

Radiography software: a key diagnostic aid

As you evaluate systems, pay careful attention to these critical issues that can affect performance and diagnostic image quality.

By Dr. Larry Emmott



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used to believe that sensors were the most important component of a digital radiography system. I now realize software is equally important.

It is critically important for the hardware to provide a high-quality image (see “Defining resolution,” a sidebar below). And with today’s high-quality sensors, the user can get a high-resolution, high-contrast, low-noise image. Often, there is more data in the high-quality image than we can immediately see on screen. Is all that detail wasted? No, that’s where the software takes over.

Many digital radiography companies have concentrated on advancing sensors. In recent years, though, we’ve seen increased focus on how software can be used to enhance the diagnostic process.

A digital image provides much more data to aid in our diagnosis than a film image offers—if we know how to uncover the digital data. As we begin to understand this process, however, we need to move beyond our typical diagnostic imaging experience, which is film.

Change your paradigm

For more than 100 years, we have been using a little piece of film, and we have learned to interpret what the film displays with our eyes. This is our old standard, and we are comfortable with it.

However, we really should not be asking vendors “What digital radiography software is most like film?” Instead, we should ask, “What radiography software is most diagnostic?”

When a dentist views a radiograph, he or she is looking for specific pathologies. These include caries, bone loss, periapical changes, calculus, bony lesions, and more. We also look at several different types of tissues, including enamel, dentin, soft tissue, bone, pulp, and cortical bone. For the best diagnosis, each tissue and each pathology should be viewed differently. This means that there is an ideal x-ray image—it has the right exposure, contrast, and brightness, for example—that gives the best diagnostic view of

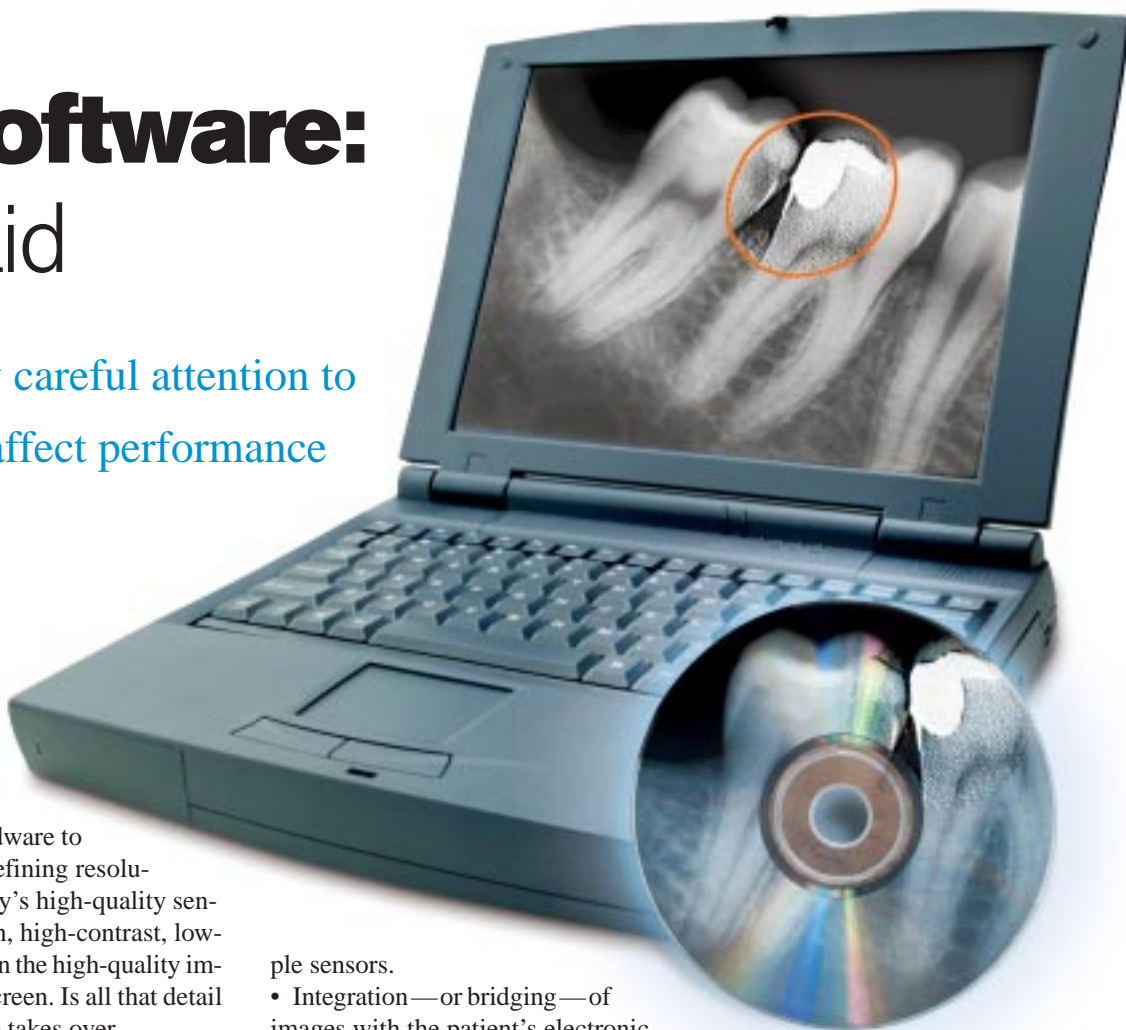
each tissue and pathology.

