

Digital Radiography Sensors: Which is Best?

Gordon and Paul's Clinical Bottom Line: Integration of digital radiography into dental practice has been slower than many anticipated. However, it offers numerous advantages over film radiography and is well accepted by most users. The challenges that have impeded its adoption continue to include the high cost and complexity of computerizing the operations, the time and effort required to learn new software, and bulky rigid sensors. *The following report discusses the latest trends in digital radiography and compares the features of eight systems.*

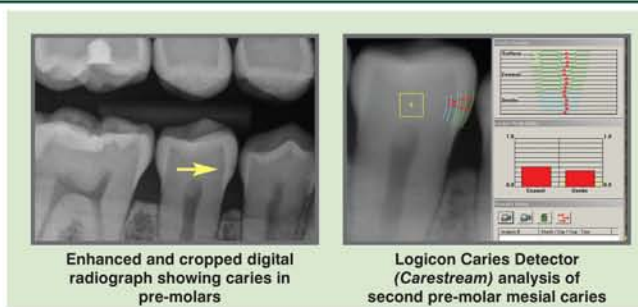
Digital intraoral radiography has similar diagnostic capabilities as film, and is used by an estimated 30-40% of general dentists in North America. Key advantages and limitations include the following:

Advantages:

Limitations:

- Instant images and quick re-takes
 - On-screen review with patient
 - Enhancement tools to aid diagnosis
 - Electronic storage in patient's file
 - Reduced exposure to ionizing radiation
 - Elimination of chemical film processing
- High cost
 - Complexity of chairside computer hardware and software
 - Large, rigid sensors
 - Continued adequate service of film

The following report explains the latest innovations in digital radiography, compares the features and performance of eight systems, and provides clinical guidance from experienced clinicians.



Enhanced and cropped digital radiograph showing caries in pre-molars

Logicon Caries Detector (Carestream) analysis of second pre-molar mesial caries

Comparison of Eight Systems

The following chart shows features and performance of eight popular digital intraoral radiography systems: Seven direct digital CMOS sensors and one PSP (phosphor plate) scanner. For comparison, only data for the size 2 (universal) sensors are shown.

Brand Company	Kodak RVG 6100* Carestream Dental	GXS-700 Gendex Dental Systems	Dexis Platinum Dexis	ScanX Air Techniques (PSP Scanner)	Visteo Owandy USA	CDR Elite Schick Technologies	DentiMax DentiMax	SuniRay Suni Medical Imaging
Starting costs	\$20,424 Includes size 1 and 2 sensors, software, holders, sheaths, web-based training. \$1,995 Logicon software. 3-year warranty	\$19,495 Includes size 1 and 2 sensors, holders, sheaths, on-site training. \$2,895 VixWin Platinum software. 2-year warranty	\$14,995 Includes PerfectSize (universal) sensor, software, holders, sheaths, on-site training. 1-year warranty	\$9,995 Includes one size 1 and eight size 2 plates, scanner, sheaths. \$995 Visix software. 2-year warranty	\$14,995 Includes size 1 and 2 sensors, software, holders, sheaths, on-site training. 2-year warranty	\$25,000 Includes size 1 and 2 sensors, software, holders, sheaths. \$1,200 on-site training. 2-year warranty	\$11,999 Includes size 1 and 2 sensors, software, holders, sheaths, web-based training. 18-month warranty	\$14,995 Includes size 1 and 2 sensors, software, holders, sheaths, on-site training. 2-year warranty
Sensor sizes available and replacement cost	Size 0: \$9,264 Size 1: \$10,199 Size 2: \$10,999	Size 1: \$9,995 Size 2: \$10,995	PerfectSize: \$10,495	Size 0, 1, 2, 3, 4 \$30-\$96 each	Size 1: \$6,995 Size 2: \$7,999	Size 0: \$7,096 Size 1: \$10,476 Size 2: \$12,204	Size 1: \$5,499 Size 2: \$6,499	Size 1: \$5,995 Size 2: \$6,495
Size 2 Sensor								
Dimensions (Thickness with cord)	44.0 x 32.2 mm 7.6 mm thick (14.4 mm)	41.7 x 30.5 mm 7.6 mm thick (12.4 mm)	38.8 x 29.7 mm 8.3 mm thick (13.7 mm)	41.1 x 31.1 mm 0.4 mm thick (0.4 mm)	41.6 x 30.5 mm 8.5 mm thick (14.8 mm)	43.9 x 31.2 mm 6.3 mm thick (13.6 mm)	43.2 x 30.6 mm 5.5 mm thick (11.5 mm)	43.6 x 31.6 mm 5.8 mm thick (12.5 mm)
Image Area	920 mm ²	850 mm ²	780 mm ²	1080 mm ²	830 mm ²	910 mm ²	890 mm ²	890 mm ²
Patient comfort	Good-Fair	Excellent-Good	Excellent-Good	Good-Fair	Good	Fair	Good-Fair	Fair
Infection control	Excellent-Good	Excellent-Good	Good	Good	Excellent-Good	Excellent-Good	Good	Good
Ease of image capture	Excellent	Excellent-Good	Excellent-Good	Good	Excellent	Excellent	Good	Excellent-Good
Image enhancement tools	Excellent-Good	Excellent	Excellent	Excellent	Good	Excellent-Good	Fair	Fair
Image quality	Excellent-Good	Excellent	Excellent	Excellent-Good	Good	Excellent-Good	Excellent-Good	Good-Fair
Software ease of use	Excellent	Excellent-Good	Excellent-Good	Excellent	Good	Excellent-Good	Fair	Good-Fair
Caries detection software	Yes, Logicon	No	No	No	No	No	No	No
Overall Grade	Excellent-Good 	Excellent-Good 	Excellent-Good 	Excellent-Good 	Good	Good	Good	Good-Fair

