

Development of an object test to dental image verification

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Abstract

An object test was developed to verify the dental images best quality in relation to the exposition time. It consists of high purity perforated aluminum plates, with different thickness and dimensions of 3 x 4 cm. The plates were covered by acrylic, making its total thickness of 3.0 mm. It was irradiated together with the film from 0.1 to 0.5 seconds. The irradiation of 0.2 s showed the best image, reducing the regular time exposition in 0.3 s.

Keywords : dental diagnostic radiology, image quality, quality control, time exposition

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Introduction

Quality assurance programmes in diagnostic radiology have been increased in the last years due to the fact that the extensive use of X-rays in medicine for diagnosis of injuries and diseases represents the largest man-made source of public exposure to ionizing radiation (Bushong, 1997). Many international organizations have published documents with radiation protection recommendations, including to dental practice (SEFM, 2002; EC, 2004; NCRP, 2003). The main objective of those publications is to provide methods and procedures for radiation protection in the use of x rays in order to eliminate unnecessary radiation exposure to patient and to ensure that exposures are within recommended limits and meet the ALARA principle. To meet the goals the assessment and control of the image quality is an essential part of a quality assurance programme.

The Brazilian Health Ministry Regulation 453, published in June 1998, established basic lines of radiological protection in medical and dental diagnostic radiology, in order to guarantee the health of patients, workers and of the public (Brazilian Health Ministry, 1998). In dental area, one of the recommendations of this regulation is the evaluation of the radiographic image quality throughout an object test (standard phantom) in relation to contrast, clearness, sensibility (Yakomakis et al, 2001; Kunzel et al, 2003; Servomaa, 1993).

The objective of this work is the development of an object test order to verify the best quality of the image in relation to the smaller exposition time in dental diagnostic radiology systems. It would be applied in dental clinics, in order to

achieve an improvement in the radiological image qualities and the patient dose reduction.

Materials and Methods

To simulate a medium tooth it was used high purity aluminum plates (>99.9%), with thickness varying from 0.05 to 1 mm, with the same dimension of the dental X-ray films, 3x 4 cm. The plates were overlapped and perforated using a dental engine with holes from 0.05 to 0.7 of depth. After that, the plates were covered by an acrylic plate. The perforated plates can be seen at Figure 1.

The holes diameter was varied from 0.25 to 1.0 mm. The aluminum plates together have 1.5mm of thickness recovered by an aluminum plate of 1.5 mm. Its total thickness is 3.0 mm, as can be seen at the Figure 2.

Results

The film characteristic curve describes its optical density variation (blackening level) related to the exposure time. In this work this curve was obtained throughout films irradiations with exposure times from 0.1 to 1.5 seconds, using a dental 70 kVp X ray machine. They were processed according to manufacturer instructions. The result is showed in Figure3. According to this curve the best optical density is obtained with 0.5 s of exposure time.

The next step was the irradiation of the object test and the Kodak Ektaspeed film together using the exposure time selected to provide the optical density of the image in the dental X-ray film high contrast range, obtained by its characteristic curve. The exposure time interval was from 0.1 to 0.5 seconds, using the same dental 70 kVp X ray machine.

The films were conventionally processed and the one irradiated with 0.2 s showed the higher number of eye observed roles, as can be seen in the Figure 4. The use of this object allowed the reduction of the exposition time of 0.5 seconds, the maximum value of the linear region of the characteristic curve, to 0.2 seconds.

Conclusions

The importance of the quality control in dental diagnostic radiology systems is essential due to the constant use of X radiation in dental clinics. The PF453 recommends the frequency of at least two years for the constancy tests. However, it is suggested that the professional, surgeon-dentist, should be responsible for the internal control of the image quality obtained from the X rays device. This can be done through periodic exposures of the object test developed in this work.

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Figure captions

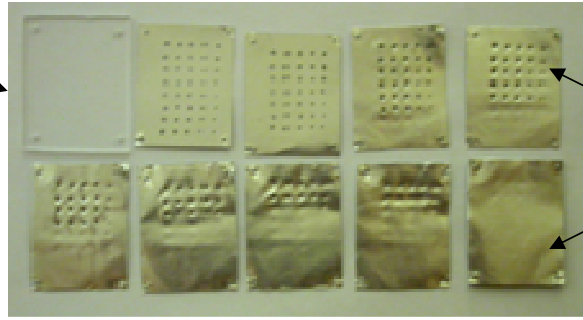
Figure 1 : Acrylic plate, perforated aluminum plates and the aluminum base.

Figure 2 : (a) Acrylic, aluminum and dental X-ray film. (b) Mounted object test

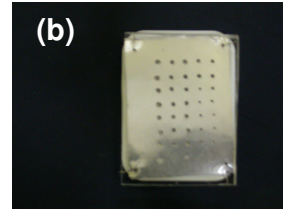
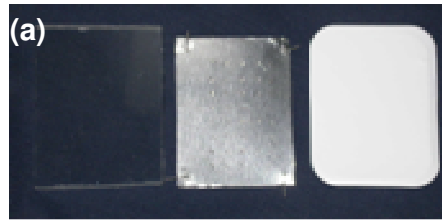
Figure 3 : : Kodak Ektaspeed film characteristic curve.

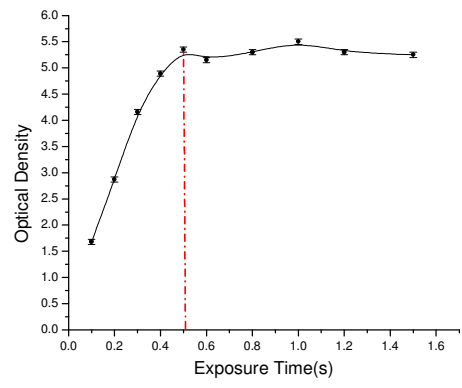
Figure 4: The object test images to different exposure times

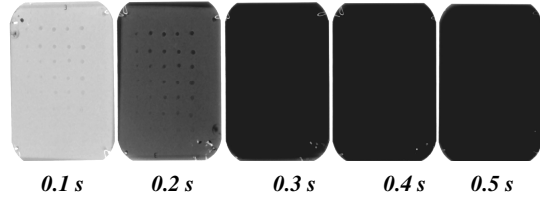
Acrylic plate



Aluminum plates







0.1 s

0.2 s

0.3 s

0.4 s

0.5 s