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## OBSERVATIONS

# Why switch to digital radiography?

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Digital radiography in dentistry has been around for more than a decade, and it has improved significantly during that time.

However, the majority of practitioners in the United States have not abandoned conventional radiography, and many question the need to change to digital radiography. Is it finally time to move to this form of recording radiographic images? In this column, I will present a candid view of this technology and make a few personal conclusions about the state of the art in digital radiography.

The comments that follow represent my personal conclusions on the current state of digital radiography. My conclusions are based on several years of occasional use of this technology, current full-time use and in-depth clinical evaluation of most of the devices available in the last five years.

## ▶ ADVANTAGES OF DIGITAL RADIOGRAPHY

The following list of advantages is prioritized in order of my personal conclusions on digital radiography. They are based on clinical usage and research, and they may or may not be the same conclusions as those reached by other clinicians.

**Immediate observation of radiographic images.** If this were the only positive aspect of digital radiography, I still would choose it over conventional radiography. Keep in mind that only some digital radiography devices provide immediate viewing. Charge-coupled devices, or CCDs, provide immediate viewing. However, phosphorous-plate technology requires placement of the irradiated sensor in a processing device to scan it and put the information into a computer so that the image can be viewed.

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In conventional radiographic techniques, the delay in reading the image usually forces the clinician to change gloves and do something else as the radiograph undergoes development. On returning to the patient, the clinician must wash his or her hands, don new gloves and reorient himself or herself to the clinical procedure at hand.

Immediacy of viewing the image is a significant clinical advantage in accomplishing many oral procedures. It is especially important in endodontic therapy, implant surgery, evaluation of crown fit, placement of posts in endodontically treated teeth, evaluation of potential overhangs or open margins in newly placed restorations, detection of radiopaque foreign objects in soft tissue, patient education and innumerable other situations. When accomplishing implant placement, using conventional radiography is a major inconvenience, as the entire aseptic procedure is disrupted and time is wasted while the clinician awaits the development of the films several times during the implant placement procedure.

I have used both conventional and digital radiography for several years, but I easily can conclude that because of its advantage of immediate image viewing, digital radiography is highly desirable.

**Ability to enhance images.** How many times have you looked at a radiographic image and thought that it needed to be lighter or darker, or that you would like the image to be somewhat larger? Digital radiography allows the clinician to change contrast (to lighter or darker), enlarge images, place color enhancements or superimpose various textures on images. All of these changes of the original image facilitate easier detection of any pathosis that is present, and they also allow immediate and effective patient education.

**Data storage.** Pulling up specific stored radiographic images from a computer database is easy because of the highly organized nature of computer file storage. When using conventional radiography, all of us have had times when we have looked unsuccessfully for the paper chart and radiographs of a patient treated some years ago. With similar frustration, we have misplaced active patients' charts and radiographs, sometimes never finding them.

Patients who have been in any specific practice for many years have charts that are enormous because of the accumulation of bulky panoramic and full-mouth conventional radiographs organized in their plastic or cardboard holders. Conversely, it is amazing to observe how much data can be stored in the relatively miniscule space occupied by a computer, and how easily and rapidly the data can be retrieved. Of course, there is the obviously time-consuming challenge of placing previously made conventional radiographic images into digital form for storage in the computer. I will discuss this subject later.

**Developing solutions and conventional film developers.** One of the less desirable tasks in dental practice is maintaining and changing the radiographic developing and fixing solutions and keeping the often unreliable developing devices in a functional state. In digital radiography, those tasks are eliminated, along with the dark-room that still is present in some offices that do not use automatic film processors. The problems of odors and stains from the developing and fixing

solutions and the space occupied by the developing devices are eliminated when digital radiography is incorporated into a practice.

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**Communication with other practitioners.** One of the most useful advantages of digital radiography is the ability it gives clinicians to send images to other practitioners in a matter of minutes, even while talking on the telephone. I have used that advantage numerous times as I have been consulted about a specific technique or have been required to send images to another practitioner while the patient in question was being treated. There are various ways to send an image, but the commonly used e-mail method is one of the easiest.

**Less radiation.** When using conventional radiography, I often have been hesitant to make a radiograph because it exposes the patient to radiation. The reduction in radiation offered by digital radiography—usually 70 to 80 percent, and at times even more—allows multiple periapical images for the same radiation exposure involved in a single periapical image obtained via conventional radiography. This reduction in radiation is especially important in implant placement or difficult endodontic therapy, in which multiple images frequently are needed.