*CR also evaluated the Kodak RVG 6500 wireless system, which had similar results.

Summary of Chart

- Cost:** Cost of sensors is still high despite maturity of technology.
- Sensor size:** Size 2 sensors meet most needs and show more oral structures. Size 1 and 0 sensors are critical for small mouths and other situations.
- Infection control:** All sensors tolerate wipe disinfection, few tolerate immersion, and none can be autoclaved. Form-fitting sheaths were generally preferred.
- Ease of image acquisition:** Best systems captured images quickly with little or no computer manipulation.
- Image enhancement tools:** Best systems had automated enhancements and simple, intuitive tools.

- Image quality:** All systems were useful for diagnosing clinical conditions. Higher quality images showed details of subtle structures, caries, soft tissue, and margins clearly.
- Software ease of use:** Software complexity is a problem. Systems with higher grades had more intuitive controls, automated steps, and better enhancement tools.
- Automatic caries detection:** Currently, only Kodak RVG systems offer Logicon software for diagnosing interproximal caries. A future report by TRAC Research will characterize Logicon.
- Overall grade:** Overall grade is based on cost, sensor size, patient comfort, image quality, ease of use, enhancement tools, infection control, and unique features.

Digital Radiography Sensors: Which is Best? (Continued from page 1)

Latest Innovations and Trends In Digital Intraoral Radiography

- Fast and reliable sensor connection and recognition using USB ports
- Field-replaceable cords minimize replacement of the entire sensor
- Swiveling cord connection to reduce cord twist and improve positioning

- Reliable wireless sensors using Wi-Fi connections
- Rounded corners and smaller sensors improve access and patient comfort
- Sensors that detect position of x-ray head to correct alignment problems

CR Survey on Digital Radiography (n=1476)

Digital Use: 65% digital, 26% film, and 9% both

Convert to Digital: 8% plan to convert in next 6 months, 11% in 1 year, 24% in 2 years, 57% 5 years or never

Barrier to Converting to Digital: 1) cost, 2) retiring soon, 3) poor cost/benefit ratio, 4) quality of images compared to film, 5) size of sensors or don't see it as advantageous, 6) no computers

Main Advantages (ranked in order): 1) immediate viewing of images, 2) decreased radiation exposure to patient, 3) enhancement of images, 4) digital storage of images, 5) no developing/chemicals

Main Disadvantages (ranked in order): 1) cost, 2) rigidity and size of sensor, 3) sensor cord damage, 4) maintenance and repair, 5) learning curve, 6) software is difficult to use