Of course, with a film radiograph, we typically have only one image from which to diagnose. However, with a digital radiograph, we can create more than one image, using various software tools to enhance a high-resolution image until we create an ideal view of different conditions to improve diagnosis.

Software features

Radiographic software programs offer a variety of features. Here are some examples:

- An electronic storage system to capture, store, retrieve, and display images.
- Basic enhancement tools, including brightness, contrast, and zoom.
- Interoperability—the ability to capture images from multi-



ple sensors.

- Integration—or bridging—of images with the patient’s electronic record.

- DICOM (Digital Imaging and Communications in Medicine) conformance. The DICOM standard allows dentists to transfer identified digital radiographs from one software system to another on software systems that are DICOM conformant, according to a workshop on the standard given at the American Dental Association’s Tech Day on Oct. 18, 2002.¹ The DICOM standard calls for the transfer along with the image of essential data, such as the patient’s name and the date the image was taken.

- Ease of use. It should be simple to do these tasks: Apply each enhancement tool and see the results, return to the original image, and move

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Digital radiography resources

For a list of companies currently offering digital radiography systems, see page 76.

Defining resolution

What do terms such as “lp/mm,” “megapixel,” and “bit” mean when it comes to defining image resolution? Here’s a look at these three terms.

Line pairs per millimeter (lp/mm)

This is a measure of resolution that refers to pairs of lines pressed tighter and tighter together until they eventually merge into a single line. The more lines that can be pressed into a millimeter and still be seen as individual lines, the higher the resolution. Digital radiography sensors can acquire images ranging from 8 to 22 lp/mm. The unaided human eye can distinguish about 10 to 14 lp/mm. Is that extra resolution lost? Not really. That’s where the software takes over.

Pixel and megapixel

Pixel is short for picture element. Basically, a pixel is a dot on the computer screen. The dots are arranged in rows and columns on the screen, and they are so

close together that they appear to be connected. The dot can be a shade of gray or a color. A typical 800 by 600 image has 480,000 pixels. The more dots that make up an image, the better the resolution. A megapixel is simply 1 million pixels.

8 bit or 12 bit

A bit is short for binary digit. In graphics, the term refers to the number of different shades or colors a single pixel can display. An 8-bit image is $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ —or 2 to the 8th power. If you do the math, that comes to 256. Most monitors display an 8-bit image, meaning each pixel could be one of 256 different shades of gray. A 12-bit image is 2 to the 12th power or 4,096 shades of gray. True color is 24 bits, which allows for 16 million different shades. At most, the unaided human eye can distinguish 100 shades of gray. Is the extra detail useless? It depends on the software.

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from one image to another with minimal mouse commands.

- Software manipulation for optimization of different tissues
- Pre-set, ideal-viewing settings for different tissues, such as soft tissue, tooth, bone, or enamel.
- Enhancement tools that help locate caries or enhance a calculus problem.

Enhancement tools

As you evaluate the various types of enhancement tools with any radiography software program, it's important to focus on the module's diagnostic value as much as its other benefits. For instance, if you are evaluating a digital-radiography sys-

tem at a trade show and the salesperson demonstrates an enhancement tool such as colorization or 3-D embossing, you'll want to discuss the diagnostic benefit of this feature so that you can understand its uses and benefits. You may want to know what clinical research supports using a given image enhancement feature.

