Wireless digital sensors

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Fig. 1_Wireless digital sensor technology is the most popular digital radiography process worldwide.
Fig. 2_Wired chip sensors with bitewing images.
Fig. 3_The PSP sensor is quite pliable and has a reasonable flex upon insertion into the mouth.

_When digital dental radiography was first introduced in the late 1980s, conventional X-rays had been in use for almost a century. The radiograph had, over the years, expanded the dentist's investigative capacity in many ways; it was possible to confirm health, or to detect disease, in many previously invisible areas of concern to the profession, including coronally, pariapically, and periodontally. Visual access, complemented by radiographic interpretation, provided a comprehensive environment for earlier and more accurate diagnosis.



Fig. 1

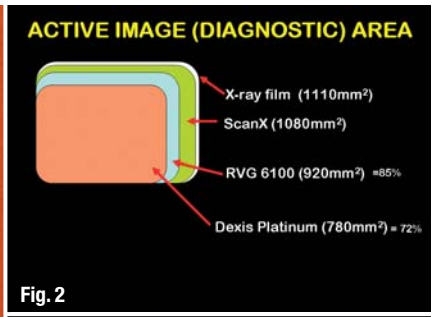


Fig. 2

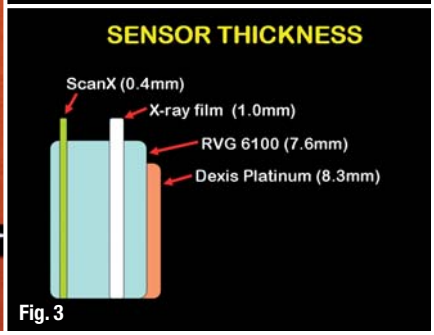


Fig. 3

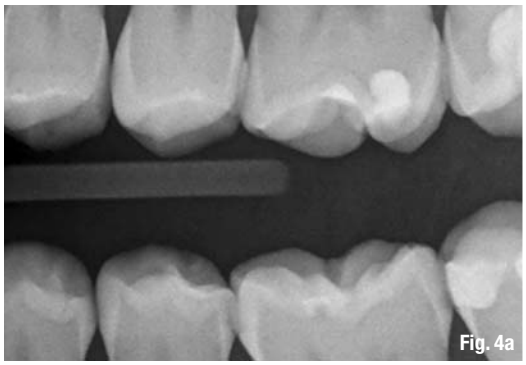
_Advantages of digital radiography

For the practitioner, the lost production of the conventional X-ray's developing downtime (5 to 10 minutes) has always been a very costly break in the production day. The virtually immediate computer-generated radiographic image eliminates this irritating issue. For the dental team, the elimination of the darkroom, its chemicals, solution replenishment routines, foul odours, and increasingly complicated environmental liabilities are welcome changes.

Modern digital radiographic systems today provide highly accurate and clinically relevant diagnostic information. Their many advantages include: virtually immediate results, clinical accuracy, expanded diagnostic options, decreased patient radiation, convenient data storage and communication, ease of clinical use by auxiliaries, decreased consumable costs, and a more environmentally friendly profile.

_Digital radiography options

Several categories of innovative dental radiographic imaging technologies have been intro-


Fig. 4a

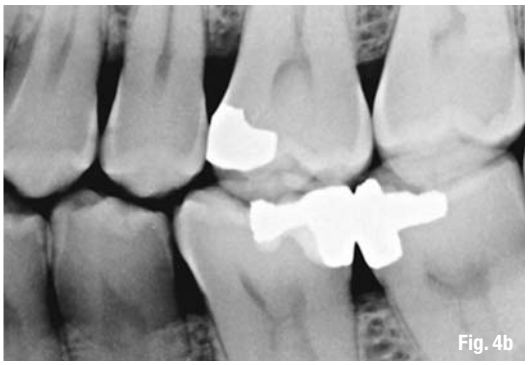

Fig. 4b

Fig. 4a & b_In some cases, effective imaging requires a greater radiation exposure for the patient.