Most Used Digital Systems: 1) Dexis, 2) Schick, 3) Kodak, 4) Gendex, 5) Suni, 6) others

Cordless vs. Coded: 13% use cordless sensors

Good Investment: 99% of those who use digital radiography (n=1100) stated it was a good investment

Enhancement of Images: 16% enhance digital images for diagnosis on every radiograph made, 37% on almost every radiograph, 38% sometimes, 8% infrequently, and 1% never

Software Ease of Use: 47% excellent, 46% good, 6% fair, 1% poor

Immediate Image Quality (without enhancement): 30% excellent, 57% good, 12% fair, 1% poor

Accuracy of Radiographs: 54% believe digital radiographs are more accurate than film

Patient Education: 34% always use digital radiographs for patient education, 56% often, 9% Sometimes, 1% rarely, 0% never.

Lead Apron Use: 88% use for every patient with digital radiography

Concern with Excess Radiation: 2% extremely concerned, 51% somewhat, 47% not concerned

Staff/Dentist Stay in Room during Exposure: 1% always, 3% often, 11% sometimes, 85% rarely or never

Handheld Radiation Source: 1% use a handheld source (such as *Nomad*) with digital

Recommendation to Film Users: 52% of digital users state to convert immediately as the benefits outweigh limitations; 47% state convert soon if time, space, and finances allow; 1% state convert in a few years; 0% state stay with film

Digital Radiography FAQs

1. Is digital radiography more accurate for diagnosing caries than film-based radiography?

CR research has demonstrated that they are very similar (*Clinicians Report March 2011*). However, with enhancement features and diagnostic tools available (such as *Logicon by Carestream*), digital is easier for diagnosing caries and should replace film.

2. Is digital radiography better than film-based radiography?

Yes. Although there is a substantial difference in cost, the overall benefits of digital far outweigh its limitations.

3. What are the new innovations that are available for digital radiography?

Replaceable cords are now available for some systems (*CDR and Visteo*) to limit expense of replacement or damage. Wi-Fi wireless sensor (*Kodak RVG 6500*) eliminates the cord stretching across the operatory to the patient.

4. What are the major differences among digital systems?

Cost, software ease of use, patient comfort, image quality, and manufacturer support.

5. Which is better: CMOS sensors or PSP (phosphor plates)?

Both are excellent choices with adequate image quality for diagnosis. Phosphor plates are thin and cordless but do not provide an immediate image. Both have advantages and limitations. Consider what is best for your practice.

6. Should I use wireless sensors or corded sensors?

Both provide adequate images, however, there is increased potential for loss of wireless sensors.

7. What are the major areas of improvement still needed for digital radiography?

The overall cost to clinicians needs to decrease significantly. CMOS sensors are too large and rigid making placement a challenge when attempting to capture all root apices and anatomical structures.

8. Will the digital radiography system integrate with my current practice management software?

This varies by digital radiography system as direct integration to practice management software is not available with every system. Bridging to the practice management system takes an extra step, requiring more time for software use.

9. What other factors should I consider before converting to digital?

Test each system at a convention or by contacting your distributor or the manufacturer. Understand and consider the warranties and maintenance plans available. Look for a system that will fit well with your practice style and needs.

10. When should I convert to digital radiography?

As soon as possible.

CR Conclusions: All digital intraoral radiography systems evaluated, both direct digital and phosphor plate systems were adequate for clinical diagnoses. No system had all ideal features and long-term durability is still unknown, however, the technology is stabilizing and ongoing refinements are improving reliability and ease of use. High cost and chairside computer use continue to be major limitations. Clinicians can base purchase decision on budget, compatibility with practice management software, image quality, features, and ease of use. Kodak RVG 6100, GXS-700, Dexis Platinum, and ScanX had best combination of performance, features, and cost.

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1. **CLINICAL FIELD TRIALS** where new products are incorporated into routine use in a variety of dental practices, and compared by clinicians to products and methods they use routinely.
2. **CONTROLLED CLINICAL TESTS** where new products are used and compared under rigorously controlled conditions, and patients are paid for their time as study participants.

3. **LABORATORY TESTS** where physical and chemical properties of new products are compared to standard products.

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