Magnification tools are a great example of the benefits that diagnostic software offers. Most every radiography-software system offers some type of magnification tool. This provides a magnified view of a section of the image (and each company has a proprietary name for this magnification feature). The magnification tool allows us to focus on a very specific

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**Ergotron
jr 1/3 h**

See us at the XXX Meeting, Booth XXX.
Use XXX on card or at www.dentalproducts.net

**Ribbond Inc
jr 1/4 v**

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Use XXX on card or at www.dentalproducts.net

Digital radiography resources

To find out more about digital radiography systems, check out the product offerings of the companies listed alphabetically below. You can get free information on each of the products these companies offer by circling its **Select No.** on *Dental Product Report's Product Information Card*, found in the front of this issue.

SCANX PHOSPHOR-PLATE-BASED DIGITAL RADIOGRAPHY SYSTEM

Air Techniques Inc.
800-AIR-TECH
(800-247-8324)
www.airtechniques.com
Select 216.

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JUPITER PLUS CDX RADIOGRAPHY SOFTWARE

Bio-Med USA Inc.
973-278-5222
www.biomedus.com
Select 217.

CYGNUSRAY MPS DIGITAL X-RAY SENSORS

Cygnus Technologies, a Progeny Dental Co.
800-626-2664
www.cygnus-technologies.com
Select 218.

IMAGERAY DIGITAL X-RAY SENSORS

Dentrix Dental Systems Inc., a Henry Schein Co.
800-DENTRIX
(800-336-8749)
www.dentrix.com
Select 219.

GX-S^{USB} SENSORS

Dentsply Gendex
800-800-2888
www.gendexxray.com
Select 220.

DENOPTIX WIRELESS PHOSPHOR-PLATE-BASED DIGITAL RADIOGRAPHY SYSTEM

Dentsply Gendex
800-800-2888
www.gendexxray.com
Select 221.

EVA INTRAORAL DIGITAL RADIOGRAPHY SYSTEM

Dent-X Corp. USA
800-225-1702
www.dent-x.com
Select 222.

DEXIS 5.0 DIGITAL RADIOGRAPHY SOFTWARE WITH CLEARVU IMAGE-ENHANCEMENT TOOL

Dexis
888-88-DEXIS
(888-883-3947)
www.dexray.com
Select 223.

SIGMA DIGITAL X-RAY SYSTEM WITH CLINIVIEW SOFTWARE

Instrumentarium Imaging Inc.
800-558-6120
usa.instrumentarium.com
Select 224.

VIPERRAY DIGITAL X-RAY SENSORS WITH VIPERSOFT SOFTWARE

Integra Medical, a Henry Schein Co.
877-VIPER-60
(877-847-3746)
www.vipersoft.com
Select 225.

LIGHTYEAR PORTABLE HANDHELD DIGITAL X-RAY SYSTEM

Lightyear Technology Inc.
866-946-2431
www.lightyeartechtechnology.com
Select 226.

MEDIADENT SDX DIGITAL X-RAY SENSORS AND DIGITAL IMAGING SOFTWARE

MultiMedia Dental Systems Inc.
877-770-8514
www.mediadentusa.com
Select 227.

PAXORAMA XI PHOSPHOR-PLATE-BASED DIGITAL RADIOGRAPHY SYSTEM WITH DENT-A-VIEW SOFTWARE

Orex Computed Radiography
888-844-7775
www.orex-cr.com
Select 228.

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area of the image and enlarge it to nearly full screen. Special filters can also make the image clearer.

(*Editor's note:* For a look at specific features of currently available digital radiography systems, see "Digital radiography systems," a Practice Innovations report, in

DPR's February 2003 issue.² This article also can be viewed on our Web site: www.dentalproducts.net. For specific details on how to find the article on our Web site, see "What's online" on page 80. For a list of companies that make digital radiography systems, see "Digital radiography resources," right.)

If we truly evaluate radiography software features based on their diagnostic value, we can better understand what aspects of the technology, including the sensors, truly lead to the capture and display of a high-quality image (high contrast, high signal-to-noise ratio, and high spa-

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Digital radiography resources

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PROMAX DIGITAL PANORAMIC X-RAY UNIT WITH DIXI2 SENSORS

Planmeca USA/Planmeca Inc.
630-529-2300
www.planmecausa.com
Select 229.

RVGUI ULTIMATE IMAGING DIGITAL RADIOGRAPHY SENSORS

*PracticeWorks Inc./Trophy Radiologie S.A.**
800-944-6365
www.practiceworks.com
Select 230.

QSIRAY DIGITAL RADIOGRAPHY SYSTEM

Quality Systems Inc.
800-888-7955
www.qsii.com
Select 231.

CDR WIRELESS INTRAORAL SENSORS

Schick Technologies Inc.
800-873-7683
www.schicktech.com
Select 232.

