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Commentary

Auto exposure control (AEC) modality in CBCT devices: Revisiting the reported parameters in current orthodontic literature

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Dear Sir,

By the advent of newer imaging modalities such as cone beam computed tomography (CBCT) devices and their extensive applications in dentistry, and in particular in orthodontics, concerns have been raised regarding their optimal ionizing radiation dosage. Many strategies have been suggested to reduce the exposure hazards by optimization and individualization of CBCT parameters. This short commentary introduces the widely used methods to control the ionizing radiation and with casting doubt on properness of reports in orthodontics literature with emphasis on importance of automatic exposure control (AEC) strategy.

Introduction of computed tomography (CT) scans and more recently cone beam CT (CBCT) scans have shed light on the path of diagnosis and prognosis of medical and dental illnesses. Of note, the high exposure to ionizing radiations

and the risk of developing cancers, especially in children, are the major concerns. Regarding “as low as reasonably achievable [ALARA]” law, meticulous efforts have been made to reduce the radiation dose. Besides the appropriate patient selection as the first step, suggested technical strategies for dose reduction in CT scans may be addressed as beam filtration, beam collimation, tube current modulation (TCM) with AEC, optimal tube potential, improved detectors, and noise reduction algorithms.¹

AEC is currently available in almost all manufactured CT and CBCT devices. This method may provide dose reduction by 17% and 27% in anterior posterior (AP-AEC) and latero-lateral (LAT-AEC) head CT image acquisitions, respectively.² Generally, this reduction rate falls in the range of 4.7–61.7% and depends on desired anatomic level considering the whole body CT imaging.³

The rate of dose reduction by AEC is influenced by patient's age (e.g., children vs. adult), patient's size (e.g., slim vs. obese),

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direction of beam (e.g., anterior posterior (AP-AEC) vs. latero-lateral (LL-AEC)), and the anatomic locations (e.g., head vs. thorax and abdomen).^{2,3}

Automatic exposure control should not be mistaken for “Automatic Exposure Compensation”, also abbreviated as AEC, in which a post-processing manipulation of images is performed with a histogram stretching technique.⁴

In AEC method, first the patient is exposed with a short test exposure. Thereafter, the tube current is modulated. The AEC unit performance in various devices may be different in terms of modulation algorithms [e.g., sinusoidal-based, attenuation-based (more common)], timing [e.g., real time with automatic feedback, pre-programmed sophisticated algorithm, or combination of these methods (more common)], and preliminary direction [e.g., x-y axis (angular), z-axis or combination of three axes (more recently)].^{2,3} This method performs on an attenuation-based modulation algorithm considering the patient's size and shape. Hence, it is not surprising that even AP and LAT exposures of a same patient's skull are different due to the different shapes in AP and LAT directions. Accordingly, automatically selected parameters may vary on the basis of individual characteristics.

One may prefer to switch off the AEC mode when s/he aims to study the skulls to investigate the cortical bone thickness of desired orthodontic miniscrew insertion sites. Nevertheless, reporting a fixed set of parameters for living patients means that either the device is not equipped with AEC modality or this mode is off. The third presumable cause could be the incorrect report of CBCT by the scholar. The two former reasons are currently against the ALARA law.

In recently published manuscripts in *American Journal of Orthodontics and Dentofacial Orthopedics* (AJODO), either fixed setups (Shinohara et al., 2013, 3D Accuitomo, Japan; Minich et al., 2013, probably CB MercuRay, Japan; Ryu et al., 2012, i-CAT, USA) were reported or such parameters were not reported (Solem et al., 2013, CB MercuRay, Japan).^{5–8} Of note, Suzuki et al. have used a Accuitomo device and reported a range of performance for the tube voltage and current.⁹

In addition, Kim et al. applied a 3D i-CAT CBCT device (Imaging Science International, Hatfield, PA, USA), which is published in the 5th issue of 2013 of *Korean Journal of Orthodontics* (KJO).¹⁰ This study included 120 patients and data acquisition parameters were as the following: 120 kVp and 47.7 mA. Cha had his research published in the same journal and the same year using a CT device.¹¹ He evaluated the soft tissue thickness of Korean population and reported automated range for mA (120 kV, auto mA, 0.625–1.25 mm slice thickness, slice pitch of 3, 4 s scanning time, and a field of view of 250 mm). Overall, it was felt that the proper and sound report of exposure parameters was simply overlooked in many published works, even in well-known journals.

In brief, from the scientific and ethical scope, scholars should make every effort to reduce the radiation dose to lessen its serious side effects. Accordingly, being knowledgeable of recent achievements in terms of patient safety will indeed help the investigator to conduct the research and report it more scientifically and ethically.

Conflicts of interest

The author has none to declare.

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