THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

J A D A

Oral and Maxillofacial Radiology: Then and Now

Axel Ruprecht

J Am Dent Assoc 2008;139;5S-6S

Oral and maxillofacial radiology
Then and now

Axel Ruprecht, DDS, MScD, FRCD(C)
Guest Editor

Imaging has been a part of health care for a long time, although in its beginnings it consisted simply of hand drawings of anatomical or pathological specimens for purposes of teaching or record keeping. It is not known who was the first person to draw a lesion by hand. Certainly, photography has been used since the mid-1800s to create a more accurate record of diseases and to record their progress. Diagnostic imaging, however, had to wait for the discovery of the x-ray by Wilhelm Conrad Röntgen on Nov. 8, 1895.[1] This discovery led to a dramatic change in how patients would be examined, and in how anatomy and pathosis would be viewed.

DISCOVERY OF THE X-RAY

Röntgen announced his discovery on Dec. 28, 1895. On Jan. 12, 1896, Dr. Otto Walkoff, of Braunschweig, Germany, made the first dental radiographs. He was both the dentist and the patient. The exposure time was 25 minutes. The radiographs were somewhat similar to what would become known as bitewing radiographs, although the diagnostic quality left a great deal to be desired.[2]

On Feb. 1, 1896, Dr. Walter König, of Frankfurt, Germany, made some dental radiographs. The quality was better than that of those made by Dr. Walkoff, and the exposure time was nine minutes.[3] Of course, it is not possible to compare actual exposures, because other exposure factors, output from the unit and receptor speed are not known. However, oral and maxillofacial radiology had been born. According to the Eastman Kodak Co., Rochester, N.Y., the first dental radiographs in the United States were made in 1896 with the use of Eastman NC roll film wrapped in black paper. Among those who may have been the first to make dental radiographs in the United States were Drs. Kells, Blum and Rollins.[4]

In 1913, Kodak produced the first prepackaged dental x-ray film. The packet of waxed waterproof paper contained two pieces of single-coated film. This film basically was still photographic film. In 1919, Kodak produced the first true dental x-ray film, designed for direct exposure by x-rays. The packet contained thin sheets of lead to reduce backscatter radiation reaching the film.

Since then, film speeds have increased through several iterations of new films. According to Kodak's records, the increase in film speed and, therefore, decrease in radiation needed were such that its F-speed film, introduced in 2000, required 1/60 of the radiation that its 1919 film required.

Of course, parallel to these advancements was the introduction of screen-film receptor systems that also increased in speed over the years, as the industry moved from calcium tungstate to rare-earth screens.

In the late 1970s, an alternate receptor system came onto the market. Xeroradiography, which had been used in medical radiology, was introduced to the dental profession.[5] Although it offered improved intraoral images owing to a wide latitude and edge enhancement, as well as a decrease in radiation dose, it never became commercially successful and soon passed from the marketplace.

The x-ray units also morphed from being basically Hittorf-Crookes evacuated glass tubes that used the electrons of remnant gas in the tubes as a source of the electron stream and the glass of the tube as a target. In 1913, General Electric developed a modern x-ray tube using the ability to make tungsten ductile, which had been developed by William David Coolidge. Now, a source of electrons was available that could be controlled.[4] Modern x-ray tubes still are sometimes referred to as "Coolidge tubes."

However, radiologic advancements were not finished. Computers were developed and became more powerful. At the same time, they shrank in size and cost, as they changed from using valve tubes to transistors and integrated circuit chips. This

enabled x-ray units to evolve into modern computed tomography (CT) units. Parallel to this—and outside the focus of this supplement—was the development of ultrasonography, magnetic resonance imaging and nuclear medicine imaging, all with various subsets of imaging modalities and protocols.

In dentistry, the developments leading toward modern intraoral x-ray units were complemented by the development of pantomographic units, which were based on the work of Paatero in the 1940s.[6] This resulted in units such as the Orthopantomograph (originally manufactured by Palomex Oy; now manufactured by Instrumentarium Dental, Tuusula, Finland) in Europe and the Panorex (originally manufactured by S.S. White; now manufactured by Imaging Sciences International, Hatfield, Pa.) in North America entering the market in the 1960s.

