



3-D redefining dentistry

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Although **2-D IMAGING MODALITIES** have long been important diagnostic adjuncts in the assessment of dental patients, it is a new breed of imaging technologies that is hitting the sweet spot of our collective attention. **3-D digital computer-based imaging technologies**, including cone beam computed tomography (CBCT), intraoral and extraoral surface scanners, and computer-assisted design and manufacturing (CAD/CAM), are redefining the way we diagnose, treatment plan, and execute treatments. These new systems, which are rapidly approaching the technological mainstream, also are challenging some of the longest-standing paradigms in the profession.

Cone beam computed tomography (CBCT)

The recent introduction of CBCT to dentistry represents a true shift from a 2-D “planar” approach to dental radiography, to a 3-D “volumetric” approach. These systems, specifically designed for the maxillofacial region, provide comprehensive, accurate, and undistorted images of the hard tissues of the jaws, teeth, and related anatomical structures. With submillimeter accuracy, CBCT has created much excitement by expanding the role of imaging from pure diagnosis to image-guided treatments and custom appliance fabrication.

With the patient sitting, standing, or lying down, CBCT projection images are acquired on a single rotation of the X-ray source and detector around the patient. The scan and reconstruction times are relatively fast, being dependent on resolution, field of view, and the number of projection images acquired. CBCT provides an equivalent patient radiation dose of between one to 48 days of background radiation, depending on the manufacturer, field of view, and the acquisition parameters chosen, providing a substantial dose reduction over conventional CT of the maxillofacial region.

Surface scanners, optical impressions, and chairside CAD/CAM systems

Surface scanners are used to create digital impressions of intraoral anatomy, including restorative preparations. This is achieved through the use of a handheld optical scanner using laser, video capture, or light emitting diode (LED) technology to capture a scan of the region of interest.

The resulting data points comprise a “virtual impression,” which can be used in conjunction with a chairside CAD/CAM system for restoration fabrication. The data file also can be transmitted via the Internet to a laboratory for processing. Besides supporting the fabrication of inlays, onlays, short span bridges, and full coverage restorations, these virtual impressions can be used to create virtual or “real” study models. They also can be used to facilitate the fabrication of custom-designed orthodontic appliances and treatments.

3-D facial scanning

Using the principles of stereo photogrammetry, 3-D facial scanning is a noninvasive imaging technique. It is performed using a bank of precisely positioned, specialized digital cameras around the patient. Using a computer and monitor, software algorithms produce and display accurate surface models of the patient’s facial contours, complete with photo texture rendering. This technology is an effective method for precisely documenting a patient’s facial anatomy, and also improves surgical treatment planning and provides an objective foundation for quantifying patient outcomes in orthodontic and orthognathic treatments. 3-D face scan data can be combined with CBCT data.

In an effort to better understand the impact 3-D imaging technologies will have on patient care and the business of dentistry, this column will explore the topic in depth and interview some of the leading clinicians in 3-D dentistry. I will question those who have acquired deep knowledge of the topic, and who have leveraged 3-D technologies successfully in the disciplines of restorative dentistry, implant dentistry, endodontics, orthodontics, and radiology.

There is no denying that 3-D diagnostic imaging will continue to dominate and influence clinical practice. The trend to obtain more accurate three-dimensional data with less “guesswork” will undoubtedly lead us to better treatment-planning decisions and, hopefully, more predictable outcomes. **DE**

References available upon request.

Dr. Gane has a longstanding passion for dental imaging and has published and lectured both nationally and internationally on this topic. Dr. Gane serves as vice president of Dental Imaging for PracticeWorks Inc., the exclusive maker of Kodak Dental Systems. Reach him at david.gane@pracitceworks.com.