TA3 – Dosimetry and Instrumentation

Evaluation of the Field Size in Dental Diagnostic Radiology System

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ABSTRACT

In this work the field size of a dental X rays machine was evaluated considering the recommendation of the Brazilian Health Ministry Regulation 453 which established basic lines of radiological protection in medical and dental diagnostic radiology. The diameter of the field should not be superior to 6 cm in the localizer end point, limiting the radiated area and protecting the head-neck region. The measurements were carried out in a dental X rays machine, Dabi Atlante, model Spectro 70X Seletronic. For the field size or useful beam determination, the intra-oral films were positioned on a plain surface to be exposed in four stages and two focus-film distances (FFD), 20cm and 27.5 cm: 1) with spacer cone; 2) without spacer cone; 3) with spacer cone and film-holding device; 4) without spacer cone and film-holding device. The results show that the diameter of the field size is satisfactory only for FFD = 20cm. When the film-holding device is used, which is recommended by the Regulation 453, item 5.8d(ii), the diameter of the field size exceeds the maximum recommended value of 6 cm.

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(1). The assessment and control of the performance characteristics of X-ray generators and tubes 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(2). In dental area, specifically for intra-oral radiography, one of the recommendations of this regulation is the evaluation of the field size, which represents the exposed area of patient to the primary X rays beam. The diameter of the field should not be superior to 6 cm in the localizer end point, limiting the radiated area and protecting the head-neck region(3,4). Consequently the determination of the field size in dental diagnostic radiology systems is very important.

The objective of this work is the elaboration of a reference procedure, following the recommendations of the regulation 453, for the radiation field size determination 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

The measurements were carried out in a dental X rays machine, Dabi Atlante, model Spectro 70X Seletronic. Its nominal characteristics are: 70 kVp of tube voltage, 8 mA of tube current, inherent filtration of 0.51mmAl, additional filtration of 1.4 mm and focus-film distance of 20 cm.. The determination of the field size is part of this system quality control programme, other tests have already been performed[5,6]. The X rays machine can be seen in the figure 1.

Figure 1. Dental X rays machine, Dabi Atlante, model Spectro 70X Seletronic, Characteristics: 70kVp, 8mA and nominal filtration of 2.71mmAl.

The intra-oral radiographic films used were Kodak, speed E (ektaspeed), 3 x 5 cm, lot 3103576, produced in February 2005. It was used two set-ups with four films, as showed in Figure 2(a), and two set-ups using nine films. The diameters of the field or useful beam size were measured using a calibrated ruler.

Some measurements were taking using the film-holding device showed in Figure 2(b). This accessory is used to fix the radiographic films in the patient's mouth, leaving them parallel to teeth, making easy the rays-X beam alignment. The regulation 453 recommends its use. It reduces, significantly, the loss of radiographies due to the film movement, fold distortions or/and patient head positioning errors[7].

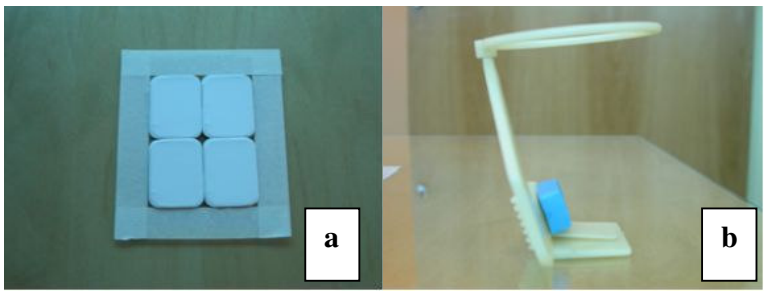

Figure 2: a) Radiographic films for the field size determination of the X radiation system b) Film-holding device frequently used in dental practices to fix radiographic films and to line up them with the X radiation system spacer cone.

The irradiations were performed positioning the intra-oral radiographic films in four different conditions as described in Table 1. The exposition time was 0.5 seconds in all cases. Figure 4 shows the irradiation conditions **A** (FFD 20 cm, with cone spacer) and **C** (FFD 27,5 cm, with cone spacer and film-holding device).

