University of Southern California School of Dentistry

Center for Diagnostic Sciences BULLETIN

January 2005 **Issue #9**

This bulletin focuses on Digital Imaging. We thank Dr. Robert Danforth for his contribution to this issue. As always, we invite your comments, questions, and suggested topics for future bulletins. Please forward your comments to Anisa Marino at anisamar@usc.edu.

Digital Imaging: An Era of Change for Dentistry - How did it all begin?

Wilhelm Roentgen, a professor a Württemberg University in Germany, accidentally discovered x-rays in 1895, while conducting cathode ray experiments. Realizing the significance of his finding and the need of a study subject, he quickly engaged his wife as the laboratory assistant. Her hand became the first recorded human radiographic image, and as such, could also be considered as the first "digital" radiographic image.

When and how did imaging become an integral part of dentistry?

Shortly after the discovery, dentists recognized the diagnostic potential of x-rays and began making dental radiographs. Little did either medicine or dentistry know at the time that, other than modest improvements in film related technology, there would be no significant change in imaging until the early 1970s. Thorn EMI, a company of varied interests, was working to develop what would become computer-assisted tomography (the CAT scanner). Fortunately for EMI they were also a recording company and just happened to be the label for the new fad group "The Beatles." So while the Beatles were conquering the music world, EMI was using the proceeds to assist Dr. Godfrey Hounsfield to conquer digital imaging. The development of the 3D imaging CT scanner changed everything for imaging. The ability to image in a 3D volume was as significant a development as Roentgen being able to see his wife's hand. **Innovation and Discovery** ushered us into a new world of computerized digital imaging.

While for the next decade and a half most of the significant developments in digital patient imaging were for medicine, dentistry wasn't totally forgotten. In France, Françoise Mouyen was developing an intraoral digital radiography system for dentistry. His "RVG-Trophy" system was first introduced in the United States around 1987. Sensor size somewhat restricted use to single procedure imaging best suited for endodontics. In the following years, sensor size changed and so did acceptance. Some of the latest *Dental Products Report* surveys have digital radiography use for endodontists as high as 48% and overall use in general dentistry up to 16%. Both are increases from 31% for the first endodontic survey in 1999 and from 10% for the 2002 survey of general dentists.

What are the Advantages & Disadvantages?

Digital radiography offers many advantages over film. **Rapid image acquisition** is most apparent, but image enhancement, electronic storage and elimination of darkroom expense and hazardous waste are also important advantages. Start-up expense, patient comfort, technique learning curve, and image quality are some of the stated disadvantages. The fact that use has steadily increased among dentists suggests that the advantages are perceived to outweigh the disadvantages.

What is the Role of Dental Education?

As dental educators observing this trend toward digital imaging acceptance in the practicing community, we must ask ourselves what is our role in preparing future dentists to function in a digital dental environment. Furthermore, what is our role in **Innovation and Discovery** to shape this environment and in the process demonstrate **Eminence and Excellence** to our students, university and the dental profession?

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In 2002, Dr. Lisabeth Su and I conducted a survey of North American dental schools and found that 48 schools indicated using digital radiography, but only 5, including USCSD, used it for teaching full-mouth series in their preclinical laboratories while another 16 did selected imaging. For patient care, use was primarily for endodontic purposes as reported by 23 schools. Digital panoramic use was reported by 18 schools with oral surgery/implants (11) and patient screening (8) the primary uses. At that time only two schools were reporting to be "digital" which means digital imaging and record management. USCSD wasn't one of them.

At the most recent annual meeting, November 3-6, 2004, of the Academy of Oral and Maxillofacial Radiology, the entire Saturday afternoon session was devoted to the introduction of digital radiography into the dental schools. This was a very informative session as the various options and considerations for "going digital" were discussed. It was also apparent that little "going digital" has happened since 2002, as only 3 more schools indicated they were digital. Most schools have a working computer management program similar to Axium, but the method for providing digital patient images is still undecided. Some of the earlier schools opted to go with phosphor plate technology (Dentoptix, Scanora, Air Techniques) and found that in a school environment the screen-plates became so scratched that in a study from one school after only 37 documented uses they were rendered nondiagonstic. Thus, the perceived advantages of film size and alleged patient comfort were offset by unrealistic replacement expenses. Those choosing rigid sensors indicated some problems with patient comfort and the need for a back-up system when patient compliance was not obtainable. No "digital" school, or those pending implementation of digital imaging, considered returning to *"the horse-drawn buggy days"* of a film-based environment.

