

Digital Radiography: The Standard of Care

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It was not very long ago that there was debate about whether digital radiographs were as good as conventional x-ray films in the diagnosis of disease and dental decay. The argument was that digital intraoral x-ray technology was not only cumbersome to use but also inferior to x-ray film in producing a quality radiograph. While conventional x-ray film is still capable of producing an excellent radiographic image, an increasing number of dental professionals are choosing to use digital radiography over conventional film radiography in diagnosing dental caries for a variety of reasons. Digital radiography requires less radiation exposure than traditional x-ray film to capture an image, which is a key health benefit. Also, today's digital radiography systems are compatible with most existing x-ray equipment and most advanced imaging software systems. Digital radiographs have proven to be superior to conventional x-ray films in diagnosing the smallest lesions because of the ability to enlarge, enhance, contrast, and even colorize an image through the use of advanced imaging software. Digital radiographic images can increase the dentist's ability to share images for patient education or professional communication in an immediate and powerful manner, thereby elevating patient and professional service. Lastly, with digital radiography's advancement into two-dimensional and three-dimensional (3D) imaging, leading clinicians have concluded that digital radiography should be considered the standard of care.

INTRAORAL DIGITAL RADIOGRAPHY

There are two types of intraoral digital radiography systems, indirect (phosphor plate technology) and direct (sensor technology). Both systems produce an enhanced digital radiographic image that is superior to conventional x-ray

film in every way. Indirect digital radiography is similar to conventional x-ray film in that the phosphor-coated plates used to capture an image are similar in size to film and their use mimics film techniques. An individual plate is required to capture each desired radiographic image. Therefore, to acquire

16 images for a full mouth series, 16 phosphor plates will be required. The phosphor plates are placed into disposable barriers and then into the patient's mouth with the same holders that are used with conventional film. In essence, the same technique is used to expose phosphor-plates as for traditional x-ray film. After the images have been captured, the plates are placed in a scanning device, scanned over a period of 1 to 2 minutes, and then transferred to the computer where they can be saved in the patient's virtual record and viewed on the monitor. Indirect systems have some advantages. Because the plates and film are similar in size and the same technique and holders can be used for acquisition, indirect digital radiography requires little to no change for the dental team and patients, thus providing the comfort factor. Also, the phosphor plates are reusable, and their lifetimes are directly proportional to the care taken in their handling. While some systems only scan intraoral plates, several of the indirect digital scanning systems have the ability to produce panoramic digital images as well. This is especially attractive to offices that have an existing traditional panograph machine.

Direct digital radiography uses sensor chip technology through the use of either a charged-coupled device (CCD) or complementary metal oxide semiconductor (CMOS). Both technologies are direct in that after a sensor is placed in a disposable barrier and then into the patient's mouth, the image captured is transferred to the computer directly where it is stored in the patient's virtual record and displayed on the screen. The entire process from exposure to transfer takes place in 3 to 4 seconds. One sensor can be used for an entire full mouth series. Initially, some clinicians found the sensors were large and cumbersome; however, newer, thinner, and more comfortable sensors now are available.

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Also, many manufacturers now provide education and training on technique for team members, with most dental teams trained in 2 to 3 days. The marked advantage of direct systems over indirect is the speed at which the images can be captured and transferred to a patient's virtual record. A disadvantage to direct systems is that an office will require a separate panograph solution if it desires to use panographs for diagnosis.

Both direct and indirect digital radiography produce images that offer significant improvements over traditional x-ray film. There is no comparison between a 1 inch by 1.5 inch x-ray film on a view box and a digital image enlarged to the size of a computer screen when it comes to patient education and increased diagnostic capability. Patient understanding of the diagnosis is paramount for taking responsibility of his or her dentition and ownership of his or her dental treatment.

Because there is no difference in image quality produced by indirect and direct digital radiography, the system chosen by the practice is a matter of personal choice. Currently, there are four indirect digital radiography systems on the market and more than 20 direct systems. The main objection to intraoral digital radiography for most general dentists is the perceived high cost. However, when considering the cost of film, film mounts, a processor, processor repairs, chemicals, and chemical removal, digital radiography is very cost-effective. In addition, there is no comparison in the increased time and communication efficiency digital radiographs provide over the use of x-ray film.

