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Paediatric organ and effective doses in dental cone beam computed tomography

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Objectives
Cone beam computed tomography (CBCT) is an emerging x-ray technology which has been applied widely in dento-maxillofacial imaging. CBCT has been associated with lower radiation dose than multislice CT (MSCT) but with higher dose compared to panoramic and intraoral imaging. Even though several studies have assessed the radiation dose to patients using adult anthropomorphic phantoms, none has estimated the paediatric organ and effective doses. The aim of this study was to estimate average organ and effective doses using two paediatric anthropomorphic phantoms for a range of CBCT units and imaging protocols.

Methods
Two ATOM tissue-equivalent anthropomorphic phantoms and thermoluminescent dosimeters (LiF:Mg,Cu,P) were used. An adult ATOM female phantom was used to simulate an adolescent as there are no commercially available adolescent tissue equivalent anthropomorphic phantoms and a 10 year old phantom was used to simulate a child. Absorbed doses were measured in the brain, salivary glands, thyroid gland, red bone marrow, bone surface, skin for a range of imaging protocols. Measurements were done on an i-CAT NG, 3D Accuitomo 170, Promax 3D, Kodak 9000C 3D, NewTom VG, Scanora 3D, Galileos Comfort. The effective doses were calculated using the ICRP 103 tissue weighting factors.

Results
The thyroid, salivary glands and brain received the highest absorbed doses for both phantoms. The red bone marrow absorbed dose was low but its contribution to the effective dose was significant due to its high radiosensitivity. For most of the imaging protocols and CBCT units, the salivary glands contributed the most to the effective dose for the adolescent phantom while for the 10 year old phantom there was an almost equal contribution from the salivary glands, red bone marrow and thyroid gland.

Depending on the CBCT unit studied and the imaging protocol used, preliminary results showed that the effective doses ranged from 5 μSv to 99 μSv for the 10 year old phantom and from 4 μSv to 63 μSv for the adolescent phantom. The effective doses for the 10 year old phantom were higher than those of the adolescent phantom for most of the CBCT units and imaging protocols. This was mainly due to the size of the phantom and positioning of the thyroid, salivary glands and brain with respect to the primary beam. The average effective dose for both phantoms was 37 μSv.

Conclusions

The effective doses were higher for the 10 year old than for the adolescent phantom. The average CBCT effective dose for both phantoms was much lower than the MSCT effective dose but four times higher than the average panoramic dose published by the UK Health Protection Agency.

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