Where is USCSD in this Era of Change?

Actually, we are in good shape. Digital radiography has been taught in the preclinical oral radiology teaching clinics to every class since 1999. Additionally, in the same year, digital panoramic radiography was available to the school. Unfortunately, this initial introduction to digital panoramic was undermined by not having an appropriate digital viewing system. Axium has resolved this. In fact, Axium and establishing the digital Oral Health Center (OHC) was the major first step toward becoming digital. The learning experience acquired from the smaller OHC environment has allowed Arnel Mendoza and his IT group to resolve many of the issues involved with "going digital" and environment.

School-wide use of digital radiography is the next step. In fact, this has begun. By using the viewer programs in the clinical computers, we are now capable of viewing digital radiographs as they were intended, using the monitor. In Axium, under the attachment file in a patient's record, we can view any of the patient's radiographs either scanned or direct digital including panoramic. This approach may be a short-term quick-fix, but it does allow us to be digital without having to wait for a more robust viewing program to be installed in our system. To support this approach, the Clinical Practice Committee, in September 2004, voted to make digital panoramic radiographs whenever a panoramic is prescribed. Next is the development of the intraoral digital system. Axium supports several types of systems, and the selection process for the first phase of implementation has been completed. The School received a generous donation from **Kodak-Practice Works** of three complete intraoral **"Trophy"** sensor systems and a digital panoramic/cephalometric imaging machine. This donation, combined with additional purchases of **Schick Technology** intraoral digital sensors, gives the school a great boost toward our goal of a digital clinic. This equipment has arrived and is currently being installed. The projected utilization for both teaching and clinical use is January 2005.
This commitment will immediately challenge faculty, staff and students with a new learning curve. Such a process generally contributes to initial-use frustration; fortunately, within time, this is usually resolved for most users.

What is the Role of the Division of Diagnostic Sciences?

The Division's role is one of leadership in the process of **Innovation and Discovery** while becoming a diagnostic center of **Eminence and Excellence**. Patients receive the highest level of diagnostic services, while students are provided the opportunity and an environment to become acquainted with emerging diagnostic technology. Development of such a center in the school may require a shift in our clinical approach to patient care.

thus provided the school a solid platform upon which to build our digital.

The terms diagnosis and treatment planning have long been so closely associated that it implies they are a simultaneous function, but they are not. Diagnosis is the detection, identification and determined extent of a disease process. Treatment is any of several modalities intended to resolve, reduce or eliminate the disease. With the introduction of digital imaging into the clinic, diagnostic methods will change, and, therefore, so does the educational focus to the student. An example is the **Logicon Caries Detection** program that comes with the **Trophy** intraoral digital system. This program allows the operator to select a region of interest over the interproximal area of a tooth and will generate a histogram pattern of existing mineralization. If present, caries is shown as a red line on the graph. While this method does not have universal acceptance, it does demonstrate the changing nature of diagnostic methods. Other examples would be the use of a laser light to detect occlusal surface caries, brush biopsy techniques for oral cancer detection and 3D volume imaging.

The most significant change is the introduction of 3D volume imaging to dentistry. Application of this technology to dental imaging is already having an impact upon dental diagnosis for both advanced and common procedures. Structural spatial relationships associated with multi-plane analysis combined with digital model rendering offer presurgical diagnostic evaluations for impacted teeth, implant placement, nerve locations, oral pathology, endodontic and periodontal problems. The benefits of such evaluations are improved patient understanding of the treatment risk and benefits, reduced surgical time and reduced patient morbidity.

In a busy school such as ours, the challenge of these technologies is the faculty and staff learning curve. Application of these technologies is certainly beyond our current approach of look, chart and treat. They require diagnostic faculty to initiate the procedure and to interpret the results so as to maximize patient benefit and enhance student learning.

UPCOMING EVENTS FOR DIVISION OF DIAGNOSTIC SCIENCES

Wednesday, February 2
12:30-1:30pm-Rutherford Hall
Darik Warnke
Lexi-Comp, Inc.

Friday, February 4
12:30-1:30pm-Guggenheim
SEMINAR-*"Oral-based diagnostics: State-of-the-art and novel approaches"*
Daniel Malamud, PhD
Department of Biochemistry
University of Pennsylvania, School of Dental Medicine