Digital Radiography Sensors: Which is Best?

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:**
- 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

**Limitations:**
- 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.

### Comparison of Eight Systems

<table>
<thead>
<tr>
<th>Brand/Company</th>
<th>Kodak Rvg 6100*</th>
<th>GXS-700 Genex Dental Systems</th>
<th>Dextra Platinum Dents</th>
<th>ScanX Air Techniques (PSP Scanner)</th>
<th>Vistex Owayndy USA</th>
<th>CDR Elite Schick Technologies</th>
<th>DentMax Dent Max</th>
<th>SuniRay Oral Medical Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Starting costs</strong></td>
<td>$20,624 Includes size 1 and 2 sensors, software, holders, sheaths, web-based training $1,995 Logicon software 3-year warranty</td>
<td>$19,495 Includes size 1 and 2 sensors, holders, sheaths, on-site training $2,855 VixxRin Platinum software, 2-year warranty</td>
<td>$14,995 Includes PerfectSize (universal) sensor, software, holders, sheaths, on-site training 1-year warranty</td>
<td>$9,995 Includes one size 1 and eight size 2 plates, tray, sheaths, $995 VixxRin software, 2-year warranty</td>
<td>$14,995 Includes size 1 and 2 sensors, software, holders, sheaths, on-site training 2-year warranty</td>
<td>$25,000 Includes size 1 and 2 sensors, software, holders, sheaths, $1,200 on-site training, 2-year warranty</td>
<td>$11,995 Includes size 1 and 2 sensors, software, holders, sheaths, web-based training, 10-month warranty</td>
<td>$14,995 Includes size 1 and 2 sensors, software, holders, sheaths, on-site training, 2-year warranty</td>
</tr>
<tr>
<td><strong>Sensor sizes available and replacement cost</strong></td>
<td>Size 0: $9,264 Size 1: $10,199 Size 2: $10,999</td>
<td>Size 1: $9,995 Size 2: $10,095</td>
<td>PerfectSize: $10,495 Size 0, 1, 2, 3, 4, 5, 6 $9,995</td>
<td>Size 0: $6,995 Size 2: $7,999</td>
<td>Size 0: $7,096 Size 1: $10,476 Size 2: $12,204</td>
<td>Size 1: $5,995 Size 2: $6,495</td>
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<tr>
<td><strong>Size 2 Sensor</strong></td>
<td>PHOSPHOR PLATE</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>44.0 x 32.2 mm (7.6 mm thick)</td>
<td>41.7 x 30.5 mm (7.6 mm thick)</td>
<td>38.8 x 29.7 mm (8.3 mm thick)</td>
<td>41.1 x 31.1 mm (0.4 mm thick)</td>
<td>41.6 x 30.5 mm (8.5 mm thick)</td>
<td>43.9 x 31.2 mm (6.6 mm thick)</td>
<td>43.2 x 30.6 mm (5.5 mm thick)</td>
<td>43.6 x 31.6 mm (5.8 mm thick)</td>
</tr>
<tr>
<td><strong>Image Area</strong></td>
<td>920 mm²</td>
<td>850 mm²</td>
<td>780 mm²</td>
<td>1080 mm²</td>
<td>830 mm²</td>
<td>910 mm²</td>
<td>890 mm²</td>
<td>890 mm²</td>
</tr>
<tr>
<td><strong>Patient comfort</strong></td>
<td>Good/Fair</td>
<td>Excellent/Excellent</td>
<td>Excellent/Good</td>
<td>Good/Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td><strong>Infection control</strong></td>
<td>Excellent/Good</td>
<td>Excellent/Good</td>
<td>Excellent/Good</td>
<td>Good</td>
<td>Excellent/Good</td>
<td>Excellent/Fair</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Ease of image capture</strong></td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Image enhancement tools</strong></td>
<td>Excellent/Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Image quality</strong></td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Software ease of use</strong></td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Caries detection software</strong></td>
<td>Yes, Logicon</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Overall Grade</strong></td>
<td>Excellent/Good</td>
<td>Excellent/Good</td>
<td>Excellent/Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
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</table>

**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 tolerant 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: 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) Dentsply, 2) Schick, 3) Kodak, 4) Genex, 5) Suni, 6) others
Cordless vs. Corded: 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

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 Envisage 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 Vistec) to limit expense of replacement or damage. Wi-Fi wireless sensor (Kodak RVG 6500) eliminates the cord stretching across the operator 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, Densis Platinum, and ScanX had best combination of performance, features, and cost.

What is CR?

CR was founded in 1976 by clinicians who believed practitioners could confirm efficacy and clinical usefulness of new products and avoid both the experimentation on patients and failures in the closet. With this purpose in mind, CR was organized as a unique volunteer effort where clinicians worldwide unite their expertise for the sole purpose of testing all types of dental products and disseminating results to colleagues throughout the world.

HOW DOES CR FUNCTION?

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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.

WHO FUNDS CR?

Research funds come from subscriptions to the Gordon J. Christensen Clinicians Report. Revenue from CR’s “Dentistry Update” course supports payrolls for non-clinical staff. CR is a non-profit, educational, and research institute. It is not owned in whole or in part by any individual, family, or group of investors. This system, free of outside funding, was designed to keep CR’s research objective and candid.

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