Table 1 . Irradiations condition for the of the intra-oral radiographic films.

Irradiation condition	FFD (cm)	Cone spacer	Film-holding device
A	20	with	without
B	20	without	without
C	27.5	with	with
D	27.5	without	with

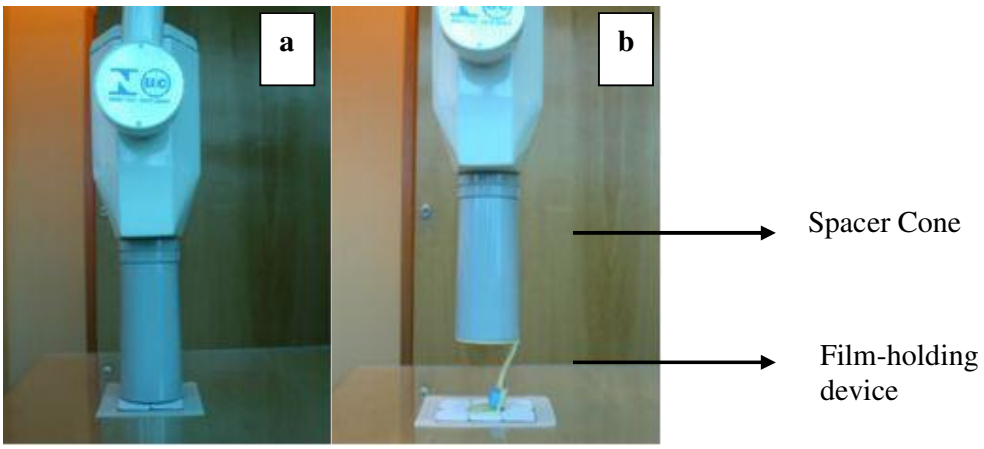

Figure 4. Set-up for the kVp measurement: a) DFF=20cm with spacer cone; b) DFF=27.5cm with spacer cone and film-holding device.

For each irradiation condition it was irradiated five film groups and the revelation of the irradiated intra-oral radiographic films was made following the recommendations of the Kodak (producer of the films), taking into account the table time/temperature[8]. The intra-oral radiographic films were mounted and analyzed in a negatoscopy, the diameter of the images were measured in 5 different positions.

RESULTS

The obtained values for the X radiation field size in the four mounted arrangements are presented in Table 2. Each value represents the medium of the five individual lectures. The uncertainties associated were classified into type A (statistical methods as the measurement means) and type B (other than statistical, as the uncertainties associated to the measure instruments)[9]. The expanded uncertainties were evaluated considering the confidence level of 95%.

Table 2 . X radiation field size using four different set-ups.

Irradiation condition	FFD (cm)	Diameter of the field (cm)
A	20	5.308±0.006
B	20	5.496±0.003
C	27.5	7.400±0.007
D	27.5	7.624±0.009

The results show that only for FFD of 20 cm the field diameter is less than 6 cm as recommended by regulation 453. As expected for FFD of 27.5 cm, when the film-holding device is used, the diameter of the field is superior to 6 cm over against the recommendations. Otherwise the use of the film-holding device is also recommended by the same regulation, item 5.8d(ii).

The dental X radiation system evaluated in this work presents satisfactory results only when is used a FFD of 20cm. According to the regulation 453, values between 4 e 5 cm are allowed only when there is an alignment and positioning system for the film, as described in item 5.7d(ii). When the film-holding device is used, the field size exceeds the maximum recommended value.

CONCLUSIONS

The obtained results show that the use of film-holding device to fix the intra-oral radiographic films and to align the X radiation beans decreases the entrance skin dose, but increases the size of the field and exceeds the maximum recommended value of 6cm. It is necessary to extend the tests to other dental X radiation systems in use in Brazil to evaluate the real benefit for the use of the film-holding device.

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