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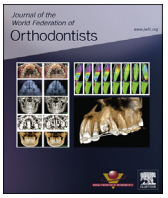

Editorial

# Cone beam computed tomography – A risk-benefit analysis!

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Radiographic imaging has always helped the inquisitive orthodontic mind with pre-treatment data, in-treatment assessment as well as the opportunity to monitor post-treatment stability. Two-dimensional imaging has ruled the speciality for more than a century providing orthodontists with approximate skeleto-dento-soft tissue relationships, but with the inherent problem of ignoring the third dimension. The introduction of multi-slice computed tomography (CT), especially cone-beam computed tomography (CBCT), has revolutionized the imaging modalities with the possibility of visualizing every structure through high resolution three-dimensional images at relatively lower dose and cost. However, it is fair to ask if the total cost has been acknowledged…or has it simply been ignored?

Signorelli et al. [1] has recently reported that the overall effective radiation dose of CBCT (131.7 μSv) is much higher than that of conventional set of orthodontic radiographs (35.81 μSv) composed of lateral cephalogram (5.03 μSv), postero-anterior cephalogram (8.90 μSv) and panoramic radiograph (21.87 μSv). With use of a thyroid shield (thyroid and salivary glands being most vulnerable organs attracting radiation), the radiation dose of CBCT has been reduced to 96.24 μSv, a 12% reduction. But this is still higher than that obtained through conventional orthodontic imaging. Major questions persist such as (1) how safe is this more comprehensive form of imaging in children, who are highly susceptible to ionizing radiation and (2) are we following the three fundamental principles of radiation protection–justification, optimization and dose limitation?

A surge in orthodontic research with CBCT as the imaging modality has been observed through a recent Medline search. The study identified 146 articles published in 2019 (pre- September) and another 170 articles in the year 2018 compared to 96 and 99 in 2013 and 2014 respectively. Considering the deterministic (cell death from higher doses of radiation over short period of time which occurs once the threshold levels are reached) and stochastic nature (altering the cellular DNA and producing irreversible changes in cell structure as well as function) of ionizing radiation, how do we justify the routine use of CBCT images in diagnostic procedures? The threshold for producing a deterministic effect is never reached in conventional orthodontic radiography unless the patient is under radiation treatment for cancer and related diseases. But a stochastic effect, which can result in radiation induced carcinogenesis, can result from low-level radiation through diagnostic imaging over a long period of time due to its cumulative nature. It is an alarming fact that the chance of inheriting the above-mentioned effects are doubled in patients who are 10–20 years of age. Considering the greater rate of cellular growth and organ development and the long-life expectancies bringing in chances for more cumulative effects of radiation exposure, specific organ and effective doses in children are considered approximately 30% more than in adults. In 2013, the American Academy of Oral and Maxillofacial Radiology published a position statement regarding safe use of CBCT in orthodontics [2]. Accordingly, this organization made it clear that the decision to obtain a CBCT image should be based on history, clinical examination, as well as available radiographic imaging. Such imaging should benefit the diagnosis and treatment of the condition outweighing the potential risk of radiation. Further, the use of CBCT should be limited unless the clinical question cannot be answered by conventional radiography. In those instances, it is better to avoid conventional radiographs to reduce radiation dose. The use of a CBCT protocol that restricts the field of view (FOV), minimizes exposure (mA and kVp), the number of basis images and resolution while at the same time, permitting adequate visualization should be practiced when possible. CBCT scans should not be used solely to produce a lateral cephalogram and/or panoramic radiograph.

The search for answers to these questions as they relate to the risk-benefit aspects were found in numerous systematic reviews comparing the conventional radiograph and CBCT when used to diagnose orthodontic conditions such as the identification of impacted teeth, root resorption, maxillary sinus-root relationship as well as the availability of alveolar bone for implant placement. Surprisingly none of the systematic reviews or studies suggested CBCT as a first-line diagnostic modality and recommended using them only in instances where conventional radiographs fail. Eslami et al. [3], concluded that even without strong supportive evidence, CBCT images provided more reliable information for the localization of impacted canines, but should be used only when the condition is difficult to evaluate with conventional radiography. Samandara et al. [4], concluded that CBCT seems to be a reliable tool for identifying orthodontically induced external root resorption but the mere identification of this with such a modality lacks clinical relevance. De Grauwe et al. [5], who assessed the diagnostic efficiency and treatment optimization role of CBCT in a pre-orthodontic paediatric population concluded that there is still lack of evidence or justification.

Until recently, the standard guidelines followed in obtaining CBCT images were derived from SEDENTEXCT (safety and efficacy of a new and emerging dental x-ray modality) as published in 2012 (described above as part of position statement from American Academy of Oral and Maxillofacial Radiology). In 2017 new guidelines for pediatric use of CBCT were proposed through a DIMITRA (dentomaxillofacial paediatric imaging: an investigation towards low-dose radiation induced risks) position statement [6]. This specific position statement provided us with indication-oriented,

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patient specific guidelines which focused on optimizing pediatric doses. It proposed moving from ALARA (as low as reasonably achievable) and ALADA (as low as diagnostically acceptable) to ALADAIP (as low as diagnostically acceptable being indication-oriented and patient specific).

The children we treat are the leaders of future generations. The diagnostic and treatment modalities we use should in no way harm their growth and future quality of life. With this in mind, we should take utmost care and follow proper guidelines in designing diagnostic and treatment planning protocols. With such low levels of evidence and justification when using CBCT as a routine diagnostic modality, we should limit its use to conditions where conventional modalities fail. No recent studies recommend the routine use of CBCT as the initial diagnostic modality, so let's 'think before we leap'.

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