duced into the dental marketplace. In general, they can be used with existing X-ray units. As a major benefit to dental patients, a significant decrease in radiation emission is required. Practitioners looking to update and upgrade their traditional (silver halide) radiographic systems have excellent clinical options. One of the most important selection criteria is the sensor-to-computer data transfer mode. Some digital chip sensors, such as the CCD (Charge Coupled Device) and CMOS (Complementary Metal Oxide Sensor), are hardwired to the computer through a USB or utilise a Bluetooth connection. The digital PSP (Phosphor Storage Plate) sensors (ScanX, Air Techniques, Melville NY) are wireless, and are most similar in appearance, function and convenience to traditional radiographic film. Wireless digital sensor technology (Fig. 1) is the most popular digital radiography process worldwide, with more than 50,000 dentists having incorporated PSP into their practices. The three types of sensors, CMOS, CCD, and PSP are equivalent in terms of the data that they accumulate per square millimetre during their very brief exposure to ionizing radiation, and then transfer to a digital image format.

Sensor diagnostic surface area

Sensor dimensions are crucial to diagnostic utility. The larger the active surface (or image) area, the greater the amount of information the sensor provides to the practitioner. A traditional size 2 film provides about 1,100 mm^2 of diagnostic area. Similarly, a size 2 ScanX wireless digital sensor offers 1,080 mm^2 of diagnostic area. Digital chip sensors typically have a smaller active area, providing correspondingly less diagnostic information. There is a further complication for the wired chip sensors with bitewing images (Fig. 2). The sensor wire must be placed between the posterior teeth, preventing their complete intercuspation. Unlike a thin cardboard or plastic bitewing tab, the wire is 4–6 mm in diameter, leaving the teeth that distance apart. The resulting empty interocclusal space is non-diagnostic for dental structures, and in fact, prevents the effective imaging of the gingival areas and the crestal bone. This often necessitates a vertical reorientation of the sensor and/or more radiographs, requiring a greater radiation exposure for the patient (Fig. 3).

Sensor thickness

The thickness of the sensor can be a major barrier to patient comfort and proper positioning of the sensor. A traditional size 2 film, at approximately 1.0 mm of thickness, can be rather uncomfortable for some patients, particularly individuals with small mouths or conditions such as lingual tori. Wired digital sensors range from 5.5–8.3 mm in thickness. Their thickness makes them more difficult position in the mouth and more difficult for the patient to retain comfortably. The ScanX wireless digital sensor is less than half as thick as a conventional X-ray film at 0.4 mm. Furthermore, unlike the rigid, wired sensors, the PSP sensor is quite pliable and has a reasonable flex upon insertion into the mouth (Fig. 4), significantly increasing patient comfort.

Fig. 5_ScanX wireless digital sensors are available in different sizes.



Fig. 5



Fig. 6_ScanX wireless digital sensors for standard bitewing.
Fig. 7_ScanX wireless digital sensors periapical.
Fig. 8_ScanX wireless digital sensors endodontic.

Wireless sensor size range

ScanX wireless digital sensors are available in a range of sizes (Fig. 5): #0 and #1 for smaller and/or constrained mouths, #2 for standard bitewing, (Fig. 6) periapical, (Fig. 7) and endodontic (Fig. 8) images, #3 for long bite wings, #4 for occlusals, panoramic, (Fig. 9) cephalometric, (Fig. 10) and TMJ. Each sensor is a reusable plate that is inserted into a disposable protective barrier sleeve, positioned as required, briefly exposed, scanned and the data is immediately transmitted to the computer for image display. During the scanning, the data is automatically erased from the sensor, preparing it for immediate re-use in a new protective barrier sleeve.

The intraoral sizes are fabricated of a flexibly soft, reusable plastic that can be curved extensively to better fit the patient's mouth. If the digital sensor is bent to the point where the surface cracks, the broken portion of the sensor surface can no longer provide diagnostic information. With reasonable care, each sensor should last for thousands of images.

Fig. 9_ScanX wireless digital sensors panoramic.
Fig. 10_ScanX wireless digital sensors cephalometric.





_Digital sensor replacement cost

Most breakdowns of chip sensors occur at the wire-sensor interface. While this should be easily (and inexpensively) repairable, there is a general reluctance to refurbish this connection, and the dentist is placed in a position where new sensors must be acquired. Whether the problem is a crushed chip or a frayed lead cable, wired digital sensors are very expensive to replace (often US$ 5,000–10,000 or more).

