Letters From Our Readers

To: Editor, *The Angle Orthodontist.*

Response to: A comparative study of the effect of the intrusion arch and straight wire mechanics on incisor root resorption: A randomized, controlled trial. Marcio R de Almeida, Aline SB Marcal, Thais MF Fernandes, Juliana B Vasconcelos; Renato R de Almeida; Ravindra Nanda. *The Angle Orthodontist*. 2018; 88: 20-26.

Thank you for your interest in our paper published in The Angle Orthodontist. This paper involved external apical root resorption (EARR) of maxillary incisors treated by intrusion arch or continuous archwire mechanics. Based on modern evidence-based orthodontics, we recognize that orthodontists are advised to use their best clinical judgment when prescribing radiographs, including CBCT scans, to obtain the most relevant data using the least ionizing radiation possible. We all know that the presence of EARR can be diagnosed by means of radiographic examinations.[1] However, standardization of two-dimensional scans is quite difficult and a number of factors hinder proper radiographic findings, including anatomical variations.[2] Furthermore, minor incisor angular changes cause significant alterations to linear measurements in the radiography. Consequently, technological innovations have made it possible to evaluate the degree of root resorption in a three-dimensional way, due to its precision in measuring root shortening. Thus, nowadays, cone-beam computed tomography (CBCT) is referred to as the most precise tool to identify external root resorption and it has been considered to assess 3D craniofacial anatomy in health and disease and of treatment outcomes including that of root morphology and angulation, alveolar boundary conditions, maxillary transverse dimensions and maxillary expansion, airway morphology, vertical malocclusion and obstructive sleep apnea, TMJ morphology and pathology contributing to malocclusion, and temporary anchorage devices. [3] In fact, CBCT has been used to discern the potential effects of treatment- or patient-specific variables on the integrity and morphology of bone around tooth roots in full-fixed appliance therapy and with both rapid and slow expansion.[4–12]

Because CBCT can generate precise images of small root defects, it provides more accurate insights into root resorption and has greater sensitivity and specificity than do panoramic or other 2D radiographs in detecting these lesions.[13–16] Also, relative to CBCT, panoramic radiographs underestimate the presence of external apical root resorption (EARR).[17,18] While 2D radiographs only provide visualization of the apex and the mesial and distal root surfaces, CBCT imaging enables the visualization of buccal and lingual root surfaces. This has led to the discovery that root loss is not only present at the root apex but often presents as a slanting root loss on surfaces adjacent to the direction of tooth movement. This finding highlights the efficacy of the 3D rendering capacity of CBCT for accurate diagnosis of both EARR and other previously uncharacterized types of root resorption. Thus, in addition to the previously accepted diagnosis of EARR that is observed in 2D radiographs, high-resolution CBCT may usher in a new diagnostic criteria of root resorption affecting root surfaces visualized by 3D but not by 2D radiographs.

For these reasons, we would like to state that our published paper is only a part of a more complete study that we are preparing for possible publication in order to analyze by means of CBCT other important parameters to give the readers the chance to better understand the clinical effects of deep bite correction using intrusion arches in adolescents given the fact that the literature is lacking such knowledge in a 3D way. We believe that the expected outcomes of the 3D information derived from CBCT relative to that obtained from traditional 2D radiographs ultimately may span from a refinement of treatment to a total modification in the treatment rendered.

The major concern of the questioners was related to use of a large Field of View (FOV) irradiating the patient's entire head. The reason for using this large FOV of the patients was that we can reproduce the lateral cephalogram as well as the panoramic views from only one CBCT scan of each patient, which allowed us to investigate other parameters without it being necessary to additionally irradiate patients in order to obtain lateral and panoramic radiographs. To date, the parameters that are being also investigated from the sample collected for the upcoming paper are: 3D analysis of buccal alveolar bone around the anterior teeth after the intrusion of the incisors, airway morphology, as well as the buccal alveolar bone around the anchorage teeth (maxillary molars) in the sagittal, vertical and transverse dimensions. CBCT research is beginning to provide critical information on

potential new diagnostic categories such as alveolar bone boundary conditions and root integrity in dimensions not observed in that of 2D radiographs.

Alveolar boundary conditions are the depth, height and morphology of alveolar bone relative to tooth root dimensions, angulation and spatial position. Kapila and coworkers[3] pointed out that, as further scientific evidence on the limitations imposed by boundary conditions and risks for root resorption on orthodontic treatment become available, clinicians may be able to answer important treatment planning questions such as (1) can the desired tooth movement be accomplished within the existing boundary conditions without damaging the roots or adjacent structures? (2) Will boundary conditions or root morphology be affected positively or negatively by skeletal or dentoalveolar expansion or tooth retraction? (3) What are the effects of compromised bone (as in periodontal disease) on the ability to move teeth in the sagittal or transverse planes? (4) How are alveolar bone adaptability and risks for root resorption affected by age, periodontal health and the pre-treatment bone and anatomic phenotype of the patient? Finally, we hope we may be able to answer those important questions raised in the near future carrying out our CBCT study.

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