CDR STANDARD INTRAORAL SENSORS

Schick Technologies Inc.
800-873-7683
www.schicktech.com
Select 233.

BIO-RAY INTRAORAL DIGITAL CCD SYSTEM

Sigma Biomedics
800-331-6077
www.sigmabiomedics.com
Select 234.

SIDEXIS DIGITAL RADIOGRAPHY SYSTEM WITH INTRAORAL, PAN, AND CEPHALOMETRIC CAPABILITIES

Sirona USA
800-659-5977
www.sirona.com
Select 235.

DIGORA FMX DIGITAL RADIOGRAPHY SYSTEM WITH WIRELESS PHOSPHOR PLATES AND DIGORA FOR WINDOWS SOFTWARE

Soredex Inc.
800-235-8854
www.soredexusa.com
Select 236.

XDR DIGITAL RADIOGRAPHY SYSTEM WITH XDR IMAGING SOFTWARE

Technology Advantage Inc./Cyber Medical Imaging Inc.
888-368-9806
www.technology-advantage.com
Select 237.

QUICKRAY UNIVERSAL DIGITAL SENSOR AND QUICKRAY DIGITAL X-RAY KIT

Video Dental Concepts
800-323-2690
www.videodental.com
Select 238.

RSV (RADIOLOGY SYSTEM VISODENT) DIGITAL X-RAY SYSTEM

Video Dental Concepts
800-323-2690
www.videodental.com
Select 239.

*In July, Eastman Kodak Co. announced that it had entered into an agreement to acquire PracticeWorks Inc., and the French subsidiary Trophy Radiologie S.A. For more on this acquisition, see the Special Report, "Snapshot—Kodak to acquire PracticeWorks, Trophy," on page 108.



Digital radiographs

are not only as good as film, **software** makes them **better.**

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rational resolution, i.e., line pairs/mm). Conversely, we will develop a better understanding of features that may improve convenience or patient communication as opposed to diagnostic quality.

For years, dentists have been asking, "Is digital as good as film?"

The answer is quite clear: "Digital radiographs are not only as good as film, software makes them better."

Digital images are better because we can use enhancement software to improve diagnostic efficiency. As we learn how to best use this amazing tool, we soon will drop the old film standard. We will use radi-

ographs in ways we can't yet imagine. The future is coming and it will be amazing! **DPR**

Dr. Larry Emmott, a recognized authority on dental technology in America, is a practicing general dentist in Phoenix. He also is a professional speaker, a featured instructor at the Las Vegas Institute, and a member of the American Academy of Dental Practice Administration. He has written hundreds of articles on dentistry, computer use, and management. He also writes a monthly electronic newsletter, "Emmott on Technology," on using dental technology. Dr. Emmott offers hands-on technology seminars to selected dentists in his Phoenix office (the next one is Oct. 3-4). Plus, this summer he held a technology seminar in Sedona, Ariz., that combined biking in the morning and classes in the afternoon. At these seminars participants receive personalized advice on setting up their office to maximize their high-tech future. Topics include digital radiology, cosmetic imaging, and treatment room design. To find out more, check out Dr. Emmott's Web site at www.drlarryemmott.com or call him at 602-279-1641.

Video Dental Concepts
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References

1. Emmott L. Report from ADA's Tech Day: DICOM interoperability demo. *Dental Products Report*. 2002;37(12):76-80.
2. The editors. Digital radiography systems. *Dental Products Report*. 2003;37(2):128-135.

Photo credit

- Photo of the RSV (Radiology System Visiodent) digital x-ray system on page 74 courtesy of Video Dental Concepts

What's online

You can find more about digital radiography systems, both live and in print, by going to our Web site: www.dentalproducts.net. On our home page, click on , and following the link, "Guide to digital radiography systems: live and in print." You will be taken to a page listing two guides:

In-print guide
A look at system features of 21 currently available digital radiography systems, as compiled by the editors of *Dental Products Report*.

Video demonstrations
Live video demonstrations of products related to digital radiography, based on editor interviews with the following seven companies:

- Air Techniques (Scan X phosphor plate system)
- Dentsply Gendex (DenOptix digital imaging system)
- Eastman Kodak (1200 Distributed Medical Imager inkjet printer)
- J. Morita USA (Versviewpocs panoramic x-ray apparatus—upgradeable to digital)
- MultiMedia Dental Systems (MediaDent digital imaging software)
- Planmeca (Digital panoramic system with CCD sensors)
- Schick Technologies (Digital panoramic system with CCD sensors)