

Occupational exposure due to working with a portable dental x-ray system

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Introduction

- There are different kinds of imaging systems which are used for dental radiography.
- Based upon the international guidelines on radiation protection, a distance of **2m** from the x-ray tube should be kept by the operators.
- The **portable dental x-ray systems** have potential for use in
 - forensic density,
 - humanitarian missions,
 - nursing homes, and
 - disabled patients.
- Since the operators have to hold the unit during the exposure, the related occupational exposure risk may be increased via using such systems.



Introduction (cont.)

- It has been conducted little studies on radiation risk by the system and most of them have been done by the manufacturers.
- In this research, based upon the ICRP criteria, it is investigated the occupational radiological quantities as well as critical organ doses of the operator in neck/head area when a portable dental radiography system is used in different exposure conditions.

GENORAY Portable Dental X-ray Characteristics:

Technical Specification & Dimension

X-ray Generator	Type	High Frequency Inverter
	Power Output	180W
	Tube Voltage	60 kV
X-ray Installation	Tube Current	2mA
	Heat Capacity	8.5 KHU
	Anode Type	Stationary
X-ray Tube	Anode Angle	20°
	Focal Spot	0.8mm
X-ray Control	Exposure Time Set	56 Steps (0.01 ~ 2.0 sec)
Power Requirement		22.2 VDC
Inherent Filtration	Al equivalent	1.8 mmAl
Battery Capacity	Number of exam	100 per full charge
Weight	Main Body	5.18lb (2.35kg)
Dimension	Main Body	7.75" x 5.78" x 5.70" (19.7cm x 14.7cm x 14.5cm)



Exposure Situations:



Mandibular Exposure



Maxillary Exposure

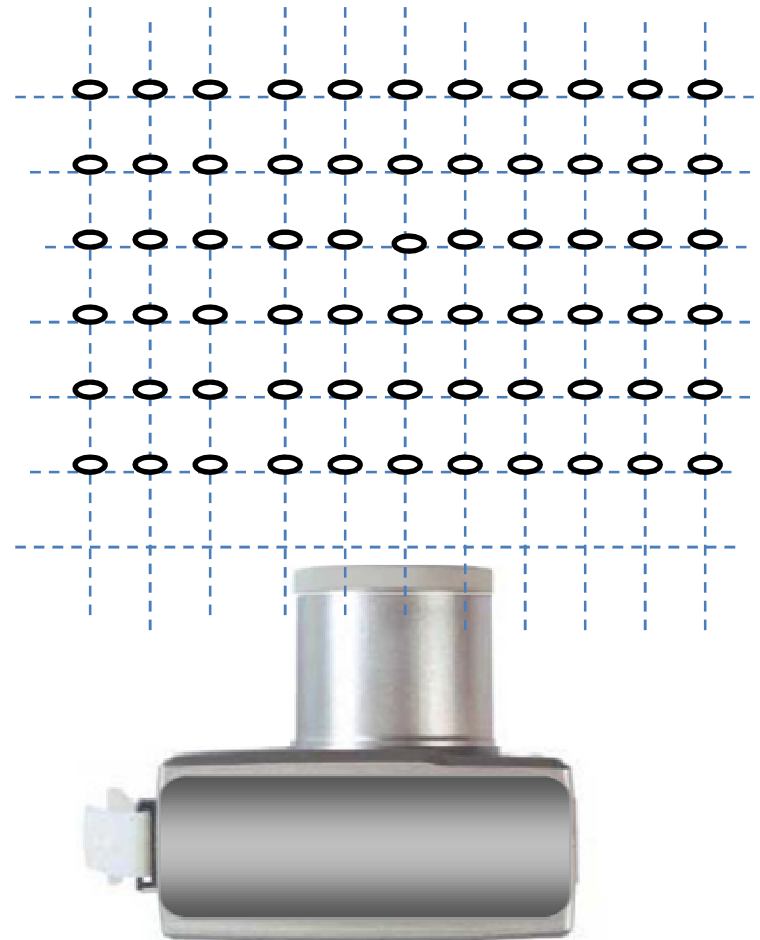
Exposures of the operator with lead apron and thyroid Shields:



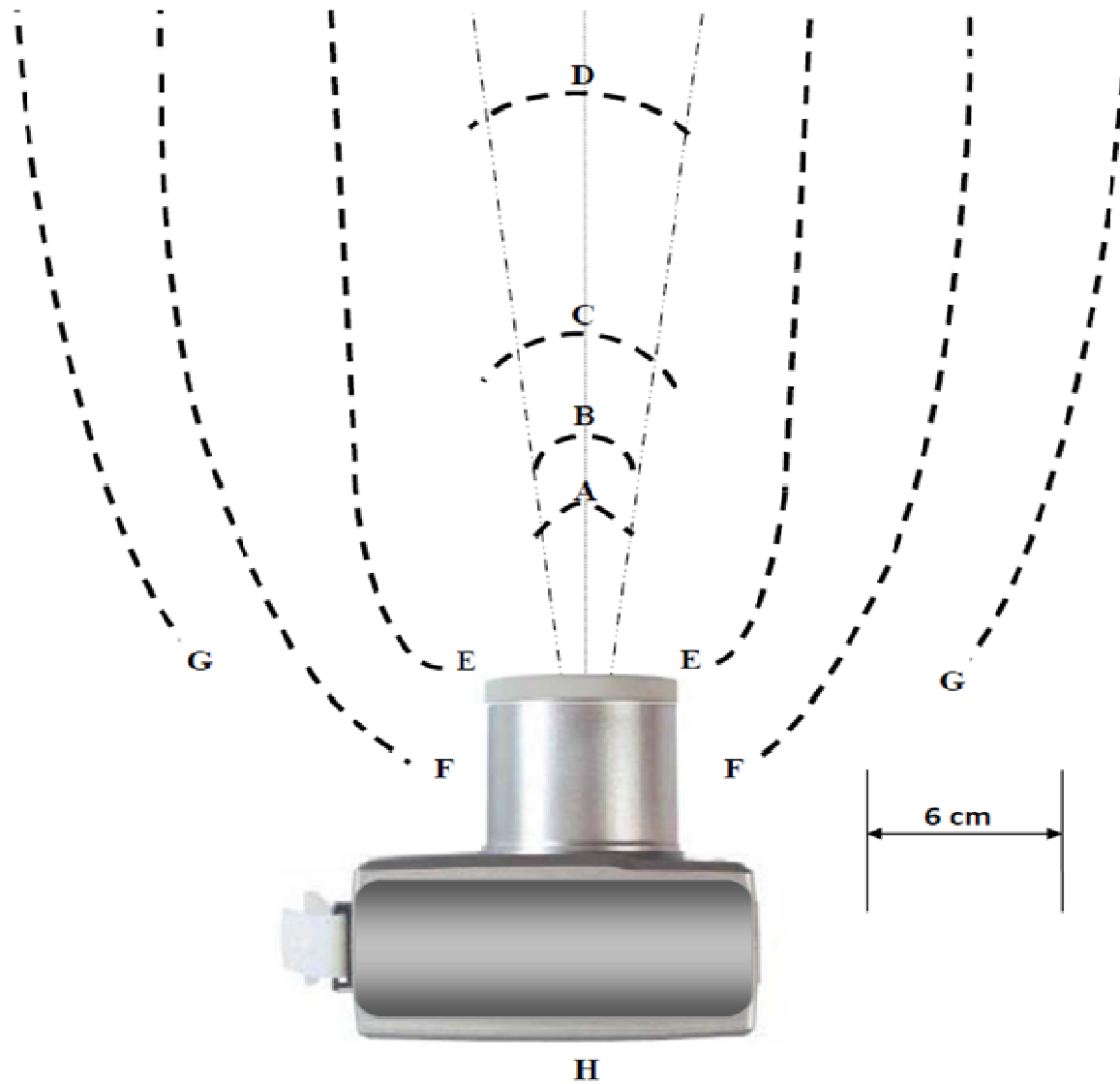
Mandibular Exposure



Maxillary Exposure



The ambient dose equivalent, $H^*(10)$, of the output of Genoray system has been measured by 150 number of TLD pellets (LiF: Mg, Cu, P) at different distances from the system. The exposure was done for 20 shots, in order to increase the accuracy of measurements.



Iso-dose output lines of a GENORAY portable X-ray unit (in mSv/shot);
 A: 4.82, B:2.61, C:1.30, D:0.96, E:0.06, F:0.015, G:0.008, H:0.005.

Table 1 The measured values of organ doses (in μSv per shot) in two different kind of examinations (The dose values are the mean values of TLDs in each organ with the related standard deviations).

Organ dose & exposed area of patient		Type of shield	Without lead shield	With lead shield (apron /thyroid shields)
Whole body [$H_p(10)$]	maxillary teeth		95 ± 14	$153.6 \times 10^{-3} \pm 20 \times 10^{-3}$
	mandibular teeth		28 ± 9	$86.2 \times 10^{-3} \pm 14 \times 10^{-3}$
Fingers	maxillary teeth		1410 ± 200	
	mandibular teeth			
Eye Lenses	maxillary teeth		111 ± 6.2	
	mandibular teeth		19 ± 2	
Thyroid gland	maxillary teeth		53 ± 3	$256 \times 10^{-3} \pm 35 \times 10^{-3}$
	mandibular teeth		10 ± 0.6	$121 \times 10^{-3} \pm 20 \times 10^{-3}$
Salivary gland	maxillary teeth		46 ± 7.3	
	mandibular teeth		6 ± 1.5	
Parathyroid gland	maxillary teeth		8 ± 1.1	Negligible
	mandibular teeth		2 ± 0.2	Negligible
Cheekbone	maxillary teeth		5 ± 1	
	mandibular teeth		1 ± 0.3	
Gonads	maxillary teeth		2.7 ± 2	Negligible
	mandibular teeth		2 ± 1	Negligible

Discussions:

- The measured values from table show that the scatterings from the head/neck/body of the patient have the most contribution in organ dose of the operator by such a system.
- The ICRP-60 recommends an annual dose limit of 20 mSv due to occupational exposure of whole body, 500 mSv for hand dose and 150 mSv for eye lenses.
- The maximum total dose was measured 0.095 mSv per shot in closed hand/arm situation of the operator when maxillary teeth of patient are exposed. As well the eye-lens and finger doses have been measured 0.111 and 1.410 mSv per shot respectively.
- The dose values in table also show that the use of shields (lead apron or thyroid shield) may decrease the values significantly.

Conclusion

- Considering sensitive organ and total effective doses, it can be concluded that the portable dental x-ray system in general could be a safe device for the operators.
- The limitation in use of the system is derived by the averaged time duration of exposures and annual dose limit of the **hands**.
- The total effective dose as well as organ doses in neck area may be decreased using the shield devices such as lead apron or thyroid shields.

Thank you

