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Original article

Dose investigation and local diagnostic reference levels for intraoral dental radiography in Beijing, China

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ABSTRACT

Objective: To investigate the examination doses of intraoral dental equipment in Beijing, and propose the typical examination doses and local diagnostic reference levels (LDRLs) for intraoral dental examinations in Beijing, China.

Methods: Incident air kerma ($K_{a,i}$) of 73 intraoral X-ray units from 73 medical institutions in Beijing, China, was measured three times at the end of the exit cone of each unit using solid-state dosemeters. Measurements were carried out with the default parameters for adult and paediatric maxillary examinations specified on the control panel of the intraoral equipment. For patient categories and different types of image receptors, the median (interquartile range) and min/max values of exposure parameters and typical value distributions were calculated. Then, Kruskal-Wallis test and Wilcoxon rank sum tests were performed according to patient- and equipment-related factors ($\alpha = 0.05$).

Results: The median values of $K_{a,i}$ were 2.15 and 1.44 mGy, and the 75th percentile (P_{75}) values were 2.97 and 2.17 mGy for adult and paediatric maxillary molars examinations, respectively. For the three types of image receptors, direct digital detector (DDD); indirect digital detector (IDD), and film, the median doses were 1.74, 2.39, and 3.05 mGy, and the P_{75} values were 2.17, 2.98, and 4.16 mGy for adults, respectively. While the median doses were 1.29, 1.53, and 2.48 mGy, and the P_{75} values were 1.44, 2.28, and 2.95 mGy for children, respectively. There was a significant difference between the dose from units used for 5 years or less and those used for more than 5 years (adults: 2.74 *vs.* 1.82 mGy, $P < 0.05$; children: 1.73 *vs.* 1.16 mGy, $P < 0.05$).

Conclusion: This study is a large-scale, multi-center investigation to analyze the typical examination doses of intraoral dental X-ray examinations in Beijing, China, and propose local DRLs. It facilitates the implementation of continuous optimization strategies through DRLs and provides methodological and data support for the establishment of national DRLs.

1. Introduction

With the proliferation of medical and dental X-rays, diagnostic radiology has become the largest man-made radiation source to the population.[1] Dental radiography is one of the most frequently conducted radiological procedures. According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2020/2021 report, dental X-ray examinations account for an average of 26.3 % of all procedures performed.[2] Despite advancements in panoramic and cone-beam CT, intraoral radiography remains the most widely used modality in dental radiography, providing a detailed and high-quality view of a particular tooth.[3,4] While individual doses and risks from dental radiography are relatively low, the collective dose remains significant due to the large number of examinations performed.[5–7]

To ensure patient safety, the principles of justification and optimization should be followed, and examinations should be performed only when the health benefits clearly outweigh the radiation risks.[8–10] In medical practice, the typical doses serve as a key basis for evaluating the medical exposure level. These doses should be periodically evaluated and compared against established diagnostic reference levels (DRLs).[11,12] DRLs, recommended by the International Commission on Radiological Protection (ICRP)[13] and the European Commission (EC),[14]

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