Further, digital radiographic images are immediately available for electronic transfer to referring dentists and dental insurance payers. This ability to transfer radiographic images electronically provides better patient service, especially for preestimates of benefits and insurance claims, which can be processed in much less time. Sending radiographs through the mail can be costly, slow, and risky as they have a greater chance of becoming lost in transition. Therefore, the numerous benefits of intraoral digital radiography over conventional film or analog radiography has led most dental digital radiography experts to agree that dental digital radiography has become the standard of care for today's practices.

EXTRAORAL DIGITAL RADIOGRAPHY

Two-dimensional digital dental panoramic radiography has existed for more than a decade. However, its use in practice mainly has been limited to the specialties of oral maxillofacial

surgery and orthodontics. Now, more general dentistry practices are using digital panoramic radiography to provide greater diagnostic information of their patients' entire maxillary and mandibular hard and soft tissue structures because general dentists are responsible for their patients' complete oral health, not just their teeth and periodontia. Whereas the previous standard of care with respect to radiographs was a full mouth series, in the author's opinion today's standard of care must include an initial and periodic digital panoramic radiographs in addition to intraoral digital radiographs.

Panoramic radiographs allow a dentist to diagnose lesions in the maxilla and mandible that are beyond the view of sizes 1 to 4 intraoral radiographs that are limited to imaging only the apices of a patient's dentition. Dentists should question if they are serving the best interests of their patients if they are not imaging the entire oral region. Many existing lesions beyond the range of sizes 1 to 4 radiographs are asymptomatic. These lesions may go undiagnosed for years, possibly with great consequence to the patient.

Today's digital panoramic radiographic technology is very space conscience, affordable, easy to use, comfortable for patients, and produces high-quality images. Most systems can capture and transfer a panoramic image directly to the computer in 30 seconds where it can be stored in the patient's virtual record. As with intraoral digital radiographs, these images can be enlarged, enhanced, contrasted, measured, and highlighted for improved diagnostic capability and patient education, as well as eliminating the loss, misfiling, or misplacement of the images. And, they, too, can be transferred electronically for better and faster patient service. In addition, many of the digital panoramic systems have cephalomatic options necessary for use by oral maxillofacial and orthodontic specialists.

More than 10 digital panoramic radiography systems are available, with a price range suitable for the general dental practice as well as specialist practices. And, many third party payers provide a payment benefit for initial and periodic panographs. Therefore, dentists who believe that a digital panograph is part of a patient's diagnostic requirements will find the cost of purchasing this technology is more than offset by the fees collected for its use. Even when cost is not an issue, the benefit to the patient is. Digital panoramic images are accepted as the standard of care by most radiography experts.

Functional Esthetics & Restorative Dentistry

Newer to dentistry is 3D or cone-beam computed tomography (CBCT). This scanning technology enables dentists to capture 3D images of all the hard and soft tissues of a patient's oral cavity. However, most experts believe that CBCT will not replace digital panoramic radiography; it will complement it. CBCT's main use is to capture 3D digital images for use in diagnosis, treatment planning, implantology, and surgical procedures. The scans provide clinicians with accurate anatomical information.

Presently, eight CBCT systems are available. Some systems have multiple uses with respect to capturing digital panoramic, cephalometric, and bitewings radiographs. However, the cost of these systems is prohibitive for most general practices. While CBCT technology may remain limited to purchase by specialist practices, most experts agree that for specialists who are diagnosing and performing surgical procedures, CBCT radiographic technology will be the standard of care.

CONCLUSION

There are no obstacles to implementing digital radiography into every dental practice. Digital radiographs have proven to be time- and cost-effective for both the dental team and patients. They have increased the ability to diagnose decay and disease over conventional x-ray films. However, the greatest benefit of digital radiography is the increased opportunity to educate patients and communicate with dental professionals and benefit payers, which translates to better patient care and service. Simply put, digital radiography is the standard of care for today's dental practices.