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Dose Measurements of a Dental CBCT in Comparison with a 4 row MSCT and a Panoramic Device

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Introduction

In dental radiology an Alderson-Rando-phantom was used to compare the dose equivalent of a dental cone beam computed tomography (CBCT) with that of a 4 row multislice computed tomography (MSCT) and a panoramic device (PAN).

Objectives

Several radiosensitive organs were chosen to determine the dose equivalent by means of tissue equivalent LiBO thermoluminescent dosimeters. The phantom was loaded with several TLDs in the head, which were exposed to the radiation beam, as well as with other TLDs, in areas which received stray radiation, i.e. scattered radiation from the phantom itself as well as leakage radiation from the x-ray tube assembly. The irradiated volumes were almost identical in all cases. Further measurements were made using a protective apron to determine the effectiveness of shielding patients.

Materials and methods

Thermoluminescent dosimeters (Panasonic UD-807) made of $Li_2B_4O_7$:Cu phosphor (Fig. 6) were first calibrated using a Cs-137 source, then placed in an Alderson-Rando-phantom according to Table A. The TLDs were read and evaluated 24 hours after the x-ray exposure of the upper and lower jaw.

The CBCT device used, is of type 3D Accuitomo 170 by Morita. FOV chosen was 100 mm in diameter and 100 mm in height, tube voltage 90 kV, tube current 5 mA, scan time 30.8 seconds. Dose was accumulated by one scout and 5 successive exposures.

The MSCT device used is of type Somatom Sensation 4 by Siemens. Exposure field chosen was 99.5 mm in length, tube voltage 120 kV, tube current time 80 mAs, scan time 33.6 seconds. Dose was accumulated by one topogram and 5 successive exposures.

The panoramic device used is of type Orthophos XG5 by Sirona. Exposure field chosen was 100 mm in length, tube voltage 90 kV, tube current 12 mA, scan time 14.1 seconds. Dose was accumulated by one prescan and 5 successive exposures.

Results

The results calculated for a single exposure are summarized in Table A for the used devices. The bar chart in Fig. 8 shows the dose equivalent values for radiosensitive organs in the x-ray beam as well as some organs in stray radiation.

The dose received by the radiation beam of the CBCT device is about 30% of that received by the MSCT; the dose received by the radiation beam of the panoramic device (PAN) is about 10% of that received by the CBCT.

Fig. 1. Experimental setup for MSCT

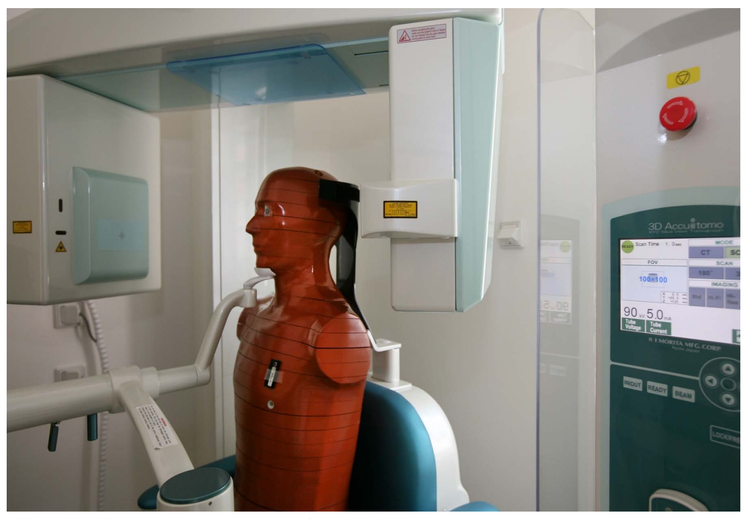

Fig. 2. Experimental setup for CBCT

Conclusion

Our study shows, that in the areas of stray radiation, i.e. scattered and leakage radiation, the dose received using a panoramic device (PAN) is almost negligible, but this is not the case when using MSCT or CBCT.

The sense of using protective aprons for exposures with a panoramic device in dental radiology can be questioned, nevertheless its use is quite common. For exposures with MSCT or CBCT the use of protective aprons is effective and therefore advisable.

