Update on Cone Beam Technology and Orthodontic Analysis

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KEYWORDS

• CBCT technology • Orthodontics • Translation in orthodontics

KEY POINTS

- For any orthodontic analysis to adequately diagnose the skeletal jaw relationship, the three-dimensional image needs to incorporate the skull base, the facial bones, and the dentition. This requires a field of view (FOV) larger than the one used in routine dental check-up.
- One of the major advantages of CBCT over conventional CT is the reduced radiation dose. However, compared with a conventional lateral cephalogram, a panoramic radiograph, and any supplemental films that are required, the radiation dose of CBCTs is still relatively higher.
- The analysis of soft tissues of the face is an important part of planning and evaluation of orthodontic treatment. Traditional methods of soft tissue analysis include measuring distances, angles, areas, and volumes based on the analysis of landmarks or points that have specific geometric locations.
- CBCT has become a vital tool in evaluating multidisciplinary orthodontic cases that require surgical planning. It has shown major advancements over the two-dimensional imaging modalities when it comes to surgery simulation, analysis of condylar resorption, and facial asymmetry evaluation.

INTRODUCTION

Some 10 years ago, when the first papers were published on cone beam computed tomography (CBCT) technology, many authors were highly enthusiastic and excited about the possibilities of this innovation,[1–4] even to the point of making this a routine

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procedure in the everyday clinical practice.[5,6] The premise of such excitement stemmed from the increased capacity to understand head and neck anatomy and to harness the information for clinical and practical usage.

CBCT technology has certainly come along way. In one of the earliest reviews of this technology, only four mainstream vendors had machines or devices available in the marketplace.[1] Today, almost 30 to 40 variations of CBCT devices are available and these are manufactured by many commercial entities.[4]

Indeed, the technology has improved over the last decade. This article discusses the current advancements and uses of CBCT. Many in the dental profession have touted that a specialist and an expert normally require 10 years of experience in a given technology and the past decade has certainly allowed us to reflect on the lessons learned on the job.

SYSTEM IMPROVEMENTS

The physics and mathematical fundamentals of CBCT technology are not within the scope of this article. However, a brief mention of the changes in the hardware, radiation dose, and software is pertinent, especially in the context of the practicing orthodontist.

HARDWARE: FIELD OF VIEW VARIATION

The variations in volume capture, also known as field of view (FOV), for all cone beam devices range from 5 to 45.7 cm. Kau[7] described the categorization of CBCT devices largely on the clinical indication and need. Small FOV devices (normally 5–10 cm) give the orthodontist a three-dimensional view of a single tooth unit and its surrounding anatomy. This specific FOV is used for assessing individual teeth, such as impacted teeth, root morphology, supernumeraries, sites for placement of dental implants, and temporary anchorage devices. Medium FOV units provide single jaw anatomy, whereas the maxillomandibular FOV gives the clinician an understanding of two-jaw anatomy, temporomandibular joint (TMJ), and occlusion. These FOVs are typically used when additional information on occlusal relationships, facial asymmetries, and bilateral TMJ evaluations are needed or when the conditions of interest, such as potential adverse boundary conditions, are present in both arches or jaws. Finally, craniofacial or large FOVs include the cranium, cranial base, and all associated structures. The large FOVs incorporate most of the whole head and help clinicians to visualize relationships between skeletal bases, between teeth and skeletal bases, and significant anomalies in patients requiring orthognathic surgery or those with craniofacial anomalies.

It is not uncommon for orthodontists to work in the FOV between 15 and 30 cm. The 15-cm FOV is used when the clinician wants images restricted to one jaw. Using the 22-cm FOV makes it possible to visualize both jaws, and depending on the size of the patient, all the craniofacial complex. In most circumstances, the orthodontist normally has to select a FOV of 30 cm or more to have a complete picture (**Fig. 1**).[8]

For any orthodontic analysis to adequately diagnose the skeletal jaw relationship, the three-dimensional image needs to incorporate the skull base, facial bones, and dentition. This requires a FOV size larger than the one used in routine dental check-up. In general, the orthodontist needs to visualize the anatomic structures that include nasion on the anterior-superior border of the image, and the mandibular points pogonion, gnathion, and menton on the anterior-inferior border. The posterior FOV must include the sella turcica, the TMJ (condylion), skull base (basion), and posterior contour of the mandible (gonion). In addition, all the cervical vertebrae to C4 need to be visible on the tomography, allowing analysis of skeletal maturation.

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