In fact, it is highly advisable to have a replacement (insurance) policy with the manufacturer or dealer to cover these eventualities. The replacement warrantee is typically more than US$1,000 per year per sensor. Wireless sensors, on the other hand, are far less costly; a size #2 replacement sensor costs about US$40. Moreover, there are no wires to break. Considering a lifespan of thousands of exposures, the per-use cost of a PSP digital sensor is negligible.

_Developing/scanning time

Conventional X-rays were developed to image viewability through chemical baths, water rinses and air dryers. The process was long and frustrating, particularly if the results were needed quickly. After intraoral exposure, a single film might be ready in 5–6 minutes, but a full mouth series took 10 minutes or longer. Wired digital sensors transmit the ionization data to the software immediately, and the images are ready for viewing as soon as they are processed (typically a very minimal delay).

ScanX wireless digital sensors are placed in the small footprint scanning unit, ScanX Swift (Fig. 11) and the images are available for viewing momentarily. The first PSP image is ready within 11 seconds, and subsequent one take 4 seconds each. Thus, a 4-bitewing series is ready for viewing in less than 30 seconds, and a full mouth series within 2 minutes. The unit automatically erases all the data on each wireless sensor, readying it for the next radiograph.

_Image enhancement

Digital radiographs have higher resolution than conventional film, and are thus clearer and more accurately diagnostic. The ScanX software has additional image enhancement tools that allow dentist to manipulate the acquired raw images (brightness, contrast, false colour, reversal) for additional analytic data without re-exposing the patient to additional radiation. These investigative tools are very valuable in pinpointing issues more specifically and far earlier than ever before. The software is intuitive and easy to use.

Viewing digital images on a screen has significantly improved both the way that practitioners diagnose their patients and the means whereby they develop simple and extensive treatment planning. The size of the monitor offers on-screen co-diagnosis and co-treatment planning that actively involve the patient in the dental treatment process.

_Data storage

The practice's radiographic data is ideally stored in a single location on the office server computer from where it is readily accessible to all the operatory. Since radiographic image files are rather large (and compression may cause the loss of important details), it is important to dedicate adequate storage space that can accumulate at least 3 years' worth of data. Cephalometric and panorex images are particularly space consuming. Off-site and multiple location backups are good safe-computing practices that eliminate the unlikely, but potentially disastrous results of fire, flood, or a total irreversible failure of the storage drive.



Fig. 11

Fig. 11_ScanX wireless digital sensors are placed in the small footprint scanning unit, ScanX Swift.

_Conclusion

Digital dental radiography is faster, cleaner, more effective and better than silver-based film. More than 99 per cent of dentists who use digital radiography recognize that it was a good investment. The obvious advantages include: immediacy of the images, decreased radiation exposure, image enhancement, digital storage, and the elimination of chemicals. The mainstream acceptance of digital radiography has been slowed by high start-up costs, however. Some of the earlier objections such as rigidity and bulkiness of sensors, sensor cord damage, and ongoing maintenance and repair have been eliminated by the PSP wireless digital sensors. While the initial costs of conversion to digital radiography may be high at first, the long-and short-term clinical and financial benefits of digital radiography are well worth the investment._

_about the author

laser



Dr George Freedman is a founder and past president of the American Academy of Cosmetic Dentistry, a co-founder of the Canadian Academy for Aesthetic Dentistry and a Diplomate of the American Board of Aesthetic Dentistry. His most recent textbook, "Contemporary Aesthetic Dentistry" is published by Elsevier. Dr Freedman is the author or co-author of 12 textbooks, more than 700 dental articles, and numerous webinars and CDs and is a Team Member of REALITY. Dr Freedman was recently awarded the Irwin Smigel Prize in Aesthetic Dentistry presented by NYU College of Dentistry. He lectures internationally on dental aesthetics, adhesion, desensitization, composites, impression materials and porcelain veneers. A graduate of McGill University in Montreal, Dr Freedman is a Regent and Fellow of the International Academy for Dental Facial Aesthetics and maintains a private practice limited to Aesthetic Dentistry in Toronto, Canada.

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