Fig. 3. TLD positions for thyroid glands

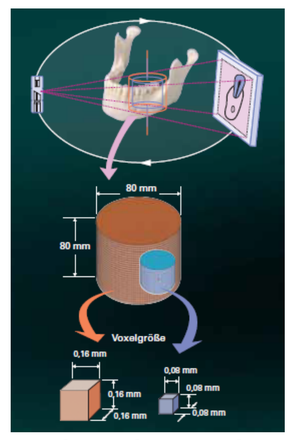

Fig. 4. Radiographic procedures for CBCT with permission by Morita

Fig. 5. TLD position for oral mucosa

Fig. 6. TLD UD-807 diam. 3mm

Fig. 7. Alderson-Rando-phantom

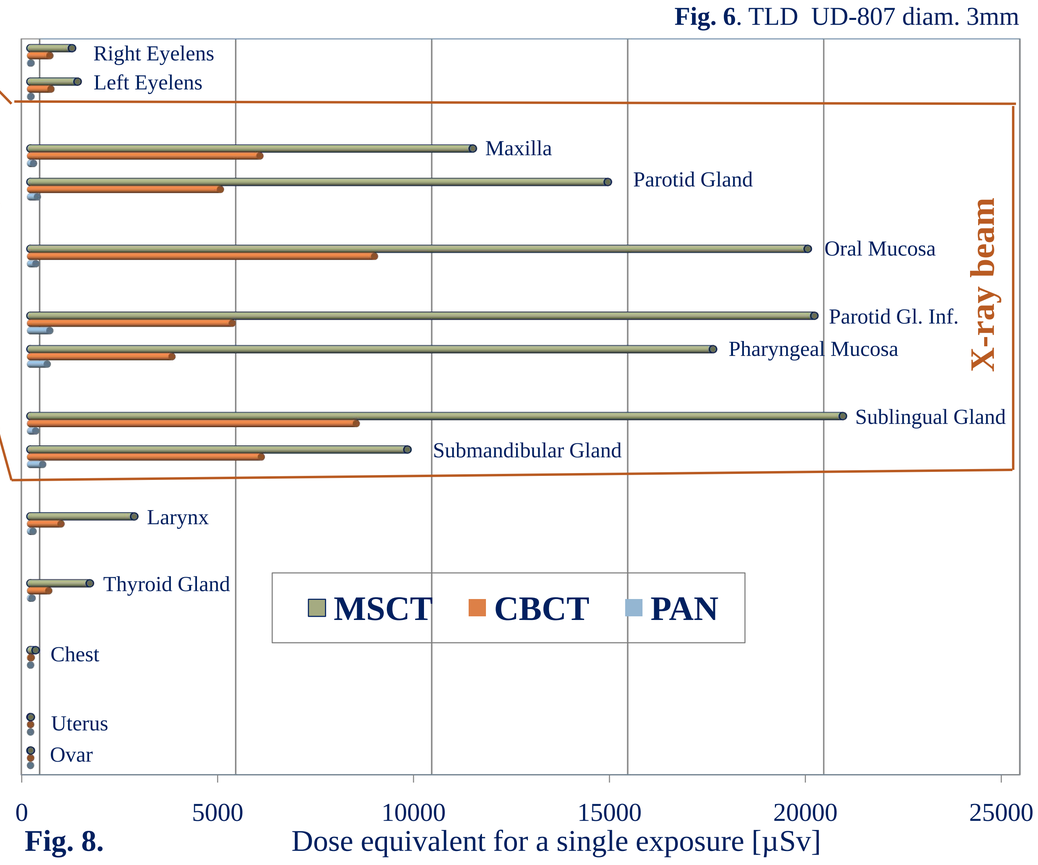

Fig. 8.

Organ	PAN [µSv]	CBCT [µSv]	MSCT [µSv]
Right Eyelens	15	494	1058
Left Eyelens	13	521	1200
Maxilla	79	5853	11281
Parotid Gland	176	4845	14725
Oral Mucosa	137	8775	19825
Parotid Gland Inferior Part	493	5146	19993
Pharyngeal Mucosa	428	3610	17408
Sublingual Gland	133	8310	20720
Submandibular Gland	312	5888	9614
Larynx	67	780	2645
Thyroid Gland	41	466	1512
Chest	4	20	83
Chest (under apron)	3	4	21
Uterus	2	4	6
Ovar	2	6	6

Table A.

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