**Loss of conventional films.** Most practices have relatively efficient ways to store conventional radiographs in their respective patient charts, but occasionally a critical film comes loose from its holder, and it is lost without the possibility of retrieval. Assuming adequate back-up procedures are observed, there is no reason to lose stored digital radiographic images.

**Ease of use.** Some practitioners who are not comfortable with computers may debate this point. However, after a short learning period, accompanied with frequent use, the simple software necessary for use of digital radiography is easily mastered. The new wireless digital radiography concept (currently available only as the Schick CDR2000 Cam, Patterson Dental Supply, St. Paul, Minn.) has simplified the clinical procedure even more. In my opinion, the digital concept is easier, cleaner and certainly faster than conventional radiography.

## ▶ **DISADVANTAGES OF DIGITAL RADIOGRAPHY**

The following disadvantages are listed in decreasing order of my own personal beliefs relative to the objectionable nature of each.

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**Cost of devices.** At the present time, the cost of purchasing a digital radiography setup is considerable, ranging from \$11,700 to \$15,500 per operator for a wired system and \$20,000 to \$22,000 for a wireless system. Practitioners must be aware of the initial cost as they consider the advantages and disadvantages of the concept. In my opinion, this technology is far more important and necessary than other highly touted technologies that cost significantly more. After due consideration, the advantages of digital radiography appear to justify the high initial cost.

**Cost of converting previous records to digital.** The cost of employee time to scan and convert previous conventionally made radiographs into digital form is no small task. I suggest that previous radiographs be converted gradually, as patients come in for recall appointments. In this manner, the labor costs are spread over many months and can be absorbed by a typical practice without difficulty. The cost of converting conventional radiographs all at once is formidable.

**Learning to use the concept.** After receiving initial education to begin using digital radiography, staff members still will require significant time to master the use of the software. Mature staff members can learn the techniques rapidly, but every new staff member who is hired must go through the learning process. In my opinion, manufacturers should strive to simplify the software for these devices further to allow an easier and faster learning period.

**Wire attached to the sensor.** CCD-type sensors may be wired or wireless. With wired sensors, the presence of a wire attached to the sensor allows immediate observation of the image. However, clinicians must work around the wire. This is not difficult, but mastering it requires some effort and a learning period. Phosphorus sensors do not provide immediate observation of the radiographic image, but they also do not have the objectionable wire.

The elimination of the wire afforded by wireless sensors is a major advantage, but it must be considered in light of the significant cost of a wireless sensor.

**Thickness of the sensor.** CCD sensors vary in thickness, from more than 3 millimeters to more than 5 mm. Although this seems to be a major disadvantage, it is surprising to note the relative ease of use of CCD sensors in spite of their thickness. Wired sensors are not thinner than wireless sensors. Phosphorus sensors are thinner than CCD sensors, but they do not offer the advantage of immediate observation of the radiographic image.

**Rigidity of the sensor.** CCD sensors are rigid and can irritate the oral soft tissues and cause pain. If the patient experiences discomfort, the clinician can use soft foam attachments on the corners of the sensors to prevent pain. An example is Edge-Ease (Strong Products, Corona, Calif.). Phosphorus sensors are less rigid but still may cause discomfort if care is not exercised in their use.

**Loss or breakage of sensors.** The cost of one typical wired sensor varies from \$6,200 to \$9,800. It is not difficult to break the wire and thus necessitate repair or replacement. The cost of one wireless sensor varies from \$10,500 to \$12,500. Because of the small size of the sensors for periapical radiographs, it would not be difficult to lose one in a clinic with numerous employees.

**Lack of universal use of digital radiography.** It will be several years before this concept is used in most dental offices. In the meantime, some practitioners are accustomed to reading digital images, and almost all practitioners are accustomed to reading conventional radiographs.



## CONCLUSIONS

I have discussed the advantages and disadvantages of digital radiography on the basis of my observations and research. The dental profession in the United States continues to use conventional radiography more than digital radiography. The advantages of digital radiography have improved significantly in recent years, but the cost to convert from conventional radiography to digital is high. It is anticipated that dentists will continue to convert to digital radiography slowly and that the cost of these devices will decline slowly.

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