Which brings us to 2008, and a look at where we are in dentistry with regard to diagnostic imaging. Dentistry really has never been far from the cutting edge of radiology, although, at times, it looked as if the profession was merely following what was going on in medicine. According to some of my more senior colleagues, in the early part of the 1900s in small-town America, it was not the physicians or hospitals that had the first x-ray units—it was the dentists. And it was to them that physicians referred patients with fractures or other problems.

DIGITAL IMAGING

Once again, dentistry is entering a new era of diagnostic imaging. The French dentist Francis Mouyen introduced digital imaging into the profession in 1987 at the 1st European Congress of Dental and Maxillofacial Radiology in Geneva.[7] Since then, it has grown into a widely used modality and, parallel to imaging in medicine, has evolved into digital radiography using electronic sensors such as charge-coupled devices or complementary metal-oxide semiconductors, as well as computed radiography using photostimulable storage phosphor plates and laser scanners. In both cases, the image is created with the use of a computer and is viewed on a monitor. More recently, cone beam CT (CBCT) has entered the field. This digital imaging system is capable of producing two-dimensional and three-dimensional images, as well as orthoradial views of the jaws, to permit more accurate assessment of bone for implant placement or localization of teeth and lesions within the jaws.

CONCLUSION

These modern developments will be explored by the authors of the three articles in this supplement. They are more qualified than I to discuss these exciting changes in radiology and dentistry. Dr. Paul van der Stelt is internationally known as a pioneer in the application of digital imaging into dental practice. He looks at both positive and negative aspects of digital radiography of which the nonradiologist dental practitioner might not be aware when considering a change from analog (film-based) radiography to digital radiography.[8] Dr. Allan Farman has been a leader in ensuring that the Digital Imaging and Communications in Medicine (DICOM) standard, as applied to dentistry, is rigorous, as well as appropriate. He and his co-authors provide an overview of digital technology, including digital imaging, in the dental office that will be of value to both the practitioner considering digital imaging and to practitioners who already are using digital or computed radiography.[9] Drs. Bruce Howerton and Maria Mora, both oral and maxillofacial radiologists, consider the role that CBCT plays in the changing face of dentistry.[10] All of the authors look at these exciting changes in dental practice from both a historical and futuristic perspective. ■

Dr. Ruprecht is a professor, The University of Iowa, Colleges of Dentistry and Medicine, DSB 801 Newton Rd., Iowa City, Iowa 52242, e-mail "axel-ruprecht@uiowa.edu". He also is the guest editor of this supplement. Address reprint requests to Dr. Ruprecht.

Disclosure. The author did not report any disclosures.

1. Röntgen W. Ueber eine neue Art von Strahlen, Vorläufige Mitteilung. [On a New Kind of Rays. Preliminary Presentation]. Würzburg, Germany: Würzburg Physical and Medical Society; 1895.
2. Ennis LM. Dental Roentgenology. Philadelphia: Lea & Febiger; 1939:16.
3. Jacobsohn PH, Fedran RJ. Making darkness visible: the discovery of X-ray and its introduction to dentistry. JADA 1995; 126(10):1359-1370.
4. Langeland OE, Sippy FH., Langlais RP. Textbook of Dental Radiography. 2nd ed. Springfield, Ill.: Charles C. Thomas; 1984:4-7.
5. Gratt BM, White SC, Sickles EA, Jeromin LS. Imaging properties of interoral xeroradiography. JADA 1979;99(5):805-809.
6. Paatero YV. A new tomographical method for radiographing curved outer surfaces. Acta Radiol 1949;32(2-3):177-184.
7. Wenzel A. Two decades of computerized information technologies in dental radiography. J Dent Res 2002;81(9):590-593.
8. van der Stelt. Better imaging: the advantages of digital radiography. JADA 2008;139(6 suppl):7S-13S.
9. Farman AG, Levato CM, Gane D, Scarfe WC. In practice: how going digital will affect the dental office. JADA 2008;139(6 suppl):14S-19S.
10. Howerton WB Jr, Mora MA. Advancements in digital imaging: what is new and on the horizon? JADA 2008;139(6 suppl):20S-24S.