-ray radiation to leak and from 0.07 to 2.60 mGy / x in the face of the patient and 60 mGy / radiography Dentist torso located 40 cm from the patient (Vega-Carrillo et al., 2015).

During their training, the dentist takes the competition to manage a unit of x rays, obtain, and interpret the radiograph. However, in the community of professionals Health Sciences prevailing idea that radiation produced by x-ray equipment is small and, therefore, is not dangerous (Dellie, Admassie and Ewnetu, 2014).

The Academic Unit of Dentistry of the Autonomous University of Zacatecas has comprehensive oral health services for the population that also serves as a learning space for students. An important step in training is the use of x-ray units.

Goal

The aim of this study was to measure the dose levels around the head of a unit of dental x to assess ray radiation leak and determine the dose received by a patient when taking a radiograph.

MATERIALS AND METHODS

The study was conducted at the Academic Unit of Dentistry, Guadalupe campus with a team CORAMEX, COR-70 / 8-03 model, which has an x-ray tube model OX-70-P. In order to evaluate ambient dose equivalent (H * (10)), at the top, back and side of the head assembly portadosímetros placed. Mg, Ti, known as TLD100: Each portadosímetro 4 NatLiF thermoluminescent dosimeters placed. The team shot 4 times using 70 kV and 8 mA, each firing lasted about 0.6 seconds.

Figure 2. Tubo de equipo de Rx

Figure 3. Cabezal de equipo de Rx

To measure the dose in terms of Ka patient a dummy or phantom was used. This 4 portadosímetros two were placed on surfaces at the entrance and exit of the x-ray beam, another on the surface above the left eye and the third was placed in the neck, approximately where the thyroid gland is, as shown in Figure 2. for this measurement the same conditions used in measuring the leakage radiation used.

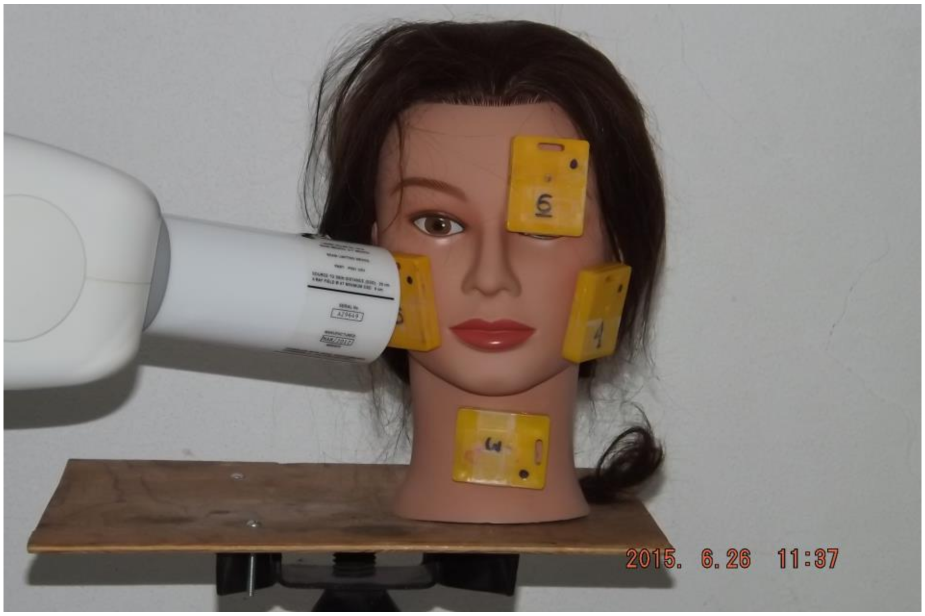

Figure 4. Fantoma del paciente

Once the radiation dosimeters are read with a Harshaw TLD reader 3500. The answer was obtained by heating the TLDs of 50-300 ° C with a gradient of 10 ° C / s. With responses of the 4 TLDs each portadosímetro the average corrected for the contribution of the background radiation was calculated, the resulting values are used to determine the ambient dose equivalent, H * (10) due to radiation leakage head and air kerma fantomas surfaces for each radiographic takes.

RESULTS AND DISCUSSION

The values of H * (10) due to radiation leaks from head to make a periapical shown in Table 1.

Table 1. H * (10) by radiography due to the leakage of the head

Posición	H*(10) [mSv/radiografía]
Lateral	55 ± 15
Superior	72 ± 14
Posterior	61 ± 9

The highest dose due to leakage was found on top probably due to scattering of x-rays into the X-ray tube; due to the symmetry of the head of a similar dose is expected on the bottom of the head. The lowest dose was found in the side portion of the head, probably because the distance between the tube blank and this section. These values allow to take operational measures for the use of such equipment since it is not safe to be near the head and the plant operator must never stand in the direction of the output beam.

Kerma values shown in Ka air in Table 2, for each shot of the equipment. The highest dose observed in the entrance surface of the beam and is less than 7 mGy recommended (DND 1997) and coincides with that observed in similar studies with different teams (Aquino et al., 2010, Azorin et al., 2015; Vega-Carrillo et al, 2015).. The Ka in the entrance surface of the patient is approximately 63 times the dose and output surfaces of the patient's face. This implies that in the dispersion of the x-rays reach the thyroid gland and lens.

Table 2. Kerma in air radiograph surfaces mannequins

Posición	K_a [mGy/radiografía]
Superficie de entrada del paciente	4.38 ± 0.10
Superficie de salida del paciente	0.07 ± 0.01
Región ocular	0.07 ± 0.01
Región del cuello	0.11 ± 0.01

In practical situations, the dentist is around the head and received a dose, which although small is unnecessary. During the taking of the radiograph the patient receives the highest dose, but at the same time the patient's risk is offset by the benefit it brings to making diagnosis radiography; however, the dentist does not receive any benefit, so that the dose received is not justified. With these values it is recommended that during the operation of an x-ray unit, the dentist is placed at least 1 m away and under no circumstances be placed in the beam area.

CONCLUSIONS

Thermoluminescent dosimetry means are measured values of ambient dose equivalent due to radiation leakage from a dental x-ray head and the Kerma was measured in air over the surfaces of the face of a phantom of a patient. From the above, the key findings are:

• During shooting of a dental x-ray radiation leak it exists head x-ray equipment.
• The dose levels in the patient are less than 7 recommended by the Norma Oficial Mexicana as reference values for periapical mGy.

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