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Effective dose range for dental cone beam computed tomography scanners

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Objective:
To estimate the absorbed organ dose and effective dose for a wide range of cone beam computed tomography scanners, using different exposure protocols and geometries.

Materials and methods:
Two Alderson Radiation Therapy anthropomorphic phantoms were loaded with LiF detectors (TLD-100 and TLD-100H) which were evenly distributed throughout the head and neck, covering all radiosensitive organs. Measurements were performed on 14 CBCT devices: 3D Accuitomo 170, Galileos Comfort, i-CAT Next Generation, Iluma Elite, Kodak 9000 3D, Kodak 9500, NewTom VG, NewTom VGi, Pax-Uni3D, Picasso Trio, ProMax 3D, Scanora 3D, SkyView, Veraviewepocs 3D. Effective dose was calculated using the ICRP 103 (2007) tissue weighting factors.

Results:
Effective dose ranged between 19 and 368μSv. The largest contributions to the effective dose were from the remainder tissues (37%), salivary glands (24%), and thyroid gland (21%). For all organs, there was a wide range of measured values apparent, due to differences in exposure factors, diameter and height of the primary beam, and positioning of the beam relative to the radiosensitive organs.

Conclusions:
The effective dose for different CBCT devices showed a 20-fold range. The results show that a distinction is needed between small-, medium-, and large-field CBCT scanners and protocols, as they are applied to different indication groups, the dose received being strongly related to field size. Furthermore, the dose should always be considered relative to technical and diagnostic image quality, seeing that image quality requirements also differ for patient groups. The results from the current study indicate that the optimisation of dose should be performed by an appropriate selection of exposure parameters and field size, depending on the diagnostic requirements.